

Keysight Technologies B1500A Semiconductor Device Analyzer

Configuration and
Connection Guide

Notices

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Manual Part Number

B1500-90090

Edition

Edition 1, May 2005
Edition 2, July 2007
Edition 3, June 2010
Edition 4, October 2011
Edition 5, June 2013
Edition 6, February 2015
Edition 7, June 2015
Edition 8, August 2019
Edition 9, December 2019
Edition 10, November 2020

Published by:

Keysight Technologies Japan K.K.
9-1, Takakura-cho, Hachioji-shi, Tokyo
192-8550 Japan

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In This Document

This document provides the following information about Keysight B1500A Semiconductor Device Analyzer.

1. B1500A Product Configuration
Describes the product configuration of the B1500A.
 2. B1500A Accessories
Describes the available accessories for the B1500A.
 3. Connection Guide for Wafer Prober
Describes how to connect the B1500A, accessories, and a DUT interface such as wafer prober and your own test fixture.
 4. Connection and Ordering Examples
Describes fixture/prober connection and ordering examples.
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B1500A Product Configuration

1.1 Product line up of the B1500A series

The Keysight B1500A Semiconductor Device Analyzer is the new generation one box solution for the semiconductor device DC/AC parametric measurement and analysis application. The B1500A provides the DC voltage/current output capability, DC voltage/current measurement capability, and AC signal output and impedance measurement capability. So you can perform a current-voltage sweep measurement and a capacitance-voltage sweep measurement for example by one instrument.



The B1500A also provides an intuitive graphical user interface, touch screen LCD panel, keyboard, and mouse for easy and effective measurement and analysis on the Windows environment. You can analyze a measurement result characteristics graph for example by using several tools such as markers, cursors, and lines.

The EasyEXPERT remote control function supports the remote execution of application tests via the LAN interface.

Also, in the GPIB remote control mode, you can control the B1500A from an external computer by using Keysight FLEX command set that is the common language for Keysight semiconductor DC measurement instruments. So you can reuse the measurement program created for Keysight 4155/4156/E5260/E5270 series.

- **B1500A Semiconductor device analyzer mainframe**
Mainframe that provides the ground unit (GNDU) and ten empty slots for the measurement facilities, and Keysight EasyEXPERT group+ software for the operating environment. The EasyEXPERT group+ is the GUI based measurement control and analysis software runs on the Windows.

The B1500A is equipped with the 15 inch LCD with touch panel, solid-state drive (SSD) DVD-RW/DVD-ROM/CD-RW/CD-ROM drive, and USB/LAN/GP-IB interfaces. The USB keyboard, the USB mouse, and the stylus pen are available as option.

- **HPSMU module (B1500A-A10)**
High power source/monitor unit module. Occupies two slots.
- **MPSMU module (B1500A-A11)**
Medium power source/monitor unit module. Occupies one slot. Needs Keysight E5288A ASU(option A29) to perform atto level current measurement or automatic switching of the measurement resources connection. ASU is effective for the B1511B MPSMU. ASU cannot be connected to the B1511A MPSMU.
- **HRSMU module (B1500A-A17)**
High resolution source/monitor unit module. Occupies one slot. Needs Keysight E5288A ASU (option A28) to perform atto level current measurement or automatic switching of the measurement resources connection.

- **MCSMU module (B1500A-A1A or A1B)**
50 μ s pulse Medium current source/monitor unit module. Occupies one slot.
- **MFCMU module (B1500A-A20)**
Multi frequency capacitance measurement unit module. Occupies one slot. Needs Keysight N1301A-100 SCUU to perform automatic switching of the measurement resources connection.
- **HVSPGU module (B1500A-A25)**
High voltage semiconductor pulse generator unit module. Occupies one slot. Up to five modules can be installed in one B1500A mainframe. One module provides two output channels. Needs Keysight 16440A (B1500A-A04) and 16445A to perform automatic switching of the measurement resources connection.
- **WGFMU module and RSU (B1500A-A30, A31)**
Waveform generator/fast measurement unit module and the remote-sense and switch unit. Occupies one slot. Up to five modules can be installed in one B1500A mainframe. One module provides two channels.
- **16440A SMU/PGU pulse generator selector (B1500A-A04)**
Used to switch the measurement resource connected to the DUT. The measurement resource can be HV SPGU or SMU. Needs the 16445A adapter to use the selector. One selector provides two switching channel.
- **16442B test fixture (B1500A-A5F)**
Test fixture for semiconductor parameter analyzers and device analyzers. Provides three Kelvin triaxial connectors (six non-Kelvin triaxial connectors) for connecting SMU, six BNC connectors for connecting HV SPGU, MFCMU, or other instruments, a GNDU connector, and an Intlk connector. Furnished with the dual-in-line package socket module, universal socket modules (two types), blank PTFE on board, and connection wires for device connection.
- **16445A selector adapter (B1500A-A04)**
Used to connect the 16440A selector (B1500A-A04) to the B1500A. Two selectors can be connected.
- **E5288A ASU (B1500A-A28 or A29)**
Atto sense and switch unit (ASU). Used to enable the 1 pA range for the atto level current measurement, also switch the measurement resource connected to the DUT. The measurement resource can be HRSMU/MPSMU or the instrument connected to the AUX terminal.
- **N1255A 2 channel connection box for MCSMU**
Connection box to make the MCSMU connection easy. Supports two MCSMU.
- **N1301A-100 SCUU**
SMU CMU unify unit (SCUU). Used to switch the measurement resource connected to the DUT. The measurement resource can be CMU or one of two SMUs connected to the SCUU.

B1500A Product Configuration
 Product line up of the B1500A series

- **N1302A-200 GSWU**
 Guard switch unit (GSWU). Needs the SCUU to use the GSWU. Effective for the accurate impedance measurements by connecting the guard lines between CMU high and low near the DUT.

Table 1-1 Mainframe Specification

Available Slots	10
Ground Unit (GNDU) sink capability	4.2 A
Instrument control	GPIB
External trigger inputs / outputs	1 BNC Trigger in, 1 BNC Trigger out, 8 Programmable Trigger In/Out
Networking	100 BASE-TX / 10 BASE-T LAN Port

Table 1-2 SMU Module Variation

Module	Key specification				
	Max. Current	Max. Voltage	Current means. Resolution	Voltage means. Resolution	Req'd slots
HPSMU (High Power SMU)	± 1 A	± 200 V	10 fA	2 μ V	2
MPSMU (Medium Power SMU)	± 100 mA	± 100 V	10 fA	0.5 μ V	1
HRSMU (High Resolution SMU)	± 100 mA	± 100 V	1 fA	0.5 μ V	1
ASU (Atto Sense and Switch Unit)	± 100 mA	± 100 V	0.1 fA	0.5 μ V	NA
MCSMU (50 μs pulse Medium Current SMU)	± 1 A	± 30 V	10 pA	0.2 μ V	1

Figure 1-1 B1500A Rear View



1.2 Options of B1500A series

This section describes Option items of the Keysight B1500A Semiconductor Device Analyzer.

Table 1-3 B1500A Options

Model/ Option	Description	OP Instruction
Mainframe		
B1500A	Semiconductor device analyzer mainframe	<ul style="list-style-type: none"> Select option 015 or 030 to specify cable length. Select option 050 or 060 to specify Power line frequency. The following accessories are included. See Table 1-3, for more details of furnished accessories. <ul style="list-style-type: none"> Keyboard USB mouse Stylus pen One Interlock cable (1.5 m or 3.0 m) One GNDU cable (1.5 m or 3.0 m) One Triaxial cable (1.5 m or 3.0 m) GNDU to Kelvin adaptor
Select standard packages (mandatory)		
B1500A-A00	Empty package for custom solution	<ul style="list-style-type: none"> No module is included in B1500A mainframe Specify Add-on package option.
B1500A-A01	Standard pack 1 -Standard package (Mid PWR unit 4ea, cables)	<ul style="list-style-type: none"> Standard package-1 contains four MPSMU and eight Triaxial cables. Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A02	Standard pack 2 -High resolution package (High resolution unit 4ea, cables)	<ul style="list-style-type: none"> Standard package-2 contains four HRSMU and eight triaxial cables. Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A03	Standard pack 3 -High power package (High PWR unit 2ea, Mid PWR unit 2ea, cables)	<ul style="list-style-type: none"> Standard package-3 contains two HPSMU, two MPSMU, and eight triaxial cables. Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A04	Standard pack 4 - Flash pack (Mid PWR unit 2ea, Hi-res unit 2ea, PGU, accessories)	<ul style="list-style-type: none"> Standard package-4 contains two MPSMU, two HRSMU, one HVSPGU and accessories for flash memory cell measurement See Table 1-8.

Model/ Option	Description	OP Instruction
Select add-on packages (optional)		
B1500A-A10	Add-on package - High power source monitor unit (B1510A) 1ea, cables	<ul style="list-style-type: none"> • HPSMU add-on package adds one HPSMU and two triaxial cables. • Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A11	Add-on package - Mid power source monitor unit (B1511B) 1ea, cables	<ul style="list-style-type: none"> • MPSMU add-on package adds one MPSMU and two triaxial cables. • Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A17	Add-on Package - High resolution source monitor unit (B1517A) 1ea, cables	<ul style="list-style-type: none"> • HRSMU add-on package adds one HRSMU and two triaxial cables. • Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A1A	Add-on Package - B1514A Medium current source/monitor unit 1ea w/ connection box	<ul style="list-style-type: none"> • 50 μs pulse MCSMU add-on package adds one MCSMU, two triaxial cables and the N1255A connection box. • Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A1B	Add-on Package - B1514A Medium current source/monitor unit 2ea w/ connection box	<ul style="list-style-type: none"> • 50 μs pulse MCSMU two modules add-on package adds two MCSMU, four triaxial cables and the N1255A connection box. • Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A20	Add-on package - Capacitance measurement unit (B1520A) 1ea, cable 1ea	<ul style="list-style-type: none"> • Capacitance measurement add-on package adds the MFCMU and one CMU cable. • Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A25	Add-on package - Pulse generator unit (B1525A) 1ea, cables	<ul style="list-style-type: none"> • HVSPGU add-on package adds one HVSPGU and two SPGU cables. • Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A28	Add-on package - Atto sense switch unit (E5288A) 1ea, cables for High Resolution Source Monitor Unit	<ul style="list-style-type: none"> • ASU add-on package for HRSMU adds one ASU, one D-sub cable, and one triaxial cable. • Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A29	Add-on package - Atto sense switch unit (E5288A) 1ea, cables for Mid Power Source Monitor Unit (B1511B)	<ul style="list-style-type: none"> • ASU add-on package for B1511B MPSMU adds one ASU, one D-sub cable, and one triaxial cable. • Cable length 1.5 m or 3.0 m is specified by option 015 or 030. • ASU and D-sub cable require ASU connector on the B1511B MPSMU module.

B1500A Product Configuration
Options of B1500A series

Model/ Option	Description	OP Instruction
B1500A-A30	Add-on package - WGFMU 1ea, Remote sense unit 2ea, cables	<ul style="list-style-type: none"> WGFMU add-on package adds one WGFMU, two RSU, and two RSU cables Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A31	Add-on package - WGFMU 1ea, Connector adaptor, Remote sense unit 2ea, cables	<ul style="list-style-type: none"> WGFMU add-on package adds one WGFMU, two RSU, and accessories for connector plate. See Table 1-19. Cable length 1.5 m or 3.0 m is specified by option 015 or 030.
B1500A-A3P	Add-on package - Probe cable kit for WGFMU (8 probe cables. WGMU not included)	<ul style="list-style-type: none"> WGFMU probe cable kit adds cables for prober. See Table 1-20. This option does not include the WGFMU module.
B1500A-A5F	Add-on package - Test fixture for packaged device (16442B 1ea)	<ul style="list-style-type: none"> Test fixture for package device measurement, adds one 16442B Parametric Test Fixture. See Table 1-21 for furnished accessories.
Specify the cable length (mandatory)		
B1500A-015	1.5 m cable	<ul style="list-style-type: none"> 1.5 m cable length (for mainframe bundled cables and for package options)
B1500A-030	3.0 m cable	<ul style="list-style-type: none"> 3.0 m cable length (for mainframe bundled cables and for package options)
Specify the power line frequency (mandatory)		
B1500A-050	50Hz line frequency	
B1500A-060	60Hz line frequency	
Select calibration options (optional)		
B1500A-A6J	ANSI Z540 compliant calibration	<ul style="list-style-type: none"> ANSI Z540 compliant calibration
B1500A-UK6	Commercial cal. certificate w/ test data	<ul style="list-style-type: none"> Test Data for ISO 9001/2 Commercial Calibration. This option provides measurement test data for the standard commercial calibration and test equipment trace information.
Specify the language of the paper manuals if you need (optional)		
B1500A-ABA	Paper manual set, English	<ul style="list-style-type: none"> Printed manuals are optional. Order this option to get the paper manuals. Contains B1500A user guide, Plug & Play driver user guide, self-paced training manual, EasyEXPERT user guide, and programming guide.
B1500A-ABJ	Paper manual set, Japanese	
Select the read-only drive if you need (optional)		

Model/ Option	Description	OP Instruction
B1500A-DR1	Replace a built-in DVD-R drive with a read-only DVD drive	<ul style="list-style-type: none"> • DVD-ROM drive option for higher security • Replace from DVD-RW to DVD-ROM
Select rack mount kit (optional)		
B1500A-1CM	Rack mount kit	<ul style="list-style-type: none"> • Rack mount kit for the B1500A. • 7U height EIA
Select WGF MU learning kit (optional)		
B1530A-0KN	Self-paced sample program learning kit for B1530A WGF MU	<ul style="list-style-type: none"> • This option becomes available when B1500A-A30 or A31 is selected.
Refurbished product		
B1500A-RMKT	Keysight Refurbished products	<ul style="list-style-type: none"> • Shipment of used product from factory.
Startup assistance		
PS-S20-01	Keysight 1 day startup assistance	<ul style="list-style-type: none"> • Startup assistance & product training.

1.3 Furnished accessories

Furnished accessories of the B1500A semiconductor device analyzer and furnished accessories of package options are described in this chapter.

Table 1-4 **Furnished accessories on the B1500A semiconductor device analyzer mainframe**

Description	Qty.	Note
USB keyboard	1	USB Keyboard for the B1500A 
USB mouse	1	USB Mouse for the B1500A 
Stylus pen	1	Stylus pen for the B1500A 
Interlock cable	1	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030. 
GNDU cable	1	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030. 

Description	Qty.	Note
GNDU Kelvin adapter	1	<p>GNDU Kelvin adapter must be directly connected to the B1500A GNDU connector for taking out the GNDU Force and Sense to the individual connectors. Then the GNDU cable must be used for extending the GNDU Force. And the triaxial cable must be used for the Sense.</p> 
Triaxial cable	1	<p>Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.</p> 
Power cable	1	Power cable for the B1500A
License Sheet	1	SWS License-to-use for EasyEXPERT group+ software.
SMU number label	1	SMU number label, only for the B1500A installed with SMU.
PG number label	1	PG number label, only for the B1500A installed with HVSPGU

Table 1-5 B1500A-A01 Standard Pack 1 -Standard package

Description	Qty.	Note
MPSMU	4	Installed Medium power source/monitor unit (MPSMU)
Triaxial cable	8	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.

Table 1-6 B1500A-A02 Standard Pack 2 -High resolution package

Description	Qty.	Note
HRSMU	4	Installed High resolution source/monitor unit (HRSMU)
Triaxial cable	8	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.

Table 1-7 B1500A-A03 Standard Pack 3 -High power package

Description	Qty.	Note
MPSMU	2	Installed Medium power source/monitor unit (MPSMU)
HPSMU	2	Installed High power source/monitor unit (HPSMU)
Triaxial cable	8	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.

Table 1-8 B1500A-A04 Standard Pack 4 -Basic flash memory cell package

Description	Qty.	Note
MPSMU	2	Installed Medium power source/monitor unit (MPSMU)
HRSMU	2	Installed High resolution source/monitor unit (HRSMU)
HVSPGU	1	Installed High voltage semiconductor pulse generator unit (HVSPGU)
SPGU cable	2	SPGU Cable (SMA to Coaxial). Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030. 

Description	Qty.	Note
16440A pulse selector	1	16440A SMU/PGU pulse generator selector 
16445A Selector adapter	1	16445A Selector adapter for 16440A
Control cable, 1.5 m	1	Digital I/O cable, 1.5 m, between B1500A and 16445A (16445A-001)
Control cable, 40 cm	1	Control cable, 40 cm, between 16445A and 16440A (16440A-003)
Triaxial cable, 1.5 m	2	Cable length 1.5 m for 16440A pulse selector.
Triaxial cable	8	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.

Table 1-9 B1500A-A10 Add-on Package - High power source monitor unit

Description	Qty.	Note
HPSMU	1	Installed High power source/monitor unit (HPSMU)
Triaxial cable	2	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.

Table 1-10 B1500A-A11 Add-on Package - Medium power source monitor unit

Description	Qty.	Note
MPSMU	1	Installed Medium power source/monitor unit (MPSMU)
Triaxial cable	2	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.

Table 1-11 B1500A-A17 Add-on Package - High resolution source monitor unit

Description	Qty.	Note
HRSMU	1	Installed High resolution source/monitor unit (HRSMU)
Triaxial cable	2	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.

Table 1-12 B1500A-A1A Add-on Package - 50 μs Pulse Medium current source monitor unit

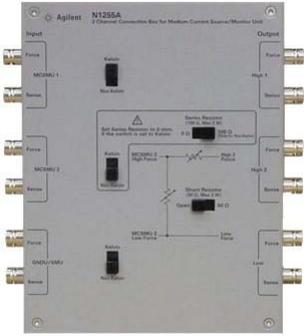
Description	Qty.	Note
MCSMU	1	Installed Medium current source/monitor unit (MCSMU)
Triaxial cable	2	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.
Connection box	1	N1255A Connection box for B1514A Medium Current Source/Monitor unit to make connection to DUT easy. 

Table 1-13 B1500A-A1B Add-on Package - 50 μs Pulse Medium current source monitor unit

Description	Qty.	Note
MCSMU	2	Installed two Medium current source/monitor units (MCSMU)
Triaxial cable	4	Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.
Connection box	1	N1255A Connection box for B1514A Medium Current Source/Monitor unit to make connection to DUT easy.

Table 1-14 B1500A-A20 Add-on Package - Capacitance measurement unit

Description	Qty.	Note
MFCMU	1	Installed Multi frequency capacitance measurement unit (MFCMU)
CMU cable	1	CMU Cable for B1500 (N1300A). Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030. 

Table 1-15 B1500A-A25 Add-on Package - Pulse generator unit

Description	Qty.	Note
HVSPGU	1	Installed High voltage semiconductor pulse generator unit (HVSPGU)
SPGU cable	2	SPGU cable (SMA to Coaxial). Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030. 
SPGU synchronous cable	2	SPGU synchronous cable (16493Q, SMA to SMA, 8 cm). 

Table 1-16 B1500A-A28 Add-on Package - Atto sense unit for HRSMU

Description	Qty.	Note
ASU	1	Atto sense switch unit (E5288A ASU), 1 ea. 
Triaxial and D-sub cable for ASU	1	Triaxial/D-sub Cable for ASU (16493M). Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030. 

Table 1-17 B1500A-A29 Add-on Package - Atto sense unit for MPSMU

Description	Qty.	Note
ASU	1	Atto sense switch unit (E5288A ASU), 1 ea.
Triaxial and D-sub cable for ASU	1	Triaxial/D-sub Cable for ASU (16493M). Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030.

Table 1-18 B1500A-A30 Add-on Package - WGFMU and RSU

Description	Qty.	Note
WGFMU	1	Installed Waveform generator/fast measurement unit (WGFMU)
RSU	2	Remote-sense and switch unit (RSU) 
RSU cable	2	RSU cable between WGFMU and RSU. Cable length 1.5 m or 3.0 m is specified by the option B1500A-015 or B1500A-030. 

Table 1-19 B1500A-A31 Add-on Package - WGFMU, RSU and connector adapter

Description	Qty.	Note
WGFMU	1	Installed Waveform generator/fast measurement unit (WGFMU)
RSU	2	Remote-sense and switch unit (RSU)
RSU cable, 2.4 m	2	RSU cable, 2.4 m, between WGFMU and connector adapter. The option B1500A-A31 cannot be selected with the option B1500A-015.
RSU cable, 0.6 m	2	RSU cable, 2.4 m, between RSU and connector adapter. The option B1500A-A31 cannot be selected with the option B1500A-015.
Connector adapter	2	Connector adapter for RSU cable, female - female (16493R-801). 

B1500A Product Configuration
Furnished accessories

Table 1-20 B1500A-A3P Add-on Package - Probe cable kit for WGF MU

Description	Qty.	Note
SSMC cable, 50 mm	2	SSMC short-open cable for current return path, 50 mm (16493R-101) 
SSMC cable, 75 mm	2	SSMC short-open cable for current return path, 75 mm (16493R-102) 
SMA-SSMC cable, 200 mm	2	SMA-SSMC cable between RSU and DC probe, 200 mm (16493R-202) 
SMA cable, 200 mm	2	SMA-SMA cable between RSU and RF probe, 200 mm (16493R-302) 

Table 1-21 B1500A-A5F Add-on Package - Test fixture for packaged device

Description	Qty.	Note
Test fixture	1	Test fixture for packaged device (16442B) 
Accessory case	1	Accessory case for furnished accessories. 
Blank PTFE board	1	Blank PTFE board for DUT stage
28-pin socket module	1	28-pin DIP (dual-in-line) package socket module
Universal socket module	1	Universal socket module, 0.075 inch pitch
Universal socket module	1	Universal socket module, 0.05 inch pitch
Connection pin set	10	Connection pin set for universal socket module
Connection wire	12	Connection wire, mini banana to pin plug. There is three colors. 4ea per each calor
Connection wire	9	Connection wire, pin plug to pin plug. There is three colors. 3ea per each calor
Connection wire	9	Connection wire, mini banana to mini clip. There is three colors. 3ea per each calor
Connection wire	9	Connection wire, mini banana to mini banana. There is three colors. 3ea per each calor

1.4 Upgrade products for the B1500A series

The Keysight B1500A has 10 slots so that users can install appropriate modules into mainframe. The upgrade/retrofit product is available to add more modules. These modules should be installed in Keysight Technologies service center to meet the specifications.

1.4.1 Option of B1500AU upgrade kit

The following table lists the upgrade products and related accessories.

NOTE Keysight Technologies service center is responsible for module installation. Contact Keysight Technologies to get an estimation and order.

NOTE Under the total power consumption limit, there is configuration limitation. Please refer to Table 1-26.

Table 1-22 Keysight B1500AU Upgrade kit for B1500A

Model/Option	Description	OP Instruction
Module upgrade		
B1500AU-010	Addition of B1510A High power source/monitor unit module	Max. 1 A/200 V, 10 fA/2 μ V resolution High power source/monitor unit module for use in the B1500A mainframe. This module consumes 2 slots.
B1500AU-11B	Addition of B1511B Medium power source/monitor unit module	100 mA/100 V, 10 fA/0.5 μ V resolution Medium power source/monitor unit module for use in the B1500A mainframe. SMU has Kelvin connection port (Force / Sense terminal) and the ASU D-sub connector. This module consumes 1 slot.
B1500AU-011	Addition of B1511A Medium power source/monitor unit module	100 mA/100 V, 10 fA/0.5 μ V resolution Medium power source/monitor unit module for use in the B1500A mainframe. SMU has Kelvin connection port (Force / Sense terminal). This module consumes 1 slot. [This is only available for used stocked modules. Contact Keysight sales representative.]
B1500AU-017	Addition of B1517A High resolution source/monitor unit module	100 mA/100 V, 1 fA/0.5 μ V resolution High resolution source/monitor unit module for use in the B1500A mainframe. SMU has Kelvin connection port (Force / Sense terminal) and the ASU D-sub connector. This module consumes 1 slot.
B1500AU-088	Addition of E5288A Atto sense and switch unit (ASU. HRSMU is required.)	0.1 fA (100 aA) resolution which is used with HRSMU. 1 Triaxial, 2 BNC input ports and 1 communication D-sub input between ASU and SMU. BNC inputs terminal can be used for CMU, PGU or other instrument.

B1500A Product Configuration
Upgrade products for the B1500A series

Model/Option	Description	OP Instruction
B1500AU-089	Addition of E5288A Atto sense and switch unit (ASU. B1511B MPSMU is required.)	0.1 fA (100 aA) resolution which is used with B1511B MPSMU. 1 Triaxial, 2 BNC input ports and 1 communication D-sub input between ASU and SMU. BNC inputs terminal can be used for CMU, PGU or other instrument.
B1500AU-141	Addition of B1514A Medium current source/monitor unit 1ea w/ connection box	1 A(Pulse), 100 mA(DC)/30 V, 10 pA/0.2 μ V resolution 50 μ s pulse Medium current source/monitor unit module for use in the B1500A mainframe. Oscilloscope view for voltage/current waveform monitoring with minimum 2 μ s resolution. This module consumes 1 slot. N1255A Connection box is included, however, it requires two Triaxial cables.
B1500AU-142	Addition of B1514A Medium current source/monitor unit 1ea w/o connection box	1 A(Pulse), 100 mA(DC)/30 V, 10 pA/0.2 μ V resolution 50 μ s pulse Medium current source/monitor unit module for use in the B1500A mainframe. Oscilloscope view for voltage/current waveform monitoring with minimum 2 μ s resolution. This module consumes 1 slot. This option is available for 2 channels configuration with option 141. This does not include N1255A Connection box and Triaxial cables. It requires two Triaxial cables.
B1500AU-020	Addition of B1520A Multi frequency capacitance measurement unit module	1 kHz to 5 MHz frequency range, 25 V dc bias (when N1301A SCUU is used with SMU, 100 V dc bias can be applied to DUT.), Multi frequency capacitance measurement unit module for use in the B1500A mainframe. This module consumes 1slot. MFCMU can be installed maximum 1 module per mainframe.
B1500AU-025	Addition of B1525A High voltage semiconductor pulse generator unit module	2 channels, 3 level pulse per channel, 40 V output, 12.5 ns minimum pulse width, 2 ns minimum transition time resolution, High voltage semiconductor pulse generator unit module for use in the B1500A. This module consumes 1 slot. Two SPGU synchronous cables are included. (SPGU cable is not include in the B1500AU-025. Please specify option S01 or S02.)
B1500AU-030	Addition of B1530A Waveform generator/fast measurement unit module with two RSUs	2 channels, Fast and flexible waveform generation with 10 ns programmable resolution. Each channel has Fast IV mode and PG mode. This module consumes 1 slot. Two RSU and related cables are includes on B1530A. WGFMU module can be installed maximum 5 modules per mainframe.
Cable option between B1530A WGFMU and B1531A RSU		
B1500AU-W01	0.6m/2.4m cable set between WGFMU and RSU(2ea). Require prober I/F with adapter	WGFMU-to-RSU cable, 0.6 m / 2.4 m cable set (2 ea). This option requires prober I/F and connection adapter.

B1500A Product Configuration
Upgrade products for the B1500A series

Model/Option	Description	OP Instruction
B1500AU-W02	3m Cable between WGFMU and RSU (2ea)	WGFMU-to-RSU cable, 3 m (2 ea)
B1500AU-W03	5m Cable between WGFMU and RSU (2ea)	WGFMU-to-RSU cable, 5 m (2 ea)
B1500AU-W04	0.6m/4.4m Cable set between WGFMU and RSU(2ea). Require prober I/F with adapter	WGFMU-to-RSU cable, 0.6 m / 4.4 m Cable set (2 ea). This option requires prober I/F and connection adapter.
B1500AU-W05	1.5m Cable between WGFMU and RSU (2ea)	WGFMU-to-RSU cable, 1.5 m (2 ea)
Triax and D-sub cable for Atto level SMU and ASU		
B1500AU-A01	Triax and D-sub cable for ASU (1.5m)	Triaxial and D-sub cables. It connects HRSMU or B1511B MPSMU to ASU. Cable length 1.5 m or 3.0 m is specified by option A01 or A02.
B1500AU-A02	Triax and D-sub cable for ASU (3m)	
Cable option		
B1500AU-C01	Addition of N1300A-001 CMU cable for B1500 (1.5m)	CMU cable for B1520A MFCMU. CMU cable is optional and length is specified by option C01 or C02.
B1500AU-C02	Addition of N1300A-002 CMU cable for B1500 (3m)	
B1500AU-S01	Addition of two 16493P-001 SPGU cables (1.5m)	SPGU output connection cable (SMA to Coaxial) SPGU cable is optional and length is specified by option S01 or S02.
B1500AU-S02	Addition of two 16493P-002 SPGU cables (3m)	
B1500AU-T01	Addition of 16494A-001 Triaxial cable (1.5m)	Triaxial cable for instruments or switches. Triaxial cable is optional and length is specified by option T01 or T02.
B1500AU-T02	Addition of 16494A-002 Triaxial cable (3m)	
EasyEXPERT extension support		
B1500AU-SWS	EasyEXPERT upgrade, extension support and subscription	EasyEXPERT upgrade, extension support and subscription includes the license to use (LTU) of EasyEXPERT software revision 5.5 or later. If you do not have the LTU, it is required to order option SWS when you upgrade software revision 5.5 or later.
B1500AU-SWD	EasyEXPERT upgrade, extension support and subscription (price adjustment)	If you quote or order the hardware upgrade and the S/N of B1500A is less than MY53280101, option SWS and option SWD for price adjustment are bundled in the order.
Power supply and board upgrade		

B1500A Product Configuration
Upgrade products for the B1500A series

Model/Option	Description	OP Instruction
B1500AU-PB1	Frame PS Upgrade	It is required Frame Power Supply upgrade depended on the configuration and serial number. Contact Keysight Technologies to upgrade the B1500A.
B1500AU-PB2	Power PC Board Upgrade	It is required Power PC Board upgrade depended on the configuration and serial number. Contact Keysight Technologies to upgrade the B1500A.
B1500AU-PB4	DVD Drive and I/F Cable Upgrade	It is required DVD Drive upgrade depended on the configuration and serial number. Contact Keysight Technologies to upgrade the B1500A.
B1500A Mainframe upgrade		
B1500AU-PC2	Mainframe upgrade (available for S/N starts with JP or less than MY53440000)	Including OS (from Windows XP/7 to Windows 10), CPU, mother board, storage (from HDD to SSD), VGA output. It is required Power PC Board upgrade (Option PB2) and/or DVD Drive upgrade (Option PB4) also depended on the configuration and serial number. Contact Keysight Technologies to upgrade the B1500A.
B1500AU-PC3	Mainframe upgrade (available for S/N MY53440101 or later)	Including OS (from Windows XP/7 to Windows 10), CPU, mother board, storage (from HDD to SSD), VGA output. Contact Keysight Technologies to upgrade the B1500A.
Drive option		
B1500AU-DR1	Replace DVD-R drive with read-only drive (available for S/N JP49090101 or later)	It is available from Serial Number JP49090101 or later. Contact Keysight Technologies to upgrade the B1500A.
Learning kit option		
B1500AU-0KN	Self-paced sample program learning kit for B1530A WGFMU	Self-paced Sample Program Learning Kit for B1530A WGFMU. This provides Demo guide and demo DUT.
Manual and media option		
B1500AU-ABA	Paper manual set, English	Printed manuals are optional. Order this option to get the paper manuals. Contains B1500A user guide, Plug & Play driver user guide, self-paced training manual, EasyEXPERT user guide, and programming guide.
B1500AU-ABJ	Paper manual set, Japanese	
Refurbished product		
B1500AU-RMKT	Keysight refurbished product	Shipment of used product from factory.
Startup assistance		
PS-S20-01	Keysight 1 day startup assistance	Startup assistance and product training.

B1500A Product Configuration
Upgrade products for the B1500A series

Table 1-23 Additional RSU for Keysight B1530A WGFMU module

Model/Option	Description	OP Instruction
B1531A	Remote-sense and Switch Unit (RSU)	The B1530A WGFMU includes two RSU. If you need additional RSU, specify this product. This does not include WGFMU cable.

1.4.2 About Plug-in modules

Keysight Technologies is responsible for the module installation of Keysight B1500A. Contact Keysight Technologies for the module installation. Then send the following equipment and accessories to Keysight Technologies.

- B1500A
- Plug-in modules to be installed
- ASU, for installing the exclusive SMU or retrofitting ASU only
- Connection cable between ASU and SMU, for installing the exclusive SMU or retrofitting ASU only
- RSU, for installing WGF MU
- Connection cable between RSU and WGF MU, for installing WGF MU

For returning ASU or RSU, do not forget to notify the combination of the unit, connection cable, and module channel.

WARNING

To prevent electrical shock, turn off Keysight B1500A and remove the power cable before removing the connection cables.

NOTE

About B1500A which supports MCSMU, HVSPGU and WGF MU

MCSMU, HVSPGU and WGF MU are supported by the B1500A serial numbered JP40Nxxxxx, JP49xxxxxx, MY5xxxxxxx or later. The other B1500A needs the mainframe upgrade by B1500AU option PB1 and/or PB2 to support the module. Contact Keysight Technologies to upgrade the B1500A.

NOTE

Connect ASU to dedicated SMU

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

NOTE

About warranty of B1500AU upgrade kit

The warranty term of B1500AU upgrade kit is 90 days as independent module. The warranty for B1500A mainframe covers upgraded modules also. If the warranty term of B1500A mainframe is not long enough, some custom extended warranty products (Return to Keysight) are available. Contact Keysight Technologies to extend warranty support.

1.4.3 Module type and locations

Module locations when the B1500A is shipped from the factory are shown in Table 1-25. This table shows the relative locations by the module types.

If the SPGUs are installed, the SPGUs must be installed in the slots from the slot number 1. And if the SPGU and the WGF MU are not installed and the HPSMUs are installed, the HPSMUs must be installed in the slots from the slot number 1. Then the same type of modules must be installed in the contiguous slots.

For example, if the module configuration is two HPSMU, two MPSMU, and one CMU, the B1500A will be shipped with the HPSMUs of the slots 1 to 4, the MPSMUs of the slots 5 to 6, the CMU of the slot 7, and the blank panels of the slots 8 to 10.

Table 1-25 **Module Installation Rule in the Factory**

Slot Number and Location		SMU type and port number
10	top	B1514A Medium Current SMU (MCSMU)
:	:	B1520A Multi Frequency CMU (MFCMU)
:	:	B1511A Medium Power SMU (MPSMU)
:	:	B1511B Medium Power SMU (MPSMU)
:	:	B1517A High Resolution SMU (HRSMU)
:	:	B1510A High Power SMU (HPSMU)
:	:	B1530A WGF MU
1	:	B1525A High Voltage SPGU (HVSPGU)
0	bottom	GNDU/ADC (Always installed)

NOTE **About SMU number**

The SMU number is counted up from bottom to top. Use the SMU number label furnished with the B1500A or equivalent to identify the SMU number.

NOTE **About HVSPGU and WGF MU modules**

The HVSPGU and the WGF MU cannot be installed to slot 10. The SPGU module must be installed in the slots from the slot number 1.

1.4.4 Maximum Module Configuration

The B1500A can contain any combination of the following module. Then the total power consumption of all SMU modules cannot exceed 84 W.

- Up to 10 MPSMU
- Up to 10 HRSMU
- Up to 4 HPSMU
- Up to 4 MCSMU
- One MFCMU
- Up to 5 HVSPGU
- Up to 5 WGFMU

1.4.5 Limitation by installing B1500AU-030 WGFMU

The following tables show the limitation of installing WGFMU and additional SMU/CMU/HVSPGU. When WGFMU is installed into B1500A frame, Module configuration needs to follow all the conditions below.

- Total Number of slots must be under 10 slots
- The maximum SMU/CMU/HVSPGU/WGFMU numbers need to meet the following formula due to the limitation of the power consumption

Total number of [Number of Module * Factor for each module] must be under 59. (Including 59)

- For example, configuration with 5*WGFMU and 5*MPSMU [total factor will be 60.] are not acceptable.

Table 1-26 Module Factor list

Option	Upgrade	Module	Factor for power consumption
B1500A-A10	B1500AU-010	High Power SMU (HPSMU)	14
B1500A-A11	B1500AU-11B	Medium Power SMU (MPSMU)	2
B1500A-A17	B1500AU-017	High Resolution SMU (HRSMU)	2
B1500A-A1A	B1500AU-141	Medium Current SMU (MCSMU)	5
B1500A-A20	B1500AU-020	Multi Frequency CMU (MFSMU)	7
B1500A-A25	B1500AU-025	High Voltage SPGU (HVSPGU)	12
B1500A-A30	B1500AU-030	Waveform Generator FMU (WGFMU)	10

NOTE

Module locations after servicing

After the module installation, upgrade, and so on, the B1500A will be returned with the module configuration decided by the rule shown in Table 1-25. If you want to change the module locations, consult the service personnel before servicing.

1.5 EasyEXPERT group+ software

This section describes Keysight EasyEXPERT group+ software and related options. For technical details of EasyEXPERT group+ software or EasyEXPERT group+ software for PC, refer to data sheet of B1500A or www.keysight.com/find/easyexpert web site.

1.5.1 Functions and capabilities

Keysight EasyEXPERT group+ software is a specially-designed Windows application program for controlling Keysight B1500A. The EasyEXPERT group+ provides the easy and effective measurement and analysis environment with intuitive graphical user interface (GUI), touch screen LCD panel, keyboard, and mouse. Some of the functions are listed below.

- Single measurement, repeat measurement, and append measurement
- Switching matrix control
- Measurement/setup data management by workspace
- Graph display and analysis with markers, cursors, and lines; and auto analysis
- Password protection and user level access control to protect the data and measurement setup
- Data import/export capability, data output by CSV/XML format, and graph output by EMF/BMP/GIF/PNG format
- Maintenance; self-test and self-calibration

NOTE

The EasyEXPERT group+ is upgradeable from the previous generation of EasyEXPERT/Desktop EasyEXPERT software.

NOTE

The latest revision of the EasyEXPERT update package can be obtained from Keysight Technologies web site.

Operation mode

The EasyEXPERT group+ has the following measurement operation environments.

- **Application test mode** - The EasyEXPERT group+ contains an application library that supports typical measurements for CMOS devices, TFT, BJT, memory, nanotechnology devices such as CNT FET, and so on. The application library includes more than three hundred test definitions. This mode realizes application oriented point-and-click test setup and execution.
- **Classic test mode** - You can perform measurements by using the user interface similar to the semiconductor parameter analyzers such as Keysight 4155/4156 series. The setup can be made by entering values into the setup tables used for the measurement module control. And it can be saved and recalled as your setup (*My Favorite Setup*).
- **Tracer test mode** - Curve tracer test mode. This test allows you to perform the high speed I-V measurement on one screen. The Tracer test screen provides GUI for selecting the used channels, setting the sweep output, and displaying the measurement

result (tracing the I-V curve). Range of the sweep output and measurement can be changed by the rotary knob on the front panel. Test setups can be saved, and used in the classic test mode for further detailed measurement and analysis. Also see “Oscilloscope view”.

- **Quick test mode** - A GUI-based quick test mode enables you to perform test sequencing without programming. You can select, copy, rearrange, and cut-and-paste any test setups with a few simple mouse clicks. Once you have selected and arranged your tests, simply click on the measurement button to begin running an automated test sequence.

Application library

Contains over 300 application test definitions conveniently organized by device type, application, and technology. You can easily edit and customize the furnished application tests to fit your specific needs.

The following table shows a part of tests included in the library. They are subject to change without notice.

Table 1-27 Application library, Category list

Category	Test items
CMOS	Id-Vg, Id-Vd, Vth, breakdown, capacitance, QSCV, etc.
BJT	Ic-Vc, diode, Gummel plot, breakdown, hfe, capacitance, etc.
Discrete	Id-Vg, Id-Vd, Ic-Vc, diode, etc.
Memory	Vth, capacitance, endurance test, etc.
Power Device	Pulsed Id-Vg, pulsed Id-Vd, breakdown, etc.
NanoTech	Resistance, Id-Vg, Id-Vd, Ic-Vc, etc.
Reliability	NBTI/PBTI, charge pumping, electromigration, hot carrier injection, J-Ramp, TDDB, etc.

Oscilloscope view

Available for the tracer test using MCSMU modules. The oscilloscope view displays MCSMU current or voltage measurement data versus time. The pulsed measurement waveforms appear in a separate window for easy verification of the measurement timings.

This function is useful for verifying waveform timings and debugging pulsed measurements. It is available when a tracer test has one or more MCSMU channels being used in pulsed mode. The oscilloscope view can display the pulse waveform at any (user specified) sweep step of the sweep output.

- Sampling interval: 2 μ s
- Sampling points: 2000 Sa
- Sampling duration: 22 μ s to 24 ms
- Data saving

Numeric: TXT/CSV/XMLSS

Image: EMF/BMP/JPG/PNG

Workspace and data management

EasyEXPERT group+ has separate work environment (Workspace). Every workspace supports the following features.

- Measurement setup and execution
- Save/Recall My Favorite (preset group) setup
- Save/Recall measurement data and settings
- Import/Export device definition, measurement settings, My Favorite setup, measurement data, and application library
- Test result data management
- Access authority (private/public) setting

The EasyEXPERT has the ability to import/export a workspace for back-up and portability.

External instrument control

EasyEXPERT group+ supports all aspects of parametric test, from basic manual measurements to test automation across a wafer in conjunction with a semiautomatic wafer prober. The following shows supported equipment list.

- Switching matrix operation panel (GUI)
Keysight B2200A, B2201A, and E5250A with E5252A cards.
- External instruments supported by application tests
Keysight 4284A/E4980A, 81110A, and 3458A
- Wafer prober control
Scripts to perform chuck move/up/down and subsite move for major semiautomatic probers are furnished. The wafer prober control can be performed in the repeat measurement process.

Furnished Software

The B1500A also furnished the following software.

- Prober control scripts
- EasyEXPERT group+ software for PC
- VXi *plug&play* driver for Keysight B1500A
- 4155/56 setup file converter
Converts the measurement setup file (extension MES or DAT) for Keysight 4155 and 4156 into the equivalent setup file for EasyEXPERT classic test mode.
- MDM file converter
Converts the EasyEXPERT test result data file (extension XTR or ZTR) to Keysight IC-CAP MDM file. Supports the data of the following classic tests
 - I/V Sweep
 - Multi Channel I/V Sweep
 - C-V Sweep

1.5.2 EasyEXPERT group+ Software for PC

Keysight EasyEXPERT group+ for PC is the same software that is built-in to the PC-based Keysight B1500A Semiconductor Device Analyzer, except that it runs on a standalone PC. In addition, EasyEXPERT group+ for PC supports Offline mode and control capability of the following 4155 series and E5270 series.

NOTE

The latest revision of EasyEXPERT group+ software is available on the “www.keysight.com/find/easyexpert” web site.

- Execution mode
 - Online and offline
- Supported instruments
 - B1500A Semiconductor device analyzer
 - B1505A Power device analyzer / Curve tracer
 - 4155B/4155C Semiconductor parameter analyzer
 - 4156B/4156C Precision semiconductor parameter analyzer
 - E5260A IV Analyzer / 8 Slot High speed Measurement Mainframe
 - E5262A/E5263A 2 Channel IV Analyzer / Source Monitor Unit
 - E5270B Precision IV Analyzer / 8 Slot Precision Measurement Mainframe
- Supported 4155/4156 functionality
 - I/V sweep
 - I/V-t sampling (except thinned out mode)
 - VSU/VMU (except differential voltage measurement using VMU)
 - PGU (41501B)
 - Switching matrix control
- 4155/4156 functions unsupported by EasyEXPERT group+
 - Log sampling measurement and Thinned out sampling measurement
 - Functions using R box
 - Differential voltage measurement using VMU (Voltage Monitor Unit)
 - DC bias output using PGU (Pulse Generator Unit) in the 41501B
 - Other functions unavailable for the B1500A

NOTE

To control 4155/56 by EasyEXPERT group+, the following 4155/4156 firmware is required.

HOSTC: 03.08 or later

SMUC: 04.08 or later

B1500A Product Configuration
EasyEXPERT group+ software

- Supported E5260/E5270 functionality
 - I/V sweep (Application test mode/Classic test mode)
 - Multi-ch I/V sweep
 - I/V list sweep
 - Switching matrix control

NOTE To control E5260/E5270 by EasyEXPERT group+, the following firmware is required.

E5260A/E5262A/E5263A: B.01.10 or later
E5270B: B.01.10 or later

NOTE The EasyEXPERT group+ for PC supports most EasyEXPERT group+ functions. However, some functions are not supported on an external computer due to differences in hardware and so on.

1.5.3 System requirements

The following table shows the minimum requirements to run the EasyEXPERT group+ or other software/program furnished with the B1500A. They are effective as of June 2015. For the latest information, go to www.keysight.com and type in EasyEXPERT in the Search field at the top of the page.

Table 1-28 System requirements

Operating System	Microsoft Windows Vista Business SP2 or later (32 bit)	Microsoft Windows 7 Professional SP1 or later (32 bit/64 bit)	Microsoft Windows 8.1 Professional SP1 or later (32 bit/64 bit)	Microsoft Windows 10 Professional SP1 or later (32 bit/64 bit)
Language	English (US)			
.NET Framework	Microsoft .NET Framework version 3.5 SP1			
Processor	Vista certified PC	Windows 7 certified PC	Windows 8.1 certified PC	Windows 10 certified PC
Memory	2 GB	2 GB	2 GB	2 GB
Display	XGA 1024 x 768 (SXGA 1280 x 1024 recommended)			
HDD / SSD	1 GB free space on the C drive, 30 GB free space on a drive for test setup / result data storage			
LAN interface	EasyEXPERT remote control function using socket service. (100BASE-TX/10BASE-T)			
GPIB interface	The programming using Keysight FLEX command, Keysight Connection Expert is required.			
IO libraries	Keysight IO libraries Suite 16.2 or later (Keysight Connection Expert)			

NOTE

If your computer does not install a software, install the software in the above order. For example, if your computer does not install Microsoft .NET Framework 3.5 SP1, install it and Keysight IO Libraries in this order. If you do not use the Online execution mode, you do not need to install the IO Libraries.

Prepare the Keysight IO Libraries software CD provided with Keysight GPIB interface to install the IO Libraries.

Open the EasyEXPERT group+ Prerequisites folder to get installation packages for the other required software.

NOTE

The EasyEXPERT revision A.03.20 or later does not require the administrator privilege which is required by the revision A.03.11 and previous revisions. However, if the software is updated from a previous revision to the revision A.03.20 or later, it still requires the administrator privilege.

NOTE

About socket services

The EasyEXPERT remote control interface is a software interface usable from the VISA/SICL library. And it is used via LAN using the socket service. Keysight instruments are standardized on using port 5025 for socket services. A data socket on this port can be

used to send and receive commands, queries, and query responses. All commands must be terminated with a newline for the message to be parsed. All query responses will also be terminated with a newline.

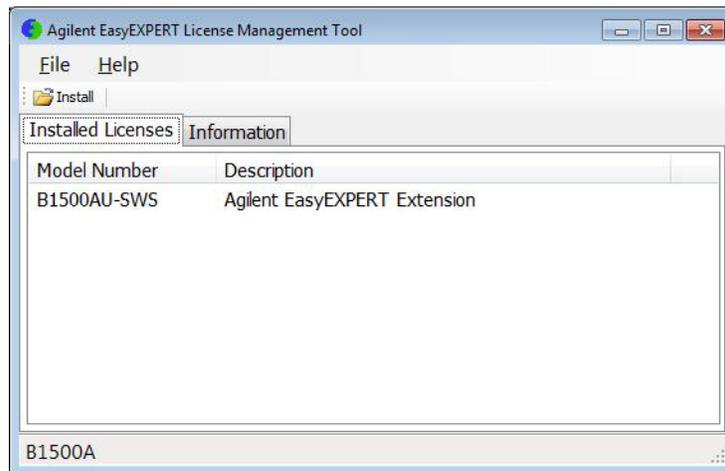
1.5.4 License Management Tool

The license management tool is the program used to install the license of the software listed below. This program is also used to confirm the licenses already installed and the host ID of the B1500 mainframe.

- Keysight B1500A-SWS EasyEXPERT Extension
- Keysight B1500AU-SWS EasyEXPERT Extension
- Keysight B1505A-SWS EasyEXPERT Extension
- Keysight B1505AU-SWS EasyEXPERT Extension

Figure 1-2

License management tool in the B1500A



NOTE

The EasyEXPERT software revision 5.5 or later requires license of Keysight EasyEXPERT Extension (B1500A-SWS or B1500A-SWS).

- **To launch program**

Click Start > All Programs > (Keysight B1500 EasyEXPERT >) Licence Management Tool.

- **To check licenses already installed**

Click Installed Licenses tab on the Licence Management Tool. The installed licenses will be displayed.

- **To check host ID**

Click Information tab on the Licence Management Tool. The host ID of the B1500 or the computer will be displayed.

- **To install license**

The following procedure installs the license.

1. Click Install icon, or click File > Install License File to open a dialog box.
2. Specify the license file (.lic file).
3. Click open.

NOTE**How to get the SWS Extension.**

The latest B1500A includes the license for SWS Extension. However, if you use old revision of EasyEXPERT and upgrade to revision 5.5 or later, the B1500AU upgrade kit with SWS option is required. Contact Keysight Technologies to upgrade the B1500A.

NOTE**How to get the license file (.lic file) for SWS Extension.**

The license file (.lic file) for SWS Extension can be gotten on the following web site with order number, certificate number and Host ID in EasyEXPERT group+ software. Please make sure order number and certificate number on LTU sheet. Keysight Software License (KSL) Redemption provides the license file for SWS Extension.
<https://asl.software.keysight.com/license/login.asp>

NOTE

The latest revision of the EasyEXPERT update package can be obtained from Keysight Technologies web site.

2

B1500A Accessories

2.1 Accessories for the B1500A

This section describes cables, adapters and accessories for the B1500A Semiconductor device analyzer.

2.1.1 SMU cables

- **Triaxial cables** - have three leads - a central conductor for the signal, an encapsulating conductor that shields the center signal by employing the same voltage thus decreasing a possible leakage current - and an outer conductor that serves as Common.
- **Kelvin Triaxial cables** - consist of two central twisted parallel leads that are connected to Force and Sense terminals of a SMU. A common guard and an outer conductor that is connected to Common further shield the two leads. By Kelvin connection it is possible to limit the influence of the connection leads on a lower resistively measurement to a minimum. Kelvin Triaxial cables should be employed when performing very sophisticated measurements.
- **GNDU cables** - have a very similar face to Triaxial cables. However the configuration of signal path is different from Triaxial cable. A central conductor for the Sense of GND voltage, outer conductor is used as GND signal, and the outermost conductor is for Common. In addition to that, the current capability of 16493L GND unit cable for B1500A is 4.2 Amps.
- **BNC cables** - Co-axial type cables. Central signal line is surrounded by shield potential. However, this is not suitable for ultra low current measurement below nA level. For these low current measurements, we recommend the Triaxial cables.

Table 2-1 SMU cables for B1500A semiconductor device analyzer

Model/Option	Description	Additional Information
Triaxial cable		
16494A-001	Triaxial cable, 1.5 m	
16494A-002	Triaxial cable, 3 m	
16494A-003	Triaxial cable, 80 cm	
16494A-004	Triaxial cable, 40 cm	
16494A-005	Triaxial cable, 4 m	
Kelvin triaxial cable		
16493K-001	Kelvin triaxial cable, 1.5 m	
16493K-002	Kelvin triaxial cable, 3 m	

Model/Option	Description	Additional Information
16494B-001	Kelvin triaxial cable to E5250A switching matrix input port, 1.5 m	
16494B-002	Kelvin triaxial cable to E5250A switching matrix input port, 3 m	
16494B-003	Kelvin triaxial cable to E5250A switching matrix input port, 80 cm	
GNDU cable		
16493L-001	GNDU cable, 1.5 m	
16493L-002	GNDU cable, 3 m	
16493L-003	GNDU cable, 5 m	
16493N-001	GNDU cable for B2200A/B2201A switching matrix input port, 2 m (2.0 m cable length only)	
ASU cable		
16493M-001	Triaxial and D-sub cable for ASU(E5288A), 1.5 m	
16493M-002	Triaxial and D-sub cable for ASU(E5288A), 3 m	
BNC cable		
16493B-001	Coaxial cable, BNC(m) to BNC(m), 1.5 m	
16493B-002	Coaxial cable, BNC(m) to BNC(m), 3.0 m	
The maximum voltage is 40 V, and Maximum current is 200 mA. The Keysight 16493B Coaxial Cable is designed for use with VSU (Voltage Source Unit), VMU (Voltage Measurement Unit) or PGU (Pulse Generator Unit) on the Keysight 4155 series Semiconductor Parameter Analyzer.		

WARNING There are potentially hazardous voltages, up to ± 100 V (MPSMU/HRSMU) or ± 200 V (HPSMU) at the Force, Sense, and Guard terminals.

To prevent electrical shock, do *not* expose these lines.

WARNING To prevent electrical shock during use, install an interlock circuit and connect the Interlock cable (See chapter 2.1.6 Other I/F and interlock).

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.

CAUTION

The GNDU can sink current of up to 4.2 A. Use the Keysight 16493L GNDU cable to connect the GNDU to a test fixture or a connector plate.

Do not use normal triaxial cable (Keysight 16494A), because the maximum current rating of the cable is 1 A.

NOTE

For the lower current measurement, use the 16494A Triaxial cable with low-noise environment. This cable can maximize the guard effects and minimize the impression of the external noise.

2.1.2 CMU accessories

- **CMU cables** - have BNC type. Accurate capacitance measurement requires dedicated cables so that cable can be compensated. B1520A MFCMU has very thin module design, so 16048D/E cannot connect with B1500A.
- **SCUU (SMU CMU unify unit)** - is used to switch the module (CMU or SMU) to be connected to the DUT. The SCUU is available for the MPSMU and HRSMU.
- **GSWU (Guard switch unit)** - is used to connect the CMU high and low guard lines together near the DUT. The connection is broken when the SCUU is in the SMU connection state. The GSWU is effective for the accurate impedance measurement.

Table 2-2 CMU accessories for B1500A semiconductor device analyzer

Model/Option	Description	Additional Information
CMU cable		
N1300A-001	CMU cable, 1.5 m	
N1300A-002	CMU cable, 3 m	
SCUU (SMU CMU unify unit)		
N1301A-100	SMU CMU unify unit (SCUU) Input: 4 BNC and 4 Triaxial Output: 4 Triaxial and 6 pin connector for GSWU cable	
N1301A-102	SMU CMU unify unit (SCUU) cable, 3 m	

Model/Option	Description	Additional Information
N1301A-110	SMU CMU unify unit (SCUU) magnet stand	
GSWU (Guard switch unit)		
N1301A-200	Guard switch unit (GSWU) Two pin cables are furnished with GSWU	
N1301A-201	Guard switch unit (GSWU) cable, 1 m	
N1301A-202	Guard switch unit (GSWU) cable, 3 m	

NOTE

Before connecting accessories to MFCMU

Turn the B1500A off before connecting the SCUU, the SCUU cable, or the CMU cable to the MFCMU.

NOTE

For the installation of the SCUU/GSWU 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 SCUU are 148 mm (W) × 75 mm (H) × 70 mm (D). Dimensions of the GSWU are 33.2 mm (W) × 41.5 mm (H) × 32.8 mm (D).

NOTE

About SCUU output cables

To perform capacitance measurements accurately, the cable length between DUT and the SCUU output must be as short as possible.

2.1.3 HVSPGU accessories

- **SPGU cables** - have co-axial type (SMA to coaxial) cables.
- **SPGU synchronous cables** - have co-axial (SMA to SMA) type cables. If multiple SPGUs have been installed, connect the SPGUs by this cable. This connection makes it possible to perform the synchronous output by the multiple SPGU channels. The primary SPGU is the module which outputs the reference signal and the secondary SPGUs are the modules which follow to the reference signal.
- **SMU/PGU selector** - Used to switch the measurement resource connected to the DUT. The measurement resource can be SPGU or SMU. Needs the 16445A adapter to use the selector. One selector provides two switching channels.
- **Digital I/O cables** - General digital I/O connection cable. This cable can connect between digital I/O port on the B1500A and 16445A SMU/PGU selector adapter.

Table 2-3 HVSPGU accessories for B1500A semiconductor device analyzer

Model/Option	Description	Additional Information
SPGU cable		
16493P-001	SPGU cable (SMA to BNC), 1.5 m	
16493P-002	SPGU cable (SMA to BNC), 3 m	
SPGU synchronous cable		
16493Q-001	SPGU synchronous cable (SMA to SMA), 8 cm	
SMU/PGU selector		
16440A	SMU PGU selector One 16440A has 2 channels and each channel can switch an SMU and a pulse generator.	
16440A-003	Control cable, 40 cm Connect between 16440A and 16445A	

Model/Option	Description	Additional Information
16445A	SMU PGU selector connection adapter, furnished with digital I/O control cable	
16445A-001	Control cable for B1500A to 16445A, 1.5 m	
16445A-002	Control cable for B1500A to 16445A, 3 m	
16493G-001	Digital I/O control cable, 1.5 m	
16493G-002	Digital I/O control cable, 3 m	

NOTE Connect the Ref Out/In, Sync Out/In, and Trig Out terminals to the specified terminal properly. Connecting to the other terminal may result in damage to the SPGU.

2.1.4 WGF MU accessories

- **WGF MU-to-RSU cables** - have D-sub connection. Two cables are required because the WGF MU has 2 channels. The 16493R-801 adapter is required and mounted on a shielding box to make connection to the RSU in the shielding box. Then the 60 cm and 2.4 m cables (16493R-001 and 002) or the 60 cm and 4.4 m cables (16493R-001 and 005) are required instead of the 1.5 m, 3 m, or 5 m cable.
- **Sync connection cable** - is required when two WGF MUs are used. One cable is furnished with B1530A.
- **Magnet stand** - is optional stand for RSU. The magnet stand is useful for fixing RSU.
- **Triaxial cables (SMU to RSU)**- can be used to connect SMU module to RSU. The 16495H-001 or 16495J-001 connector plate is required and mounted on a shielding box to make connection to the RSU in the shielding box. Then the 80 cm or 40 cm triaxial cable is additionally required.

Table 2-4 WGF MU accessories for B1500A semiconductor device analyzer

Model/Option	Description	Additional Information
16493R	WGF MU cables and accessories	
WGF MU to RSU cable		
16493R-001	WGF MU-to-RSU cable, 0.6 m	
16493R-002	WGF MU-to-RSU cable, 2.4 m	
16493R-003	WGF MU-to-RSU cable, 3 m	
16493R-004	WGF MU-to-RSU cable, 5 m	
16493R-005	WGF MU-to-RSU cable, 4.4 m	
16493R-006	WGF MU-to-RSU cable, 1.5 m	
Cable option for connection with DC probe		
16493R-101	SSMC short-open cable for current return path, 50 mm	
16493R-102	SSMC short-open cable for current return path, 75 mm	
16493R-202	SMA-SSMC cable between RSU and DC probe, 200 mm	
Cable option for connection with RF probe		
16493R-302	SMA-SMA cable between RSU and RF probe, 200 mm	

Model/Option	Description	Additional Information
Accessories for WGF MU		
16493R-801	WGF MU connection adapter (female-female)	
16493R-802	Magnet stand for RSU (1 ea) Two stands are required for one WGF MU.	
16493R-803	Sync terminal connection cable	

CAUTION

The B1500A must be turned off before connecting/disconnecting the cable between the RSU and the WGF MU Ch 1/Ch 2 terminal.

NOTE

For unused channels

Measurement terminals can be opened. Cable connection is not required. With the open condition, the channels will pass the self-test and skip the self-calibration. But controlling the channel will cause a run-time error.

NOTE

Cables used for the same measurement

Connect all measurement cables to the appropriate terminals, tie them up together, and make them stable by taping or something. This is important to reduce an environmental noise.

2.1.5 Test fixture

Keysight 16442B test fixture is designed for testing packaged devices and electronic components. You can mount the suitable socket module on the 16442B, which allows you to easily connect various devices to measurement units.

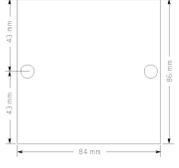
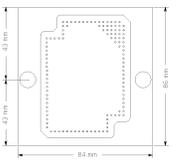
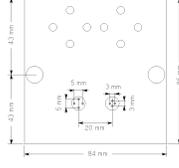
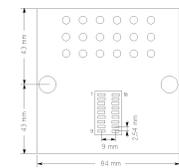
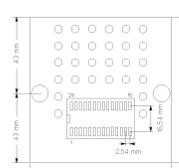
The 16442B has the following input ports.

- 6 SMU channels (Triaxial connector. It can be used either for 6 non-Kelvin or 3 Kelvin connectors.)
- 2 VSU channels (BNC connector)
- 2 VMU channels (BNC connector)
- 2 PGU channels (BNC connector)
- 1 GNDU channel (Triaxial connector. It requires the Keysight 16493L GNDU cable.)
- 1 interlock 6-pin connector

Table 2-5 16442B Test Fixture

Model/Option	Description	Additional Information
16442B	Test Fixture for Semiconductor Devices The following items are shipped as standard with the 16442B test fixture. <ul style="list-style-type: none"> • Blank PTFE board • 28-pin dual-in-package (DIP) socket module • 0.075-inch universal socket module • 0.5-inch universal socket module • Miniature banana to pin plug cables, black (4 pcs) • Miniature banana to pin plug cables, red (4 pcs) • Miniature banana to pin plug cables, blue (4 pcs) • Pin plug to pin plug cables, black (3 pcs) • Pin plug to pin plug cables, red (3 pcs) • Pin plug to pin plug cables, blue (3 pcs) • Miniature banana to miniature clip cables, black (3 pcs) • Miniature banana to miniature clip cables, red (3 pcs) • Miniature banana to miniature clip cables, blue (3 pcs) • Miniature banana to miniature banana, black (3 pcs) • Miniature banana to miniature banana, red (3 pcs) • Miniature banana to miniature banana, blue (3 pcs) • Connection pin set (10 ea) • Accessory case 	
Options for extra accessories		
16442B-010	Add four 1.5 m Triaxial cables (16494A-001)	If triaxial cables are required, select either 16442B-001 or 16442B-011.
16442B-011	Add four 3.0 m Triaxial cables (16494A-002)	

B1500A Accessories
Accessories for the B1500A

Model/Option	Description	Additional Information
16442B-800	Extra blank PTFE board	 <p>This insulation board has minimal leakage current, and so is good for extremely low current measurements.</p>
16442B-801	Add Universal socked module, 0.1 inch pitch, with 10 pins	 <p>This socket module is for measurement of virtually any device—component, DIP IC, or small-scale circuit.</p>
16442B-802	Extra Universal socked module, 0.075 inch pitch, with 10 pins	
16442B-803	Extra Universal socked module, 0.05 inch pitch, with 10 pins	
16442B-810	Extra pin set (for universal socket module, 10 pins.)	
16442B-811	Extra wire set (mini banana to pin plug, 6 ea)	
16442B-812	Extra wire set (pin plug to pin plug, 6 ea)	
16442B-813	Extra wire set (mini banana to pin clip, 6 ea)	
16442B-814	Extra wire set (mini banana to mini banana, 6 ea)	
16442B-821	Add socket module, 4-pin TO package	 <p>Part Number: 16088-60001 This socket module has two transistor sockets for measurement of three lead or four lead bipolar transistors and FETs. Maximum Voltage: 200 V</p>
16442B-822	Add socket module, 18-pin DIP package	 <p>This socket module has an 18-pin dual-in-line socket. Maximum Voltage: 230 V</p>
16442B-823	Extra socket module, 28-pin DIP package	 <p>This socket module has a 28-pin dual-in-line socket. Maximum Voltage: 230 V</p>
16442B-890	Extra accessories case	

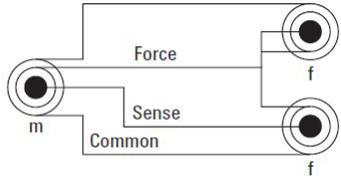
2.1.6 Other accessories and interlock

The following table lists the options and accessories available for the B1500A.

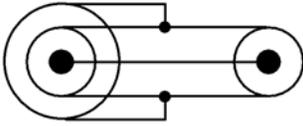
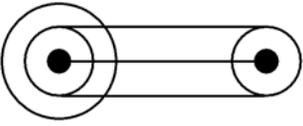
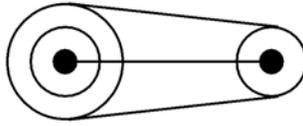
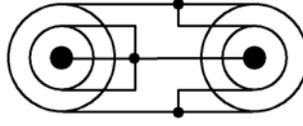
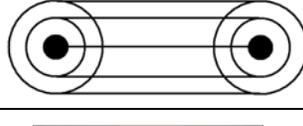
Table 2-6 Other accessories for B1500A semiconductor device analyzer

Model/Option	Description	Additional Information
Accessories for B1500A		
16444A-001	Extra USB keyboard	
16444A-002	Extra USB mouse	
16444A-003	Extra Stylus pen	
Interlock cable		
16493J-001	Interlock cable, 1.5 m	
16493J-002	Interlock cable, 3 m	
16493J-003	Interlock cable, 5 m	
GNDU cable		
16493L-001	GNDU cable, 1.5 m	
16493L-002	GNDU cable, 3 m	
16493L-003	GNDU cable, 5 m	
16493N-001	GNDU cable for B2200A/B2201A switching matrix input, 2 m	
Digital I/O cable		
16493G-001	Digital I/O control cable, 1.5 m	
16493G-002	Digital I/O control cable, 3 m	

Table 2-7 Adapter and connectors

Model/Option	Description	Additional Information
Digital I/O accessories		
N1253A-100	Digital I/O T-cable	Digital I/O T-cable has 2 male and 1 female connectors in order to connect more than two units. In order to connect three units, order one N1253A-100 and one 16493G cable.
N1253A-200	Digital I/O BNC box	<p>Adapter for connecting Digital I/O port with BNC trigger port of other instruments. Box which has 8 BNC connectors for connecting with BNC trigger port of other instruments and 25 pin D-sub connector for connecting this box to B1500A. In order to use this box for connection, need D-sub 25 pin straight cable (16493G) and BNC cable.</p> <div style="display: flex; flex-direction: column; align-items: center;">   </div>
Adapters/Accessories for DC parametric measurement instrument		
N1254A-100	<p>GNDU to Kelvin adapter</p> <p>Adapter for converting GNDU connector to Kelvin connector used only for B1500A and E5270 series. The adapter which converts the GNDU connector to 2 triaxial connectors like connectors of SMU output. This adapter can be used with only B1500A / E5270 Series. It does not fit with GNDU of 41501A/B.</p>	<div style="display: flex; flex-direction: column; align-items: center;">  <div style="display: flex; flex-direction: column; align-items: center;">  </div> </div>

B1500A Accessories
Accessories for the B1500A

Model/Option	Description	Additional Information
N1254A-101	Triaxial (m) to Coaxial (f) adapter (1250-2648)	
N1254A-102	Triaxial (f) to Coaxial (m) adapter (1250-2649)	
N1254A-103	Triaxial (m) to Coaxial (f) adapter (1250-2650)	
N1254A-104	Triaxial (f) to Coaxial (m) adapter (1250-2651)	
N1254A-105	Triaxial (f) to Coaxial (m) adapter (1250-2652)	
N1254A-106	Triaxial (m) to Coaxial (f) adapter (1250-2653)	
N1254A-107	Triaxial (m) to Triaxial (m) adapter (1250-2654)	
N/A	Triaxial (f) to Triaxial (f) adapter (1250-2618)	
N1254A-108	Magnet Stand for ASU (E5288A)	
Accessories for 16442B test fixture		
N1254A-200	Transistor socket module in 16442B-821	4-pin TO package
N1254A-201	28pin DIP socket module in 16442B-823	
N1254A-202	18pin DIP socket module in 16442B-823	
N1254A-204	Universal socket module in 16442B-801	0.1 inch pitch
N1254A-205	Universal socket module in 16442B-802	0.075 inch pitch
N1254A-206	Universal socket module in 16442B-803	0.05 inch pitch
N1254A-207	Blank PTFE board module in 16442B-800	Blank PTFE board for measuring high resistance devices
N1254A-300	Contact Pins (10 ea)	Connection pins (10 ea) included in 16442B-801, 802 and 803
N1254A-301	Mini banana - pin plug (black, 1 ea)	Mini banana - pin plug included in 16442B-811

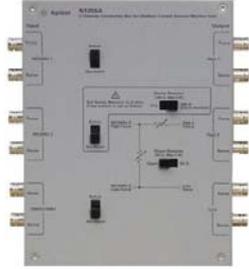
B1500A Accessories
Accessories for the B1500A

Model/Option	Description	Additional Information
N1254A-302	Mini banana - pin plug (red, 1 ea)	Mini banana - pin plug included in 16442B-811
N1254A-303	Mini banana - pin plug (blue, 1 ea)	Mini banana - pin plug included in 16442B-811
N1254A-304	Pin plug - pin plug (black, 1 ea)	Pin plug - pin plug included in 16442B-812
N1254A-305	Pin plug - pin plug (red, 1 ea)	Pin plug - pin plug included in 16442B-812
N1254A-306	Pin plug - pin plug (blue, 1 ea)	Pin plug - pin plug included in 16442B-812
N1254A-307	Mini banana - mini clip (black, 1 ea)	Mini banana - mini clip included in 16442B-813
N1254A-308	Mini banana - mini clip (red, 1 ea)	Mini banana - mini clip included in 16442B-813
N1254A-309	Mini banana - mini clip (blue, 1 ea)	Mini banana - mini clip included in 16442B-813
N1254A-310	Mini banana - mini banana (black, 1 ea)	Mini banana - mini banana included in 16442B-814
N1254A-311	Mini banana - mini banana (red, 1 ea)	Mini banana - mini banana included in 16442B-814
N1254A-312	Mini banana - mini banana (blue, 1 ea)	Mini banana - mini banana included in 16442B-814
Accessories		
N1254A-400	Coaxial cable between connector plate and probe card, black 1 m	Coaxial cable (50 ohm) between connector plate and probe card, black 1 m
N1254A-401	Triaxial connector for SMU and HCU (female)	
N1254A-402	Interlock micro switch (3101-0302)	
Accessories for B1505A		
N1254A-500	HV jack connector panel mount - Solder type	This option is available for accessories on the Keysight B1505A Power Device Analyzer/Curve Tracer. For details, please refer to the Product Guide of B1505A.
N1254A-501	HV jack to jack adapter	
N1254A-502	HV plug connector panel mount - Solder type	
N1254A-503	HCSMU coaxial cable assy 1.5 m - BNC to open-end	
N1254A-504	HVSMU jack cable assy 1.5 m - HV jack to open-end	

B1500A Accessories

Accessories for the B1500A

Model/Option	Description	Additional Information
N1254A-505	HVSMU triaxial cable assy 1.5 m - HV plug to open-end	This option is available for accessories on the Keysight B1505A Power Device Analyzer/Curve Tracer. For details, please refer to the Product Guide of B1505A.
N1254A-506	HVSMU coaxial cable assy 1.5 m - HV plug to open-end	
N1254A-507	HVSMU coaxial cable assy 1.5 m - HV plug to HV plug	
N1254A-508	Connection wire, red 1 ea	
N1254A-509	Connection wire, black 1 ea	
N1254A-510	Dolphin clip adapter, black 1 ea and red 1 ea.	
N1254A-511	Cable lag adapter, black 1 ea and red 1 ea.	
N1254A-512	SHV cable, 250 mm	
N1254A-513	SHV to banana adapter, 1ea	
N1254A-514	BNC (m) to BNC (m) adapter, 1 ea	
N1254A-515	BNC (f) - BNC (m) - BNC (f) adapter, 1 ea	
N1254A-516	BNC (f) - BNC (f) - BNC (f) adapter, 1 ea	
N1254A-517	Adapter, Triaxial Jack to Triaxial Plug, 1 ea	
N1254A-518	SHV Cable 1.5 m	
N1254A-520	10 kV Ultra High Voltage Open End Cable, 1 m	
N1254A-521	10 kV Ultra High Voltage Jack to Jack Adapter	
N1254A-522	1500 A Ultra High Current Banana to Banana Cable, 2 ea.	
N1254A-523	1500 A Ultra High Current Banana to Open End Cable, 1 m, 2 ea	
N1254A-524	500 A Ultra High Current Prober System Cable	
N1254A-525	SHV Cable Assy 1.5m - SHV Plug To Open-end	
N1254A-526	Ultra High Current Cable, 2m, No Connectors At Either End	
N1254A-527	PTFE Standoff, Jack, 4 ea.	
N1254A-528	PTFE Standoff With Banana Plug, 4 ea.	
N1254A-550	Test Leads And Connection Kit For Thermal Test, 20 cm	
N1254A-551	Test Leads And Connection Kit For Thermal Test, 30 cm	

Model/Option	Description	Additional Information
N1254A-552	Test Lead For Thermal Test, 2 m, No Connectors At Either End	This option is available for accessories on the Keysight B1505A Power Device Analyzer/Curve Tracer. For details, please refer to the Product Guide of B1505A.
N1254A-553	1500A Test lead For Thermal Test, 2 m, No Connectors At Either End	
N1254A-554	Thermo-couple, 50 cm, High Temperature Resistant, 2ea.	
N1254A-556	Test Leads And Connection Kit For Capacitance Test, 20 cm, 4 ea.	
N1254A-557	Test Leads And Connection Kit For Thermal Test with N1271A	
N1254A-558	SHV Cable 3m	
N/A	BNC-T Plug (m) -BNC (f) - BNC (f) adapter, 1 ea	1250-2405
Accessories for Medium Current SMU (MCSMU)		
N1255A	2 Channel connection box for B1514A Medium Current Source/Monitor unit	

2.1.7 Rack mount kit for Keysight standard cabinet

Keysight B1500A can be mounted in a 19-inch EIA rack cabinet. It is designed to fit in seven rack-units (7U) of space.

Table 2-8 **Rack mount parts for B1500A**

Model	Height EIA	Handle & Flange Kit	Std. slide	Support rail	D (mm)	Weight (kg)	Power Max. (VA)	Cooling & Vending
B1500A	7	5063-9225	1494-0059	E3663AC	600	25	200	Rear

2.2 Accessories for the wafer prober / connector plate

When connecting the Keysight B1500A to a prober, a connector interface may be required to feed the test leads through a shielding box. A connector plate fulfills the requirement of such an interface.

Keysight provides 2 types of Connector Plate.

- Connector (front) to connector (rear)
- Connector (front) to contacts for soldering (rear)

Figure 2-1 Difference between “connector to connector” and “connector to contact for soldering”

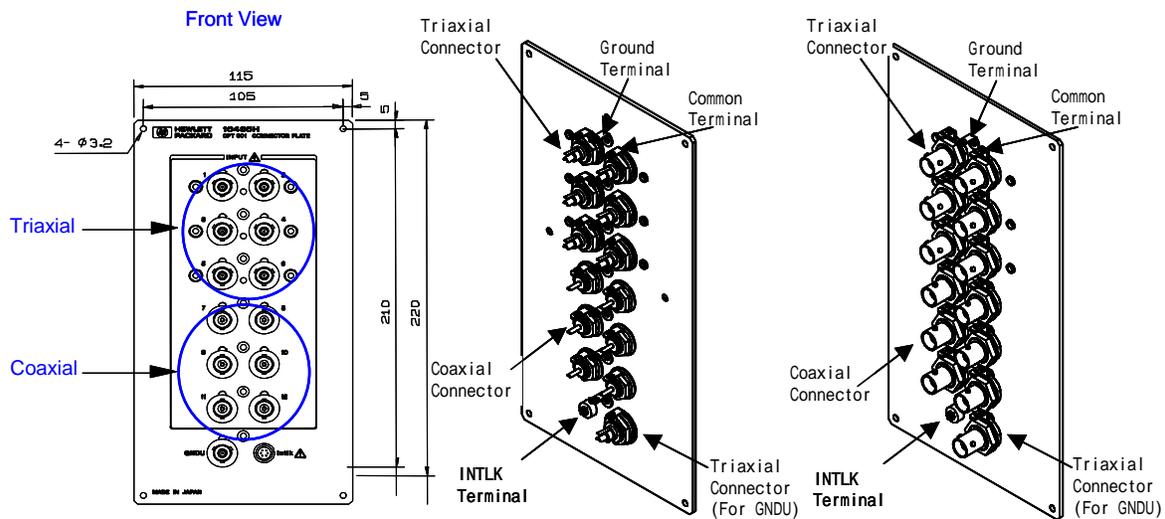


Table 2-9 Item number information of 16495F Connector Plate with 12 Triaxial Interlock and GNDU connectors

Item.	Description	OP Instruction
16495F	Connector plate with 12 triaxial, interlock and GNDU connectors	Half size connector plate with 12 triaxial, interlock and ground unit connectors. Common terminals are connected to plate. ATTENTION: Must specify either 16495F-001 or 16495F-002
16495F-001	Bulkhead feedthru connectors	Connection type is "Connector-Connector"
16495F-002	Connectors to contacts for soldering	Connection type is "Connector-Solder"

B1500A Accessories

Accessories for the wafer prober / connector plate

Table 2-10 Item number information of 16495G Connector Plate with 24 Triaxial, Interlock and GNDU connectors

Item.	Description	OP Instruction
16495G	Connector plate with 24 triaxial, interlock and GNDU connectors	Full size connector plate with 24 triaxial, interlock and ground unit connectors. Common terminals are connected to plate. ATTENTION: Must specify either 16495G-001 or 16495G-002
16495G-001	Bulkhead feedthru connectors	Connection type is "Connector-Connector"
16495G-002	Connectors to contacts for soldering	Connection type is "Connector-Solder"

Table 2-11 Item number information of 16495H Connector Plate with 6 Triax., 6 BNC, Intlk, GNDU

Item.	Description	OP Instruction
16495H	Connector plate with 6 triax., 6 BNC, intlk, GNDU	Half size connector plate with 6 triaxial, 6 BNC, interlock and ground unit connectors. Common terminals are floating. ATTENTION: Must specify either 16495H-001 or 16495H-002
16495H-001	Bulkhead feedthru connectors	Connection type is "Connector-Connector"
16495H-002	Connectors to contacts for soldering	Connection type is "Connector-Solder"

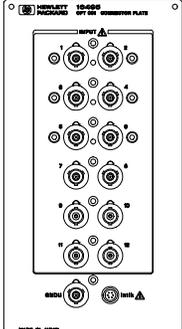
Table 2-12 Item number information of 16495J Connector Plate with 8 Triax., 4 BNC, Intlk, GNDU

Item.	Description	OP Instruction
16495J	Connector plate with 8 triax., 4 BNC, intlk, GNDU	Half size connector plate with 8 triaxial, 4 BNC, interlock and ground unit connectors. Common terminals are floating. ATTENTION: Must specify either 16495J-001 or 16495J-002
16495J-001	Bulkhead feedthru connectors	Connection type is "Connector-Connector"
16495J-002	Connectors to contacts for soldering	Connection type is "Connector-Solder"

Table 2-13 Item number information of 16495K Connector Plate with Universal Cable Holder

Item.	Description	OP Instruction
16495K	Connector plate with universal cable holder	16495K does not have any connections. This plate provides the cable hole and the cover with rubber used to block the light from the cable hole. This plate will be used with the E5288A ASU or the N1301A-200 GSWU that will be installed in the shielding box. ATTENTION: Must specify 16495K-001
16495K-001	Connector plate with rubber holder	The cable hole is to pass the cables from the ASU or GSWU to the instrument such as B1500A, E5270B, and so on. And the cables will be fixed to the shielding box by using the cover with rubber that will close the opening of the cable hole.

Table 2-14 Connector plate overview

		
16495F (12 triax., Intlk, GNDU)	16495G (24 triax., Intlk, GNDU)	16495H (6 triax. 6coax., Intlk, GNDU)
		
16495J (8 triax. 4 coax., Intlk, GNDU)	16495K Connector Plate with Universal Cable Holder for ASU	16495K inside

B1500A Accessories

Accessories for the wafer prober / connector plate

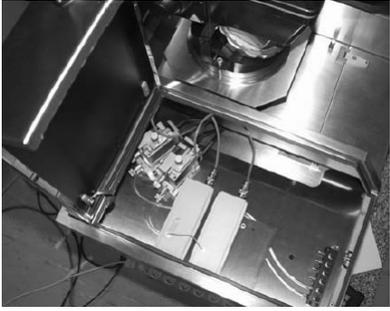
3

Connection Guide for Wafer Prober

3.1 SMU/GNDU connection with prober

This section describes how to connect a wafer prober to the Keysight B1500A semiconductor device analyzer.

Table 3-1 Semi automated prober with B1500A

B1500A with Cascade Prober	B1500A with Vector Prober
 A photograph of a Keysight B1500A semiconductor device analyzer setup with a Cascade Prober. The B1500A is on a black stand with a silver front panel. A Cascade Prober is mounted on top. Two computer monitors are visible, one on the left and one on the right, displaying test data. The number '2300' is visible on the front of the B1500A.	 A photograph of a Keysight B1500A semiconductor device analyzer setup with a Vector Prober. The B1500A is on a black stand. A Vector Prober is mounted on top. A computer monitor is visible on the left, displaying test data. The Vector Prober has 'Vector' and 'VW 3000S V' printed on its side.
B1500A with Cascade (Suss) Prober	ASUs on the probe station
 A photograph of a Keysight B1500A semiconductor device analyzer setup with a Cascade (Suss) Prober. The B1500A is on a black stand. A Cascade (Suss) Prober is mounted on top. Two computer monitors are visible, one on the left and one on the right, displaying test data.	 A close-up photograph of the probe station area of the B1500A. It shows the internal components, including the probe needles and the probe station head, which are used for making electrical contact with the device under test.

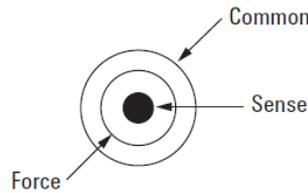
3.1.1 GNDU connections

An SMU has FORCE (SENSE), GUARD, and COMMON, but a GNDU has SENSE, FORCE, and COMMON as shown in Figure 3-1. User needs some sort of GNDU to Kelvin adapter when connecting the GNDU to standard triaxial connections.

CAUTION

User should use the Keysight 16493L GNDU cable to connect the GNDU to the connector plate; do not use a standard triaxial cable. The GNDU cable can handle the maximum GNDU current of 4.2 A, but standard triaxial cables (16494A) are only rated to 1 A.

Figure 3-1 GNDU terminal



Non-Kelvin connection

Connect the triaxial connector using an adapter for GNDU (N1254A-107) as shown in Figure 3-2. For parts information for this connection, see Table 3-2.

Figure 3-2 Example of a GNDU non-Kelvin connection

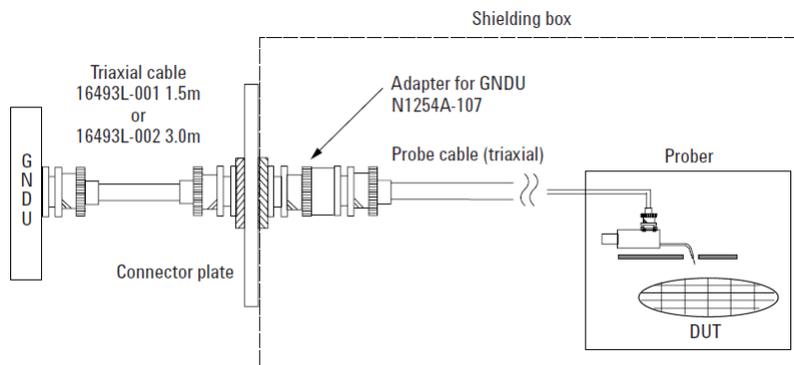


Table 3-2 Item number information for GNDU non-Kelvin connection with B1500A

Description	Qty	Product Number	Part number
Ground unit cable (1.5 m) - max 4.2 A	1	16493L-001	N/A
Ground unit cable (3.0 m) - max 4.2 A	1	16493L-002	N/A
Triaxial (m) to triaxial (f) adapter	1	N1254A-107	1250-2654

Kelvin connection

Connect the dual triaxial connector using a GNDU to Kelvin Adapter (N1254A-100) as shown in Figure 3-3. For parts information, see Table 3-3. Maximum current is restricted when the Kelvin triaxial cable is used.

Figure 3-3 Example of a GNDU Kelvin connection

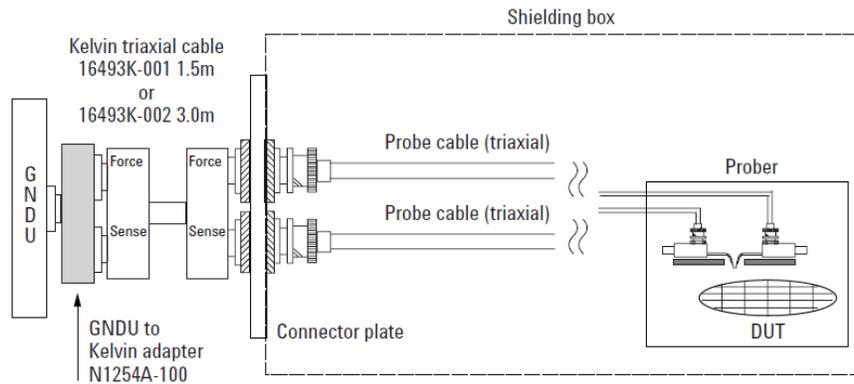


Table 3-3 Item number information for GNDU Kelvin connection with B1500A

Description	Qty	Product Number	Part number
Kelvin triaxial cable (1.5 m) - Max 3.0 A	1	16493K-001	N/A
Kelvin triaxial cable (3.0 m) - Max 2.6 A	1	16493K-002	N/A
GNDU to Kelvin adapter	1	N1254A-100	N/A

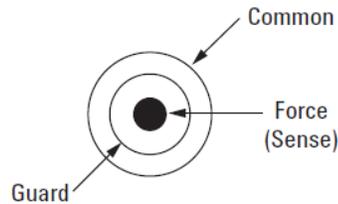
3.1.2 SMU connections

An SMU terminal is shown in Figure 3-4.

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.

Figure 3-4 SMU terminal



Non-Kelvin connection

These instructions apply when all connections are non-Kelvin. Connect the Keysight 16494A triaxial cables between the SMU and the Connector plate. Connect the triaxial connector on the probe cable as shown in Figure 3-5. For parts information, see Table 3-4.

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 user makes 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.

Figure 3-5 Example of an SMU non-Kelvin connection

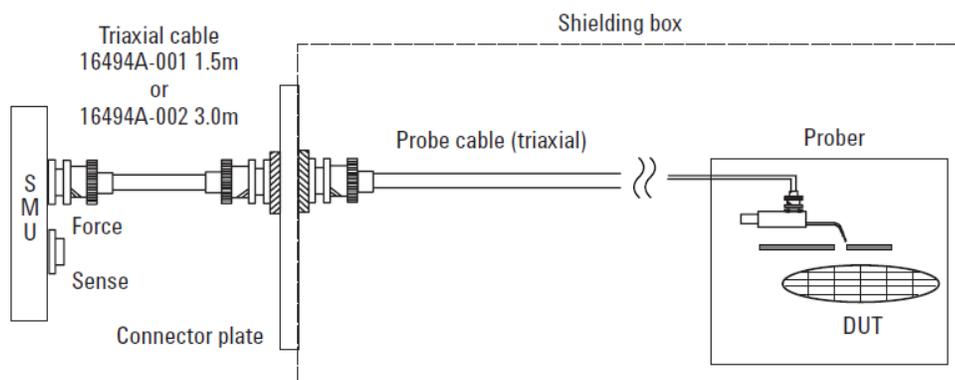


Table 3-4 Item number information for GNDU non-Kelvin connection with B1500A

Description	Qty	Product Number	Part number
Triaxial cable (1.5 m)	1	16494A-001	N/A
Triaxial cable (3.0 m)	1	16494A-002	N/A

Kelvin connection

These instructions apply when all connections are Kelvin. Two probes must contact the wafer in this connection. Connect an Keysight 16493K Kelvin triaxial cable (or two Keysight 16494A triaxial cables) between the SMU and the connector plate. Connect the FORCE and SENSE lines to probes separately. Connect the triaxial connector on the probe cable as shown in Figure 3-6. For parts information, see Table 3-5.

NOTE To prevent oscillations, do not use cables longer than 1.5 m, if you use two 16494A triaxial cables with Kelvin connections.

Figure 3-6 Example of an SMU Kelvin connection

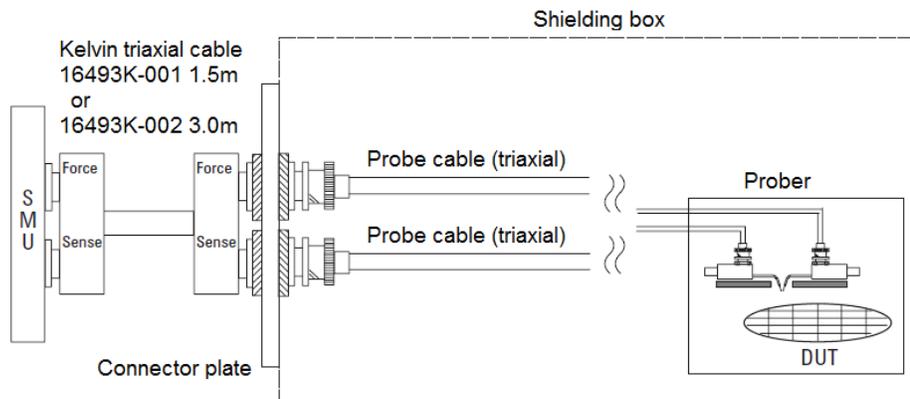


Table 3-5 Item number information for SMU Kelvin connection with B1500A

Description	Qty	Product Number	Part number
Kelvin triaxial cable (1.5 m) - max 3.0 A	1	16493K-001	N/A
Kelvin triaxial cable (3.0 m) - max 2.6 A	1	16493K-002	N/A

Kelvin to non-Kelvin connection

These instructions apply when the connections up to the Connector Plate are Kelvin, but the probe is a non-Kelvin connection. Connect an Keysight 16493K Kelvin triaxial cable (or two Keysight 16494A triaxial cables) between the SMU and the Connector plate. Connect the triaxial connector on the probe cable as shown in Figure 3-7. Connect the FORCE and SENSE lines on this side of the probe input terminal. A Tee Triaxial BNC adapter can be used. For parts information, see Table 3-6.

NOTE To prevent oscillations, do not use longer than 1.5m, if user uses two 16494A triaxial cables with Kelvin connections.

NOTE When connecting the cable and tee connector as shown in Figure 3-7, space restrictions make an adjacent connector unusable. Since three connectors are necessary for a Kelvin connection a connector plate must be used. Select the correct connector plate for your application. To make two Kelvin connections, use an Keysight 16495H. To make three Kelvin connections, use an Keysight 16495J.

Figure 3-7 Example of an SMU Kelvin to non-Kelvin connection

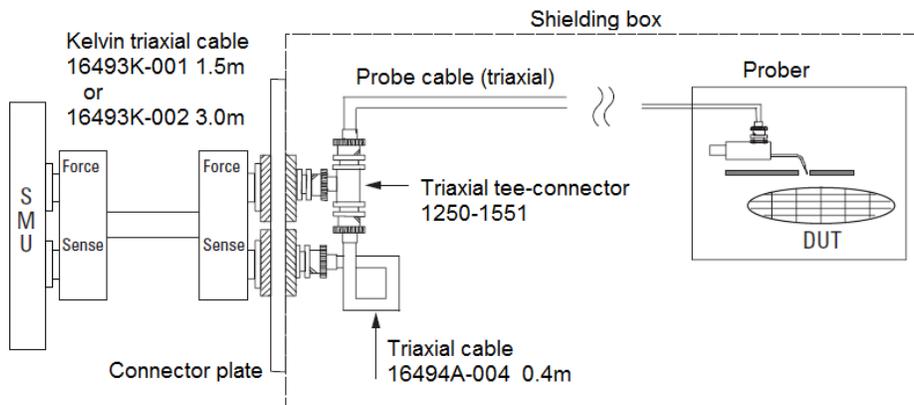


Table 3-6 Item number information for SMU Kelvin to non-Kelvin connection with B1500A

Description	Qty	Product Number	Part number
Kelvin triaxial cable (1.5 m) - max 3.0 A	1	16493K-001	N/A
Kelvin triaxial cable (3.0 m) - max 2.6 A	1	16493K-002	N/A
Triaxial cable (0.4 m)	1	16494A-004	N/A
Triaxial tee-connector	1	N/A	1250-1551

3.1.3 MCSMU connections

The MCSMU output connection example is shown in Figure 3-8.

For the connection of the MCSMU, the Keysight N1255A connection box is required. Input panel provides six triaxial connectors for connecting two MCSMU and one GNDU or SMU. Output panel provides six triaxial connectors for the High1, High2, and Low terminals. See Figure 3-11 for image of the Input panel and the Output panel. Also see Figure 3-8 for the connection image. And see Figure 3-10 for the internal connection. To connect the N1255A Output terminals to the connectors as shown in Figure 3-9, use the 16494A triaxial cable.

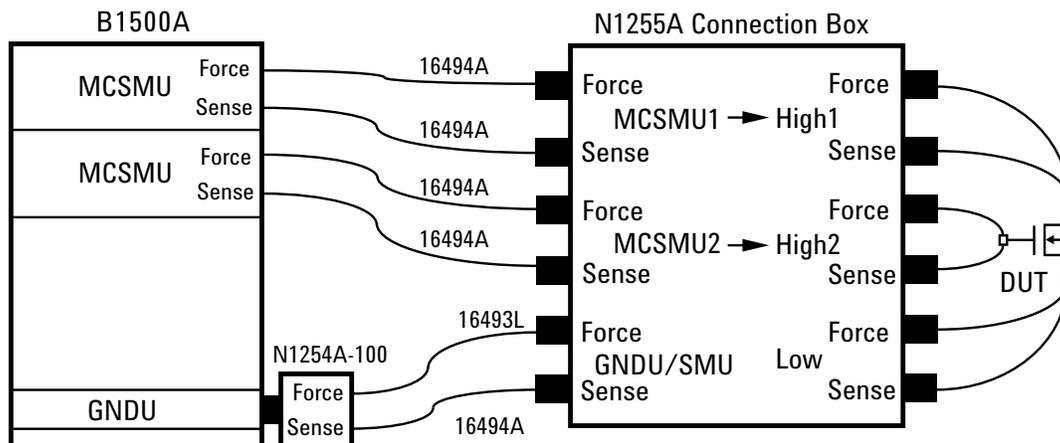
Use the following cables to connect the N1255A to the MCSMU

- 16494A Triaxial cable, 2 ea. per one MCSMU

Use the following cables and adapter to connect the N1255A to the GNDU.

- N1254A-100 GNDU to Kelvin adapter, 1ea.
- 16493K GNDU cable, 1ea.
- 16494A Triaxial cable, 1 ea.

Figure 3-8 N1255A Connection Example



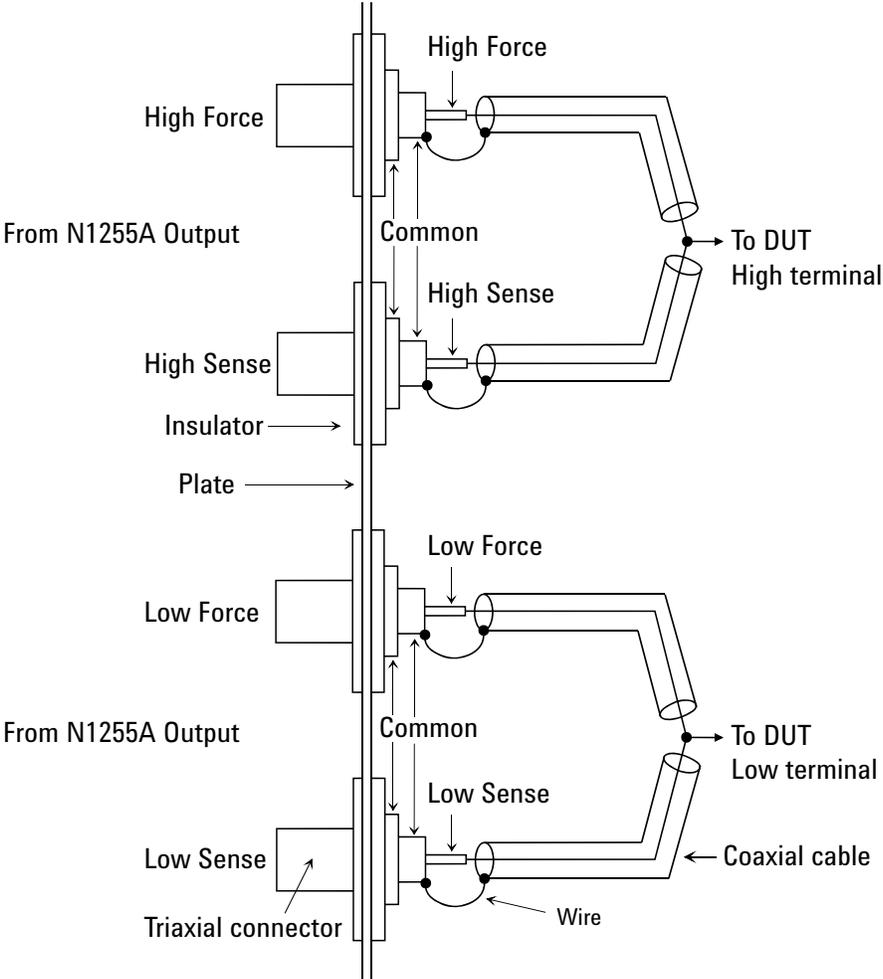
NOTE N1255A Input and Output terminals

If a MP/HP/HRSMU is connected instead of the GNDU, use the following cable. Also, do not use the SMU current range less than 100 mA.

Voltage ranging of terminals is indicated near connector on the Input or Output panel.

The N1255A cannot be used for measurement of the IEC Measurement Category II, III, or IV.

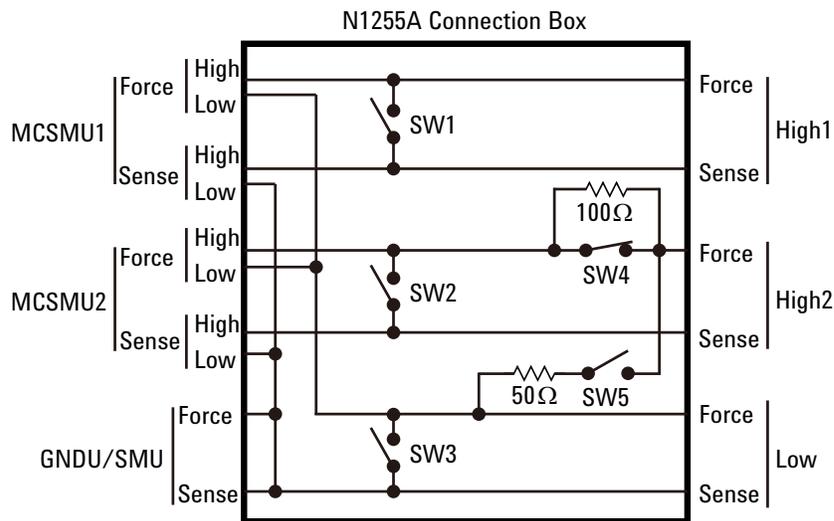
Figure 3-9 MCSMU Output Connection



The High Force/High Sense/Low Force/Low Sense lines should be connected to the DUT as shown in Figure 3-9. Wiring shown in Figure 3-14 Cable and Probing needle can be used. To simplify the connections, omit the wiring of the Common.

For the non-Kelvin connection, use the High Force and the Low Force only. Omit the wiring of the High Sense and the Low Sense.

Figure 3-10 N1255A Internal Connections



- SW1: Kelvin/Non-Kelvin selection switch for High1
- SW2: Kelvin/Non-Kelvin selection switch for High2
- SW3: Kelvin/Non-Kelvin selection switch for Low
- SW4: 0 Ω /100 Ω series resistor selection switch for High2 Force
- SW5: Open/50 Ω shunt resistor selection switch between High2 and Low, Force

NOTE

Selection switch SW2 and SW4

The SW4 switches the series resistance 0 Ω /100 Ω on the High2 Force line. The resistor is not mounted on the High2 Sense line.

Set the SW4 to “0 Ω ” if the SW2 is set to “Kelvin”.

Set the SW2 to “Non-Kelvin” if the SW4 is set to “100 Ω ”.

NOTE

Selection switch SW1/SW2/SW3

The switch is used to make or break the connection between Force and Sense in the N1255A. Setting it to “Non-Kelvin” makes this internal connection to enable the non-Kelvin connection. And setting it to “Kelvin” breaks this internal connection to enable the Kelvin connection.

If the switch is set to “Non-Kelvin”, do not extend the Sense output corresponding to it. Voltage on the Force line also appears on the Sense line. So, open the Sense connector on the Output panel.

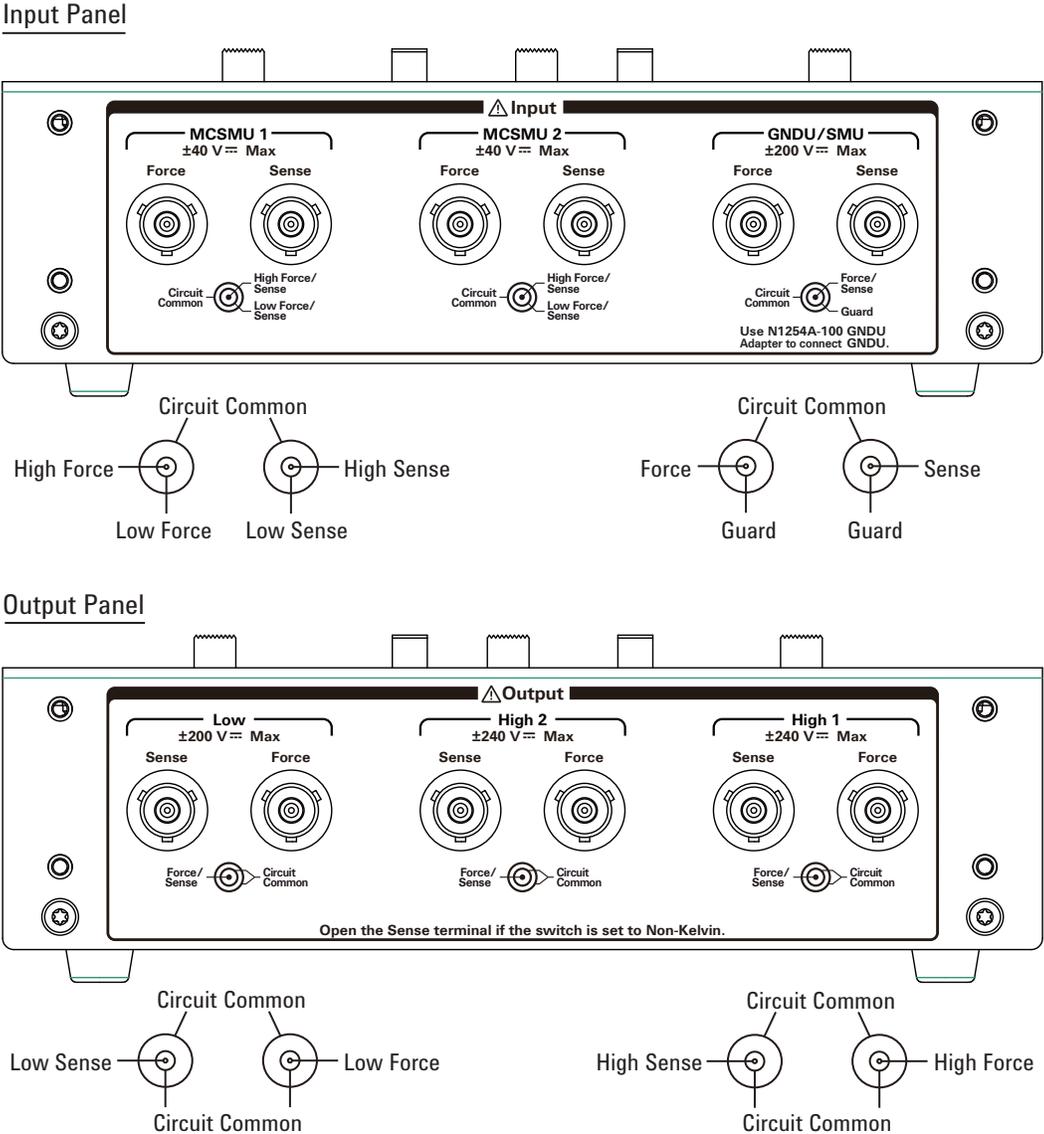
NOTE

Series Resistor and Shunt Resistor

The series resistor and the shunt resistor can be used for preventing MCSMU from oscillation. If the MCSMU oscillates, insert either 100 Ω series resistor or 50 Ω shunt resistor.

If it does not stop the oscillation, prepare the resistor of the other value and insert it between the Output High and the device under test (DUT).

Figure 3-11 N1255A Input Panel and Output Panel



3.2 Connection for low current measurement

This section provides the information useful for connecting cables and probing needles to a connector plate.

3.2.1 To make connection to reduce leakage current

To reduce the leakage current caused by connection cables, the guard technique is effective. Connect the probing needles to the coaxial cables as shown below:

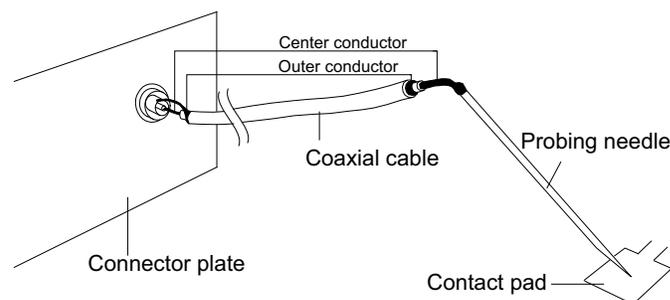
Guarding reduces the leakage current between the instrument and a DUT. This is important when you measure low current.

1. Cut and trim end of the coaxial cable so that the center conductor does not touch the outer conductor (connected to the guard terminal).
2. Connect the center conductor to tail of the probing needle. Never connect the outer conductor to the probing needle. However, the outer conductor should be extended as close as possible to the probing needle.
3. Connect the outer conductor to the outer conductor of the probing needle if it is a coaxial probing needle.

The following example connection can be used to reduce the leakage current. Extend the outer conductor as close as possible to the probing needle, This is also reduces the induced noise.

Figure 3-12

Cable and Probing needle

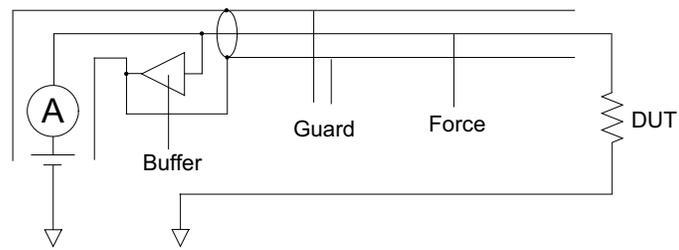


3.2.2 Guarding

Guarding reduces the leakage current between the instrument and the measurement point. This is important when you measure low current.

The following figure shows the theory of guarding. The buffer amplifier ($\times 1$) keeps the potential of the guard conductor at the same potential as the force conductor, so current does not flow between the force and guard conductors. Therefore, the current measured by the instrument is same as current at the DUT terminal because no current is leaked.

Figure 3-13 Guarding



WARNING Do not touch the guard terminal with bare hands because you may be shocked by high voltage. The potential of the guard terminal is equal to the output voltage.

CAUTION Never connect the Guard terminal to any other output, including circuit common, chassis ground, or any other guard terminal. Doing so will damage the B1500A.

3.3 Connection for low resistance measurement

This section provides the information useful for connecting cables and probing needles to a connector plate with Kelvin connections.

3.3.1 To make connection to measure low resistance

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, remote sensing), which means the Force and Sense lines are extended separately to the DUT.

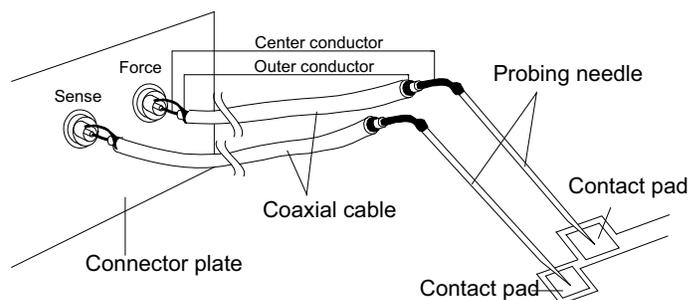
Connect the probing needles to the terminals of the connector plate by using test leads or coaxial cables. Following instruction uses the coaxial cables:

1. Cut and trim end of the coaxial cable so that the center conductor does not touch the outer conductor (connected to the guard terminal).
2. Connect the center conductor to tail of the probing needle. Never connect the outer conductor to the probing needle. However, the outer conductor should be extended as close as possible to the probing needle.
3. Connect the outer conductor to the outer conductor of the probing needle if it is a coaxial probing needle.
4. Perform 1 to 3 for both Force and Sense lines.
5. Contact the probing needles for the Force and Sense lines as close as possible to the DUT.

The following example connection can be used to measure low resistance. The Sense line is extended to the probing pad, and contacts the Force line through the pad, so the voltage drop due to the residual resistance caused by cables and test leads is canceled.

Figure 3-14

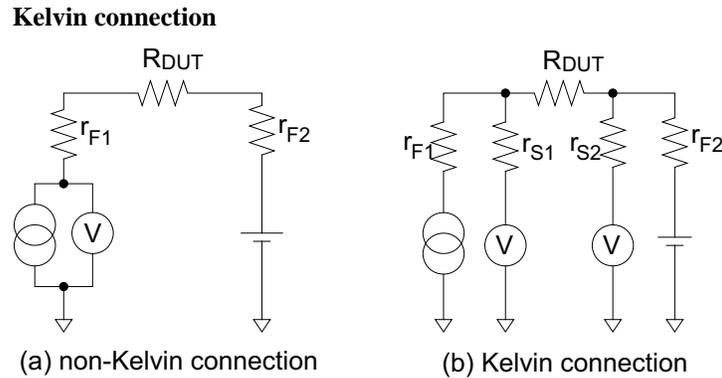
Cable and Probing needle



3.3.2 Kelvin connection

Kelvin connections give good measurement results when you force high-current. The following figure shows the equivalent circuits for Kelvin and non-Kelvin connections.

Figure 3-15



- For the non-Kelvin connection, the voltmeter measures the voltage drop of resistance 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).

NOTE

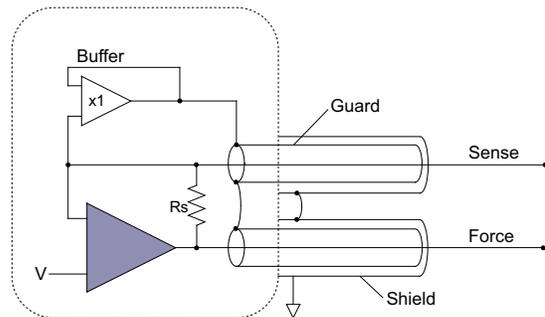
Kelvin connection and non-Kelvin connection

To make the Kelvin connection, use both Force and Sense terminals. Connecting the Force and Sense lines together at the terminal of the DUT (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.

If you want to simplify the cable connections, use the 2-wire connections by connecting the Force terminals only. Then open the Sense terminals. This is the non-Kelvin connection. The Force terminals can be used to force and measure dc voltage or current via R_s in Figure 3-16.

Figure 3-16

Simplified SMU circuit diagram



3.4 SCUU and ASU

This section describes how to connect a wafer prober to the Keysight B1500A semiconductor device analyzer with SCUU and ASU.

3.4.1 SCUU positioner-based probing connection

The SCUU should be connected to the DUT by using triaxial cables as shown in Figure 3-17. When making IV measurements using the SMUs, the outputs of the SCUU function exactly the same as the Kelvin outputs of an SMU (both FORCE and SENSE lines are available).

NOTE

In the Figure 3-17, SENSE lines are not used. When making CV measurements using the MFCMU, only the FORCE outputs of the SCUU are used. SCUU FORCE output 1 corresponds to CMH, and SCUU FORCE output 2 corresponds to CML. The SCUU can be fixed on the prober by using SCUU Magnet Stand (N1301A-110).

Figure 3-17 Example of a SCUU remote docking mode

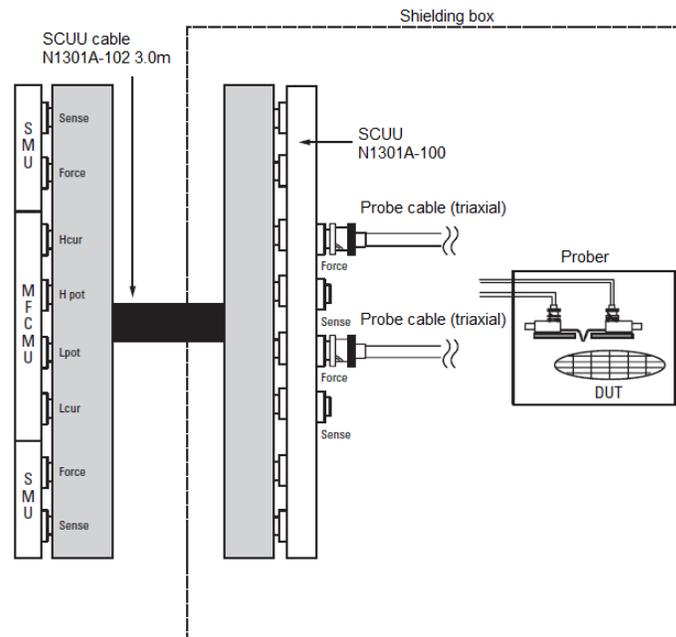


Table 3-7 Item number information for ASU connection with B1500A

Description	Qty	Product Number	Part number
SMU CMU unify unit (SCUU)	1	N1301A-100	N/A
SMU CMU unify unit Cable (3 m)	1	N1301A-102	N/A

3.4.2 ASU connection

Each ASU has one D-sub control cable, one triaxial cable, and (optionally) two coaxial cables connected to it. The cables can be connected to the ASU inside the shielding box through the 16495K plate. The ASU outputs should be connected to the DUT by using triaxial cables as shown in Figure 3-18. When making IV measurements with the SMUs, all measurements are Kelvin. The SENSE line information is fed back to the SMU via the D-sub cable. When making CV measurements, the four-terminal pair (4TP) connections are correctly terminated inside of the ASUs. The ASUs also allow for a current return path between the outer conductors to stabilize the series inductance and improve accuracy. You must connect the furnished wire between the two ASUs to enable this feature.

Figure 3-18 Example of an ASU connection

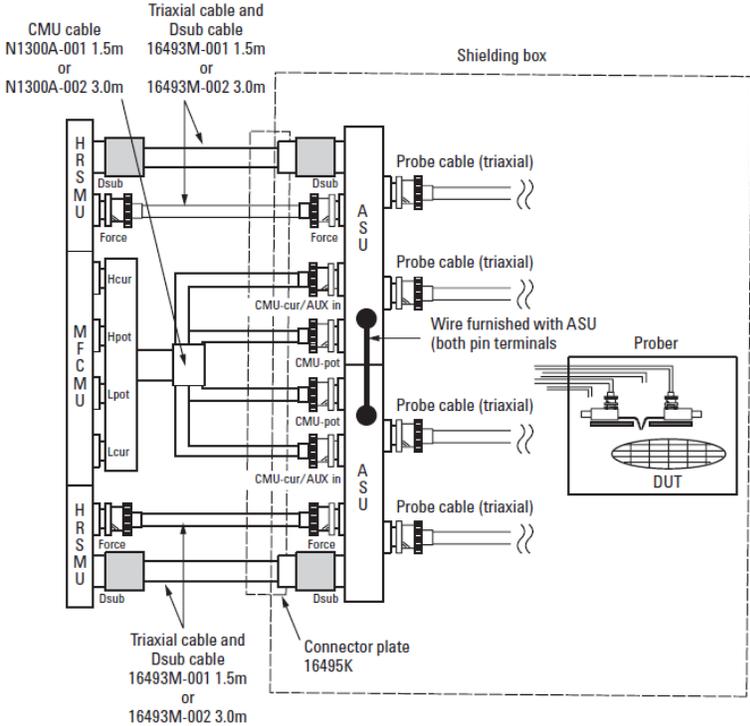


Table 3-8 Item number information for ASU connection with B1500A

Description	Qty	Product Number	Part number
Triax and D-sub cable for ASU (1.5 m)	2	16493M-001	N/A
Triax and D-sub cable for ASU (3.0 m)	2	16493M-002	N/A
CMU cable for B1500 (1.5 m)	1	N1300A-001	N/A
CMU cable for B1500 (3.0 m)	1	N1300A-002	N/A
Connector plate with universal cable holder	1	16495K	N/A

Connection Guide for Wafer Prober SCUU and ASU

NOTE**About ASU output cables**

To perform capacitance measurement accurately, the cable length between DUT and the ASU output must be as short possible.

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) × 88.5 mm (H) × 50 mm (D) excluding the connectors.

3.5 WGFMU and RSU

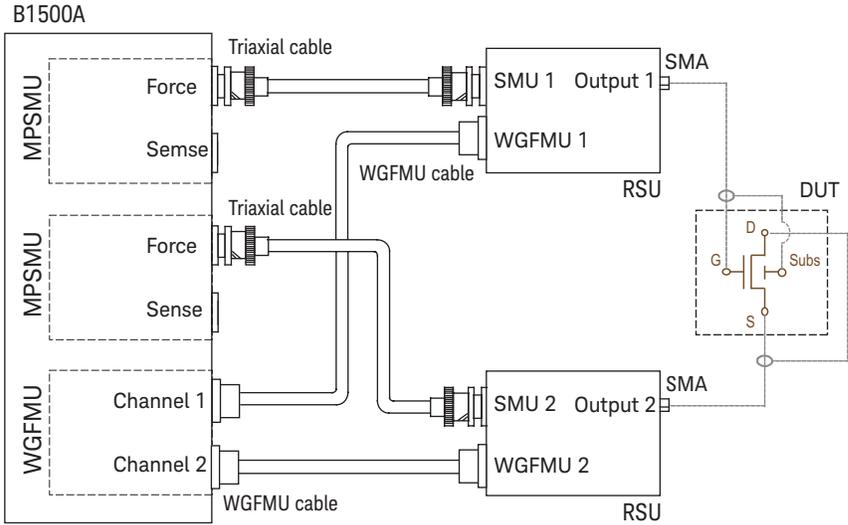
This section covers the instructions to make connection between WGFMU and RF/DC probes. Before starting the instructions, complete the installation of the B1500A installed with the WGFMU. See Keysight B1500 manual.

- NOTE** About WGFMU module installation
- Module installation of WGFMU must be performed by Keysight Technologies service personnel. Contact Keysight Technologies for the module installation.
- NOTE** RSU has SMA terminal which is coaxial connection. In this connection, ultra low current measurement can not be performed.

3.5.1 Connecting RSU

Prepare the required accessories and connect cables between RSU and WGFMU or SMU. See Figure 3-19 for a connection example. This example connects two RSUs.

Figure 3-19 RSU Connection Example



- Required accessories:
- WGFMU-to-RSU cable (D-sub), 1ea. per one RSU
1.5 m, 3 m, or 5 m cable (furnished with WGFMU module. If another length is required, order 16493R-006, 003 or 004)
The 16493R-801 adapter is required and mounted on a shielding box to make connection to the RSU in the shielding box. Then the 60 cm and 2.4 m cables (16493R-001 and 005) are required instead of the 1.5m, 3 m, or 5 m cable.
 - Sync connection cable (furnished with WGFMU module), 1 ea. between two WGFMUs

Connection Guide for Wafer Prober WGFMU and RSU

- Magnet stand (16493R-802), 1 ea. per one RSU, optional
The magnet stand is useful for fixing RSU. See Figure x-x for dimensions.
- Triaxial cable (SMU to RSU), 1ea. per one RSU, optional
1.5 m, 3 m, cable (16494A-001 or 002)
The 16495H-001 or 16495J-001 connector plate is required and mounted on a shielding box to make connection to the RSU in the shielding box. Then the 80 cm or 40 cm cable (16494A-003 or 004) is additionally required.
- 16495K-001 plate with cable holder, optional
Instead of using both 16493R-801 and 16495H/J-001.

NOTE

Keysight 16493R-801 adapter

The 16493R-801 is used to connect the cable from WGFMU and the cable from RSU. See *Keysight B1530A Waveform Generator/Fast Measurement Unit User's Guide* for the dimensions of adapter and for the opening and screw holes which are required to mount the adapter on the shield box.

Figure 3-20

RSU terminal

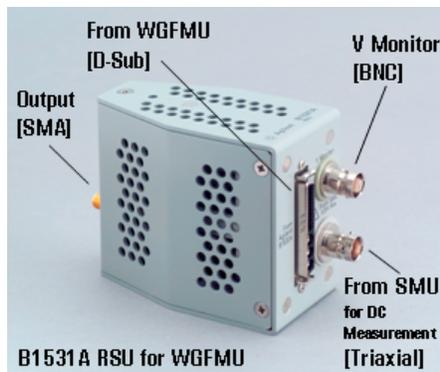
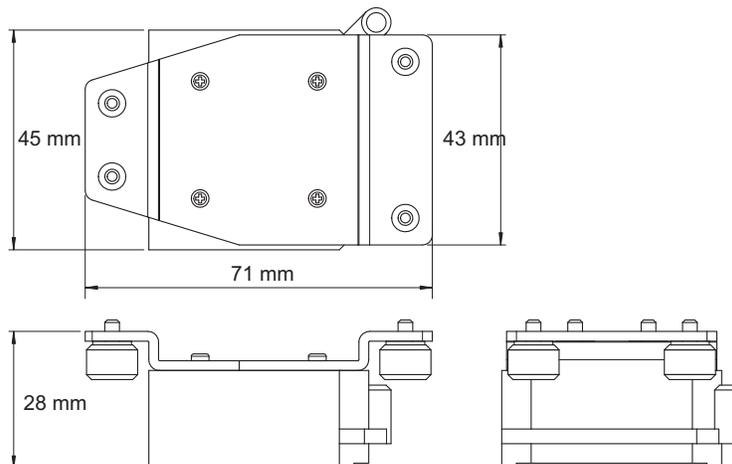


Figure 3-21

16493R-802 Magnet Stand



3.5.2 Connecting RF Probes

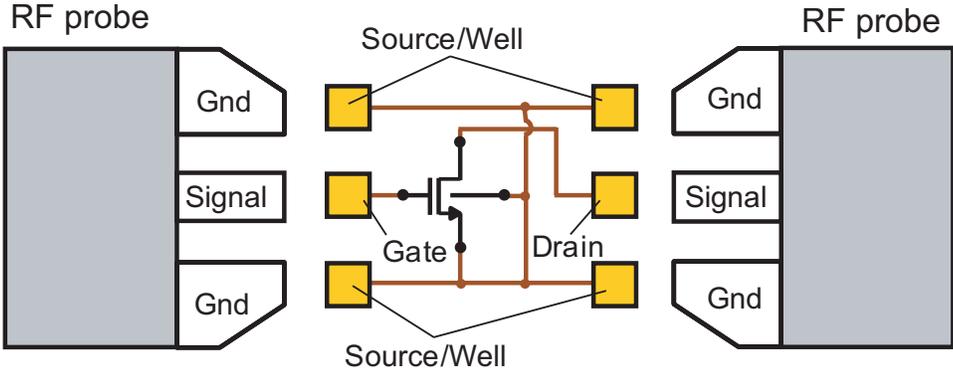
The RF measurement system supports the measurement of the three-terminal MOSFET (source and well (substrate) are shorted) by using the RF probes as shown in Figure 3-22. One measurement path is for the gate terminal and the other path is for the drain terminal. Moreover, the source/well terminal must be electrically connected to the ground via the shielding of the measurement path (RF probes and measurement cables). See Figure 3-23.

Figure 3-22 RF probes



Prepare two RF probes to perform the RF measurement. The RF probe must have the signal line and the ground lines as shown in Figure 3-23. The signal line is to connect the gate or drain pad, and the ground lines are to connect the source/well pads. For the RF probe and its installation, consult your favorite prober vender. Figure 3-22 shows RF probes from Cascade Microtech, Inc.

Figure 3-23 Contact Pad and Probe Tip



Connection Guide for Wafer Prober WGFMU and RSU

The following instructions apply when RF probes are used on Prober. Use a torque wrench and an open-end wrench to fasten the SMA connectors.

CAUTION Using torque wrench and open-end wrench

For the RF measurements, it is important to carefully contact and fasten the connectors of the RF cables. The condition of the cable connections may change the measurement result characteristics. Therefore treat the RF cables carefully, especially the RF connectors, and use the torque wrench and the open-end wrench when you fasten the RF connectors. The recommended tools are listed in the Table 3-9.

CAUTION Using cable tie

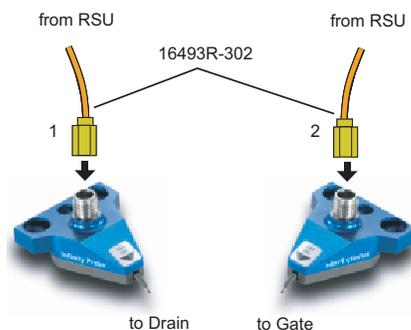
Use a cable tie to secure the cables. Then, do not tug the cable tie. You must treat the RF cables carefully to avoid the damage.

Table 3-9 Recommended Tools

Keysight part number	Description	Additional Information
8710-1582	Torque wrench, 5lb	
8710-1765	Torque wrench, 8lb	
5185-2174	Open-end wrench, 5/16 inch	
5188-4367	Open-end wrench, 11/32 inch	

Connect the following cables as shown in Figure 3-24. Use a torque wrench and an open-end wrench to fasten the SMA connectors.

Figure 3-24 Connection of RF probe



Required accessories:

- RF prober, 2 ea.
- 16493R-302 SMA-SMA cable 200 mm length, 2 ea.

Procedure:

- Connect a SMA-SMA cable between a RSU (ex: RSU1) and the Drain RF probe. And set the Drain RF probe to the appropriate place.

- Connect other SMA-SMA cable between other RSU (ex: RSU2) and the Gate RF probe. And set the Gate RF probe to the appropriate place.

Figure 3-25 **RSU connection on the Prober**



Table 3-10 **Item number information for WGFMU with RF probing connection**

Description	Qty	Option Number	Retrofit Kit
WGFMU. Including two RSU	1	B1500A-A30	B1500AU-030
3m cable between WGFMU and RSU (2ea)	1	B1500A-030	B1500AU-W02
SMA - SMA cable (200mm) between RSU and RF probe	2	B1500A-A3P	16493R-302
Magnet stand for RSU [Recommended]	2	16493R-802	16493R-802
Triaxial cable (3 m) [Optional]	2	16494A-002	B1500AU-T02

3.5.3 Connecting DC Probes

The MOSFET contact pads for DC measurement shown in Figure 3-26, are more popular than the RF contact pads shown in Figure 3-23. If device under test is configured with DC contact pads, use DC probes instead of RF probes. The DC probes are better suited for contact with the DC contact pads than the RF probes. See Figure 3-26 for the contact pads and the DC probes.

Prepare four DC probes and three connection cables to connect the DC probes together.

- 50 mm length SSMC short-open cable (Furnished with B1500A-A3P. Or 16493R-101)
- 70 mm length SSMC short-open cable (Furnished with B1500A-A3P. Or 16493R-102)
- 200 mm length SMA-SSMC cable (Furnished with B1500A-A3P. Or 16493R-202)

Figure 3-26

DC probing connection on Prober

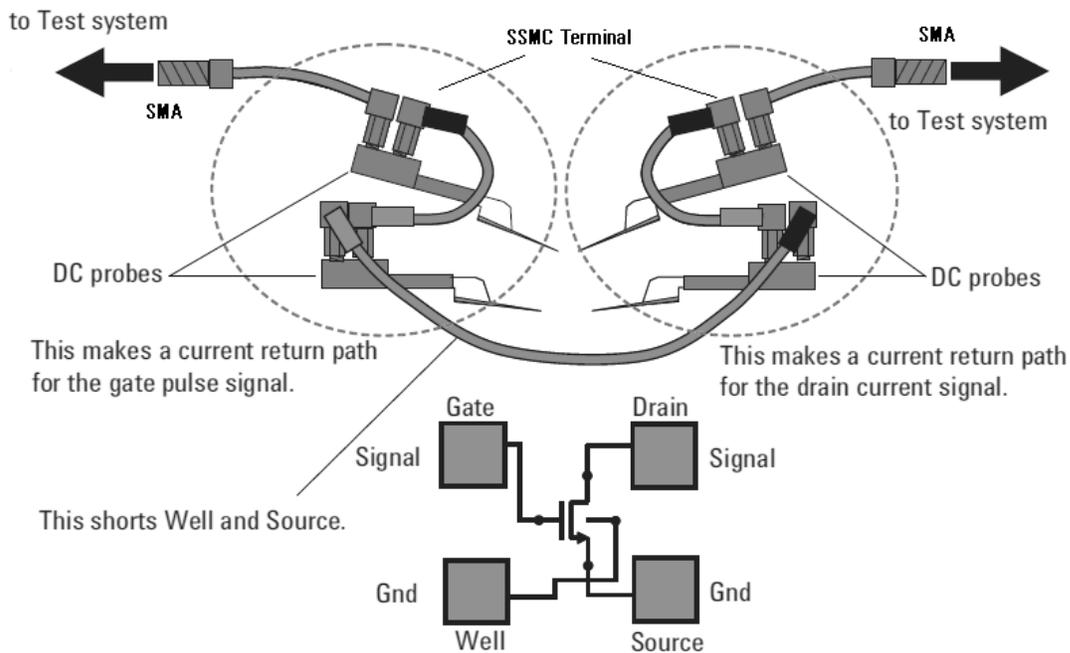


Table 3-11

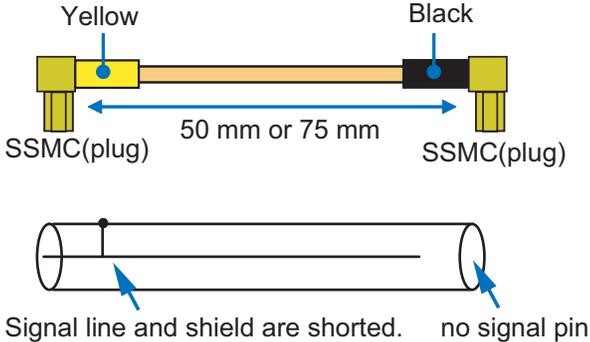
Item number information for WGFMU with DC probing connection

Description	Qty	Option Number	Retrofit Kit
WGFMU. Including two RSU.	1	B1500A-A30	B1500AU-030
3m cable between WGFMU and RSU (2ea)	1	B1500A-030	B1500AU-W02
SMA - SSMC cable (200mm) between RSU and DC probe	2	B1500A-A3P	16493R-202
SSMC-SSMC cable (75mm) for current return path	3	B1500A-A3P	16493R-102
Triaxial cable (3 m) [Optional]	2	16494A-002	B1500AU-T02

These instructions apply when DC probes are used on Prober.

- Connect a SSMC short open cable between the Gate DC probe and the well DC probe, and set the DC probes to the appropriate place. Then, the black sleeve plug must be the Gate side. This electrically connects the Well probe needle, Well probe shield, and Gate probe shield together.
- Connect a SSMC short-open cable between the Drain DC probe and the Source DC probe, and set the DC probes to the appropriate place. Then, the black sleeve plug must be the Drain side. This electrically connects the Source probe needle, Source probe shield, and Drain probe shield together.
- Connect the last SSMC short-open cable between the Well DC probe and the Source DC probe, and set the DC probes to the appropriate place. Then, the black sleeve plug must be the Source side. This electrically connects the Well probe needle, Well probe shield, and Source probe shield together.
- Connect a SMA-SSMC cable between a RSU (ex: RSU1) and the Drain DC probe. And set the Drain DC probe to the appropriate place.
- Connect the other SMA-SSMC cable between the other RSU (ex: RSU2) and the Gate DC probe. And set the Gate DC probe to the appropriate place.

Figure 3-27 SSMC Short-Open Cable



3.6 Interlock circuit

The interlock circuit is designed to prevent electrical shock when a user touches the measurement terminals.

CAUTION

You must install an interlock circuit on a shielding box to prevent hazardous voltage when the door of the shielding box is open.

Figure 3-28 shows the pin assignments of the interlock connector that should be mounted on a connector plate or test fixture.

Figure 3-28 Interlock connector pin assignments

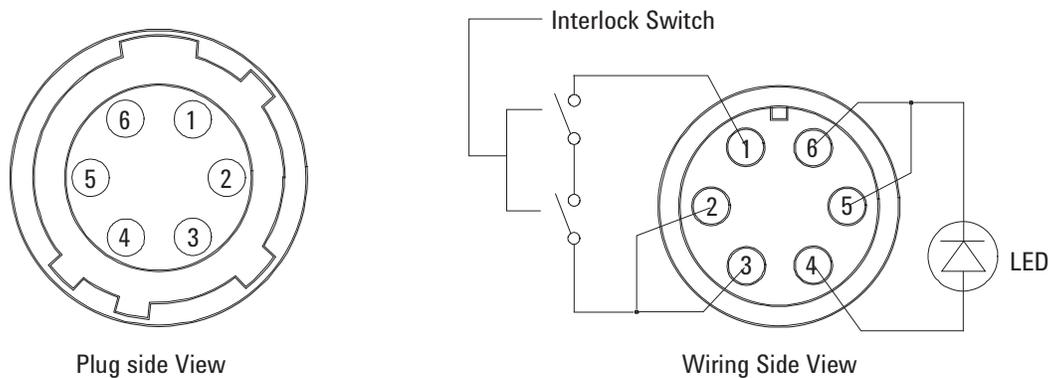


Table 3-12 Recommended parts for interlock circuit

Description	Qty	Product Number	Part number
Interlock connector (6 pin, female)	1	N/A	1252-1419
Interlock micro switch	1	N1254A-402	3101-0302 or 3131-3241
LED ($V_F \cong 2.1 \text{ V@ } I_F = 10 \text{ mA}$)	1	N/A	1450-0641
Wire (24 AWG, 600 V)	1	N/A	8150-5680

3.6.1 Installing the interlock circuit

Prepare the required parts listed in Table 3-12. And install the interlock circuit as shown below.

1. Make mounting hole for the interlock connector. See Figure 3-30 for dimensions.
2. 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 3-31 below.
3. Mount an LED on your shielding box. For the dimensions of the LED, see Figure 3-29.

4. Use wire to connect the two switches in series between pin number 1 and 2 (or 3) of the interlock connector. See Figure 3-28.
5. Use wire to connect the LED between pin number 4 and 5 (or 6) of the interlock connector. See Figure 3-28.
6. Attach the interlock connector to the mounting hole.

If Keysight B1500A Interlock connector is connected to the interlock circuit, Keysight B1500A SMU *cannot* force more than ± 42 V when the door is open. When the door is closed, it 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 3-29 Dimensions of the LED (Keysight part number 1450-0641)

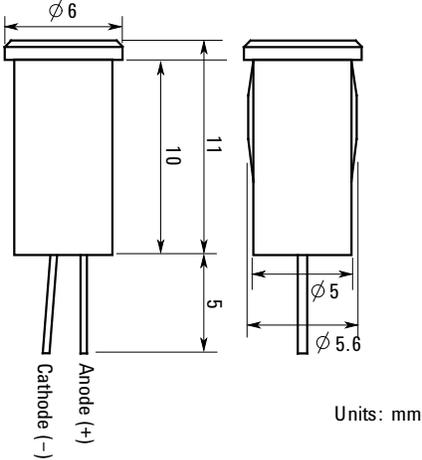
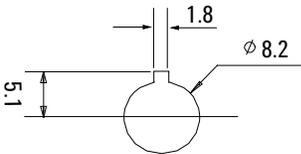


Figure 3-30 Dimensions of Mounting Hole for the Interlock Connector



4

Connection and Ordering Examples

4.1 Two terminal device

This chapter describes prober or Fixture connection and ordering example of Keysight B1500A Semiconductor Device Analyzer for 2 terminal devices.

4.1.1 General IV characterization

Figure 4-1 General IV configuration

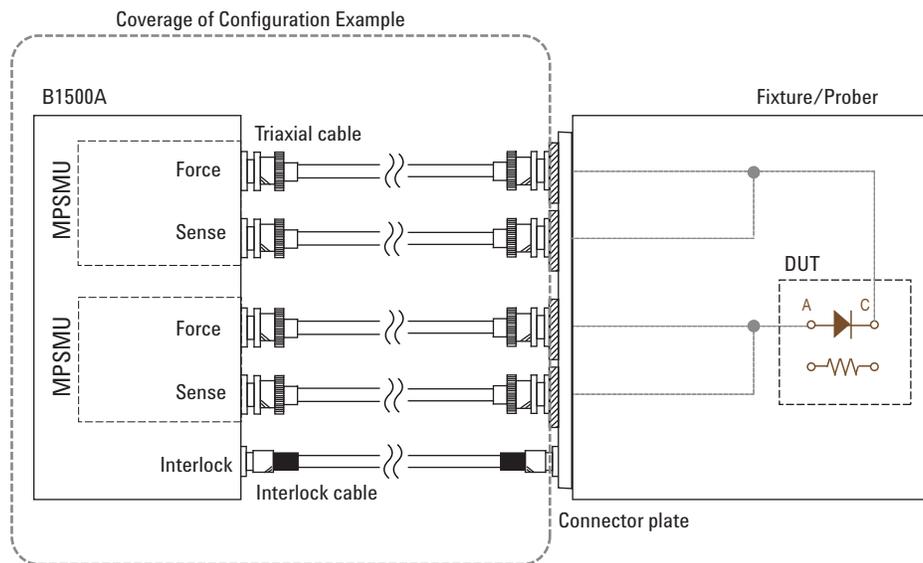


Table 4-1 Target device and application

Device	Application	Note
Diode	I_F - V_F , I_R - V_R , Breakdown	
Resistor	R-I, R-V	2-wire or 4-wire

Table 4-2 Key specification

Item	Range	Note
Maximum I/V range	100 mA / 100 V	
Minimum I/V resolution	10 fA / 0.5 μ V	

Table 4-3 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A00	Empty package for custom solution, contains no measurement module	1
B1500A-A11	MPSMU add-on package, adds one MPSMU and two triaxial cables	2
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1

4.1.2 General IV/CV characterization

Figure 4-2 General IV/CV configuration

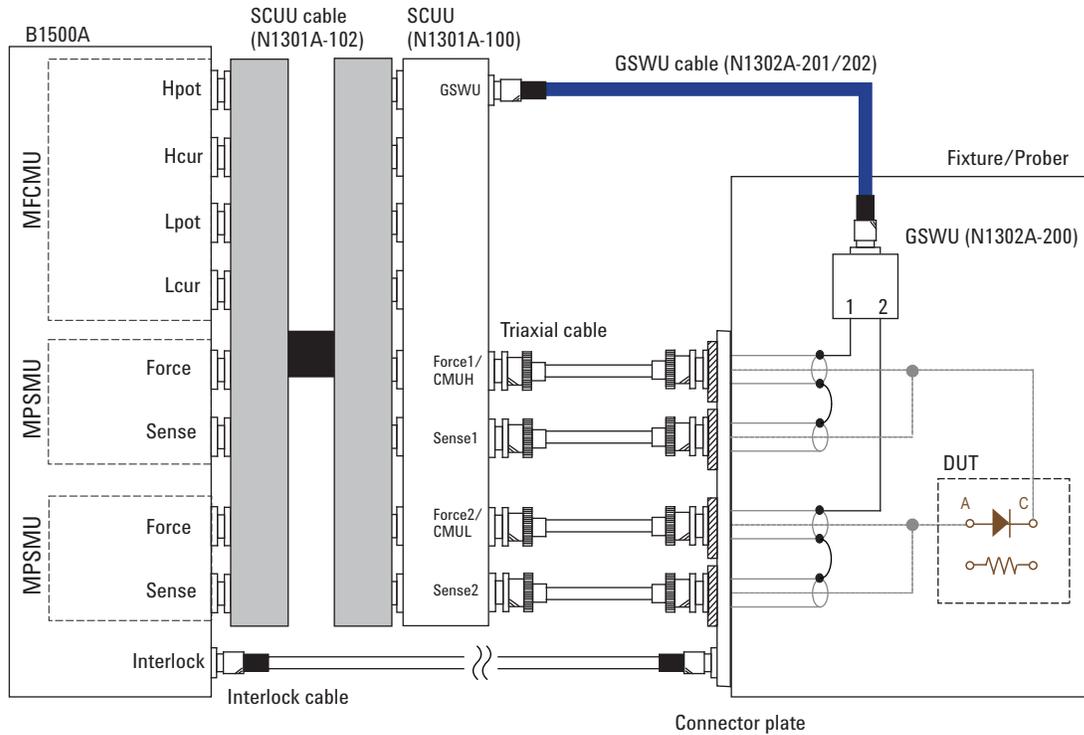


Table 4-4 Target device and application

Device	Application	Note
Diode	I_F-V_F , I_R-V_R , Breakdown, C-V, C-f, C-t	
Resister	R-I, R-V	2-wire or 4-wire

Table 4-5 Key specification

Item	Range	Note
Maximum I/V range	100 mA / 100 V	
Minimum I/V resolution	10 fA / 0.5 μ V	
CV frequency range	1 kHz to 5 MHz	
Maximum DC bias to CV	100 V	MPSMU and SCUU is required.

Table 4-6 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A00	Empty package for custom solution, contains no measurement module	1
B1500A-A11	MPSMU add-on package, adds one MPSMU and two triaxial cables	2
B1500A-A20	Capacitance measurement add-on package, adds the MFCMU and one CMU cable	1
N1301A	Accessories for CMU	1
N1301A-100	SMU CMU unify unit (SCUU)	1
N1301A-102	SCUU cable, 3 m	1
N1301A-110	SCUU magnetic stand (Optional)	1
N1301A-200	Guard switch unit (GSWU)	1
N1301A-201/202	GSWU cable, 1.5 m or 3 m	1
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1

4.1.3 High resolution IV characterization

Figure 4-3 Precision IV configuration

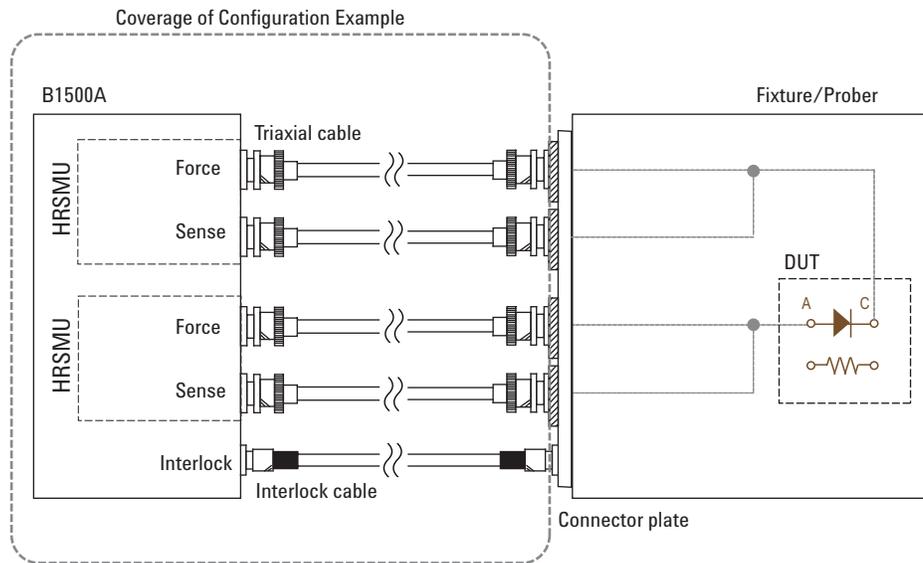


Table 4-7 Target device and application

Device	Application	Note
Diode	I_F - V_F , I_R - V_R , Breakdown	
Resistor	R-I, R-V	2-wire or 4-wire

Table 4-8 Key specification

Item	Range	Note
Maximum I/V range	100 mA / 100 V	
Minimum I/V resolution	1 fA / 0.5 μ V	

Table 4-9 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A00	Empty package for custom solution, contains no measurement module	1
B1500A-A17	HRSMU add-on package, adds one HRSMU and two triaxial cables	2
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1

NOTE The low current level is around 1 nA with the 16442B test fixture.

4.2 Four terminal device

This chapter describes prober or Fixture connection and ordering example of Keysight B1500A Semiconductor Device Analyzer for 4 terminal devices.

4.2.1 General IV characterization, Migration from 4155

Figure 4-4 General IV configuration

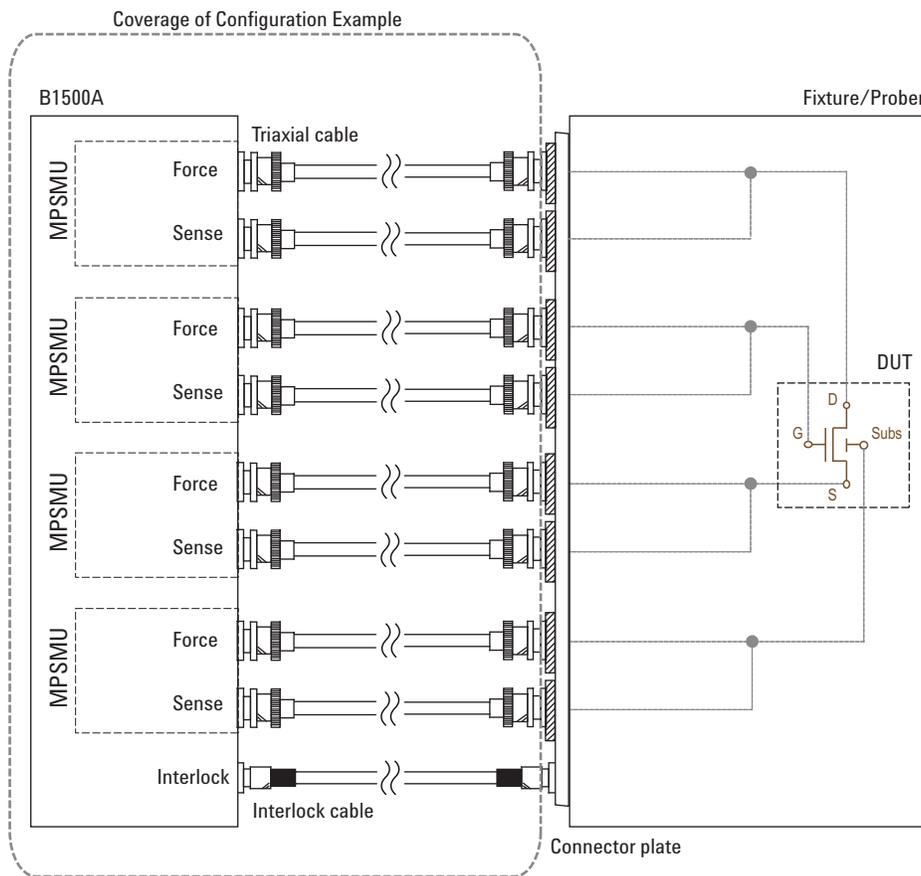


Table 4-10 Target device and application

Device	Application	Note
FET	I_d - V_d , V_{th} , BV_{dss} , I_d leak, I_g leak	

Table 4-11 Key specification

Item	Range	Note
Maximum I/V range	100 mA / 100 V	
Minimum I/V resolution	10 fA / 0.5 μ V	

Table 4-12 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A01	Standard package, contains four MPSMU and eight triaxial cables	1
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1

4.2.2 General IV/CV characterization

Figure 4-5 General IV/CV configuration

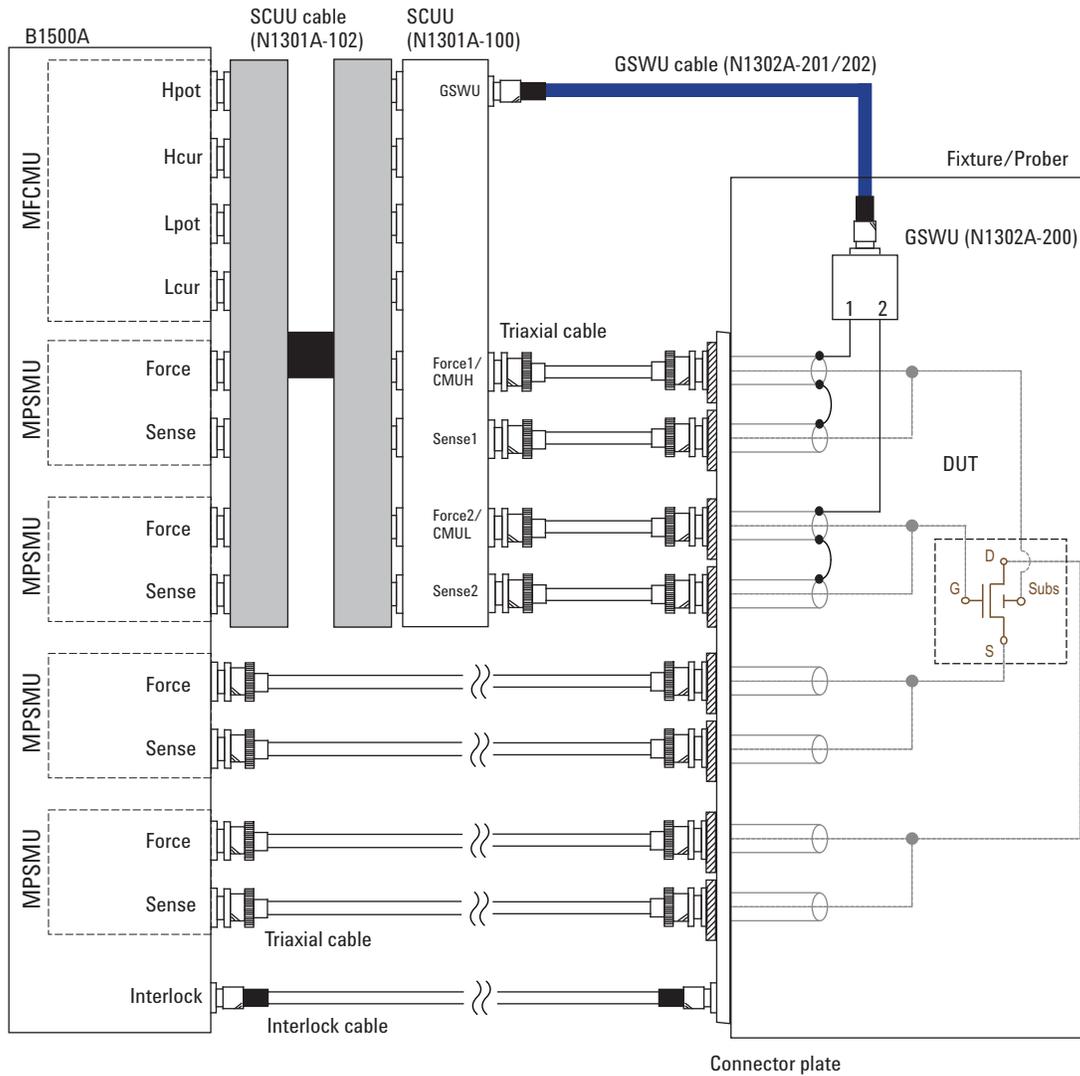


Table 4-13 Target device and application

Device	Application	Note
FET	I_d - V_d , V_{th} , BV_{dss} , I_d leak, I_g leak, C_{gb}	

Table 4-14 Key specification

Item	Range	Note
Maximum I/V range	100 mA / 100 V	
Minimum I/V resolution	10 fA / 0.5 μ V	
CV frequency range	1 kHz to 5 MHz	
Maximum DC bias to CV	100 V	MPSMU and SCUU is required.

Table 4-15 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A01	Standard package, contains four MPSMU and eight triaxial cables	1
B1500A-A20	Capacitance measurement add-on package, adds the MFCMU and one CMU cable	1
N1301A	Accessories for CMU	1
N1301A-100	SMU CMU unify unit (SCUU)	1
N1301A-102	SCUU cable, 3 m	1
N1301A-110	SCUU magnetic stand (Optional)	1
N1301A-200	Guard switch unit (GSWU)	1
N1301A-201/202	GSWU cable, 1.5 m or 3 m	1
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1

4.2.3 High resolution IV characterization, Migration from 4156

Figure 4-6 Precision IV configuration

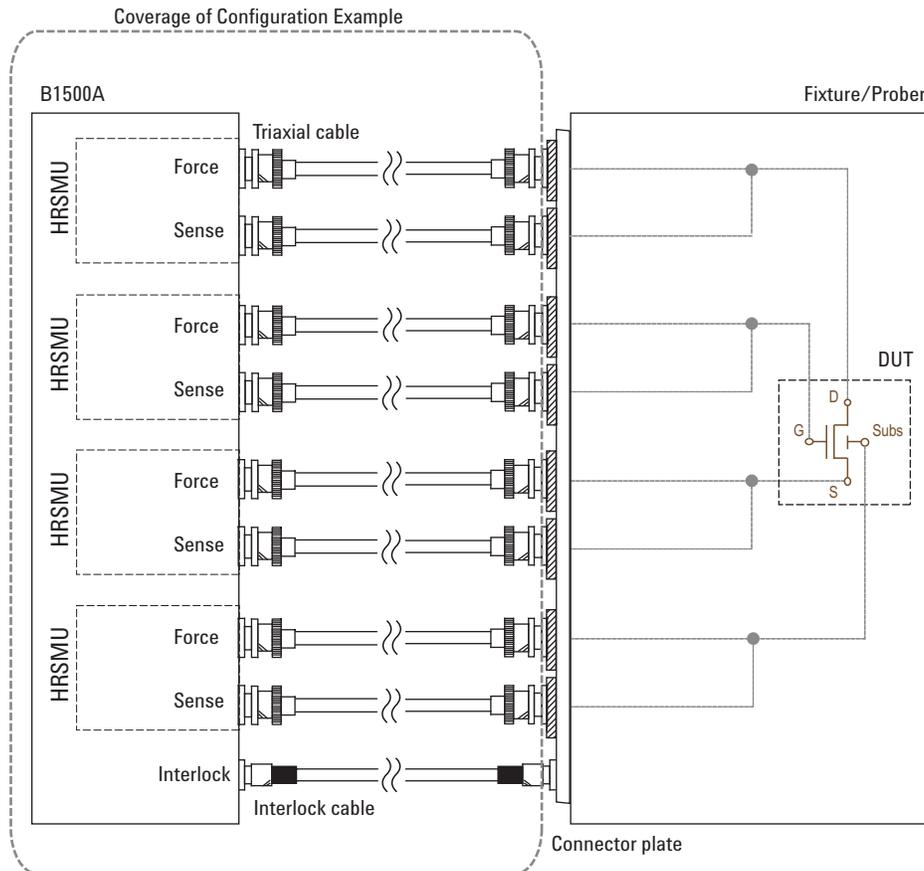


Table 4-16 Target device and application

Device	Application	Note
FET	I_d - V_d , V_{th} , BV_{dss} , I_d leak, I_g leak	

Table 4-17 Key specification

Item	Range	Note
Maximum I/V range	100 mA / 100 V	
Minimum I/V resolution	1 fA / 0.5 μ V	

Table 4-18 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A02	High resolution package, contains four HRSMU and eight triaxial cables	1
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1

NOTE The low current level is around 1 nA with the 16442B test fixture.

4.2.4 High resolution IV characterization (ASU)

Figure 4-7 Precision IV configuration

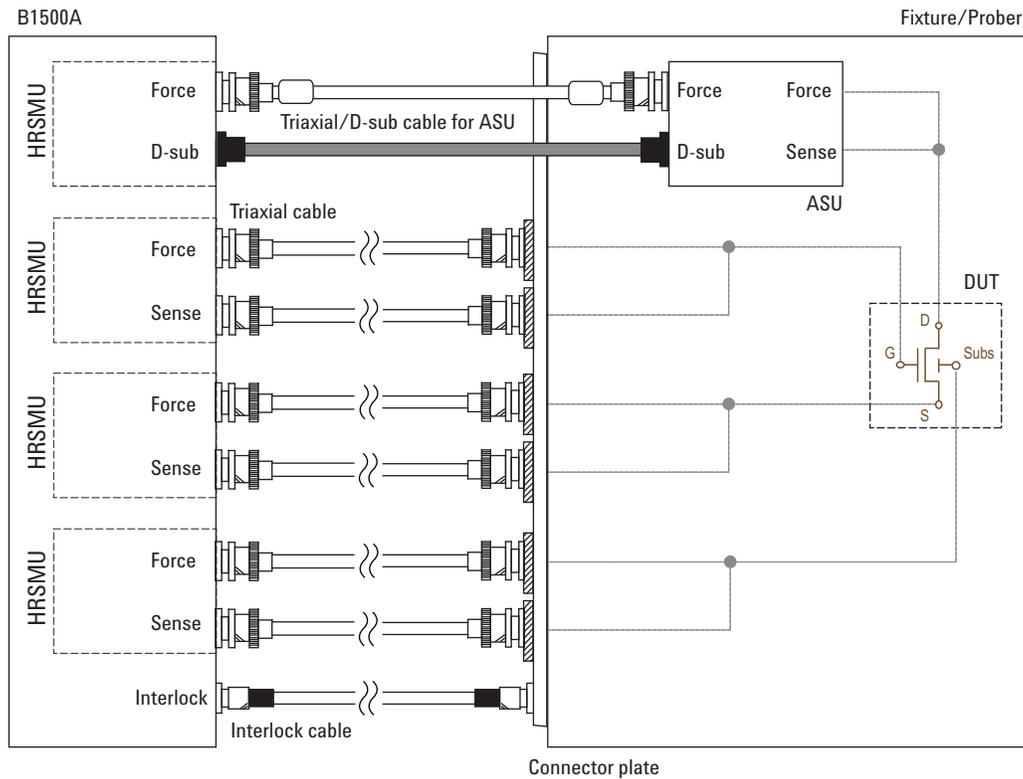


Table 4-19 Target device and application

Device	Application	Note
FET	I_d - V_d , V_{th} , BV_{dss} , I_d leak, I_g leak	

Table 4-20 Key specification

Item	Range	Note
Maximum I/V range	100 mA / 100 V	
Minimum I/V resolution	0.1 fA / 0.5 μ V	

Table 4-21 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A02	High resolution package, contains four HRSMU and eight triaxial cables	1
B1500A-A28	ASU add-on package, adds one ASU, one D-sub cable, and one triaxial cable	1
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1

NOTE The low current level is around 1 nA with the 16442B test fixture.

NOTE To connect ASU, MPSMU (B1511B) option A11 is also available.

4.2.5 High power IV characterization

Figure 4-8 High power IV configuration

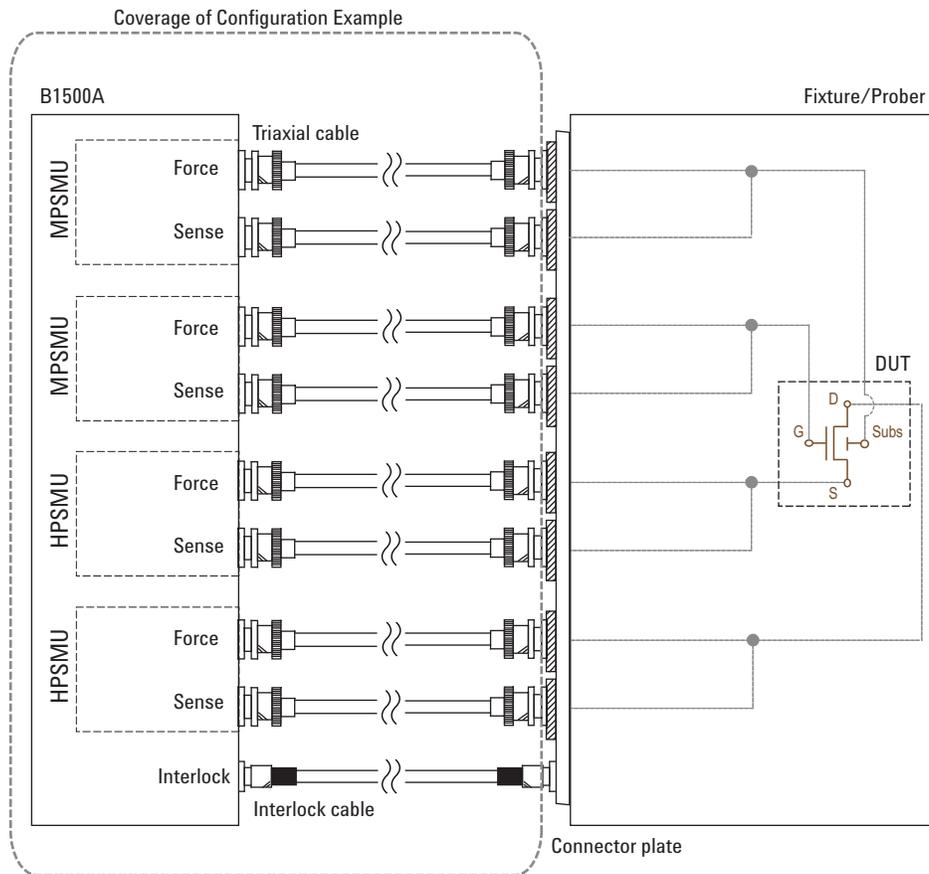


Table 4-22 Target device and application

Device	Application	Note
FET	I_d - V_d , V_{th} , BV_{dss} , I_d leak, I_g leak	

Table 4-23 Key specification

Item	Range	Note
Maximum I/V range	1 A / 200 V	
Minimum I/V resolution	10 fA / 0.5 μ V	

Table 4-24 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A03	High power package, contains two HPSMU, two MPSMU, and eight triaxial cables	1
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1

4.2.6 50 μ s Pulse IV characterization (MCSMU)

Figure 4-9 50 μ s pulse MCSMU configuration by one MCSMU module

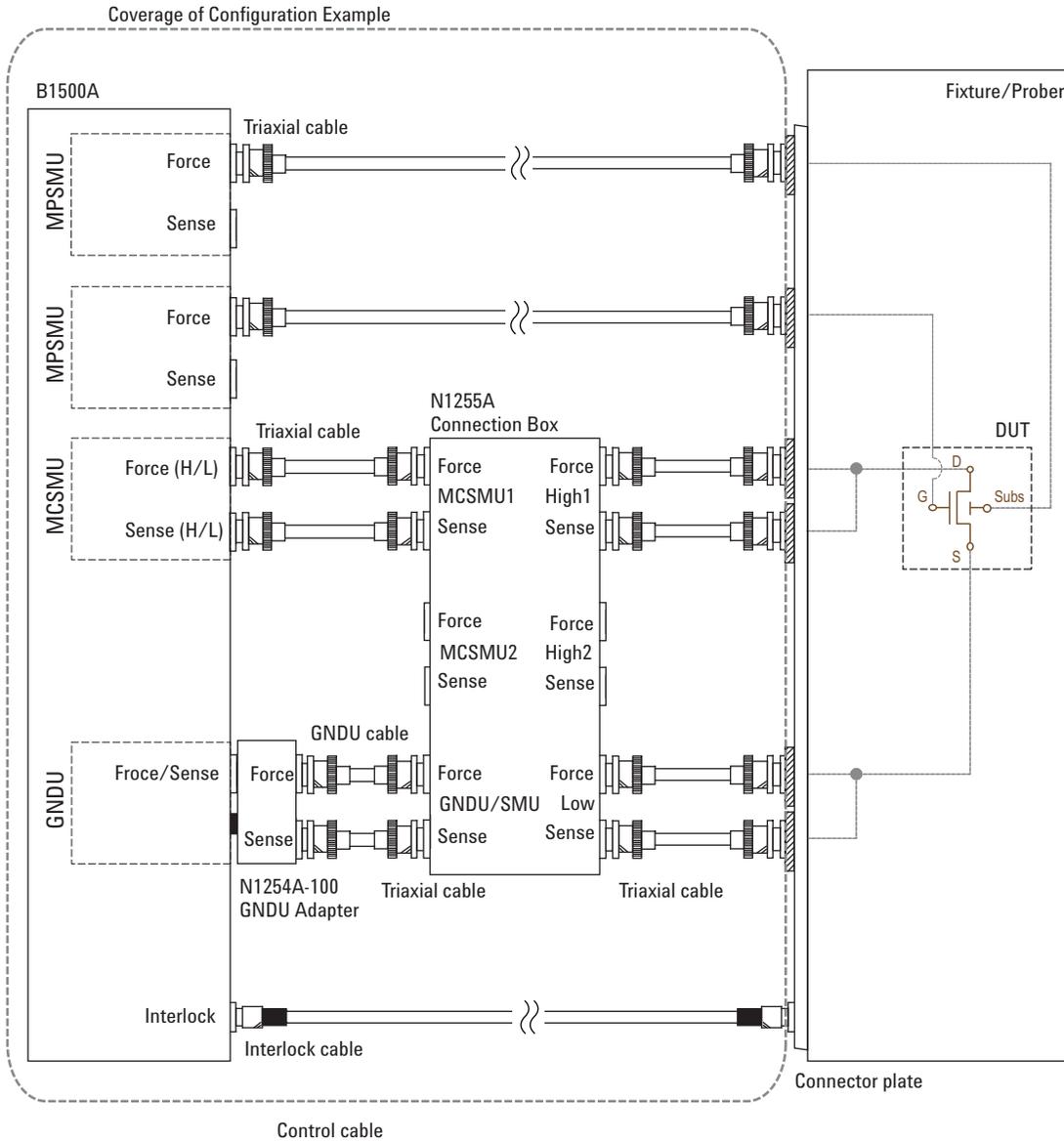


Table 4-25 Target device and application

Device	Application	Note
FET	I_d - V_d , V_{th} , BV_{dss} , I_d leak, I_g leak	

Table 4-26 Key specification

Item	Range	Note
Maximum I/V range	1 A / 30 V	Drain terminal by MCSMU
Maximum I/V range	100 mA / 100 V	Gate/Substrate terminal by MPSMU
Minimum I/V resolution	10 pA / 0.2 μ V	Drain terminal by MCSMU
Minimum I/V resolution	10 fA / 0.5 μ V	Gate/Substrate terminal by MPSMU
Minimum pulse width	50 μ s	Drain terminal by MCSMU
I_d fast sampling	2 μ s	Drain terminal by MCSMU

Table 4-27 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A00	Empty package for custom solution, contains no measurement module	1
B1500A-A11	MPSMU add-on package, adds one MPSMU and two triaxial cables	2
B1500A-A1A	MCSMU add-on package, adds one MCSMU, connection box and two triaxial cables	1
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1
16494A	Triaxial cable	4

4.2.7 50 μ s Pulse IV characterization (Two MCSMU)

Figure 4-10 50 μ s pulse MCSMU configuration by two MCSMU modules

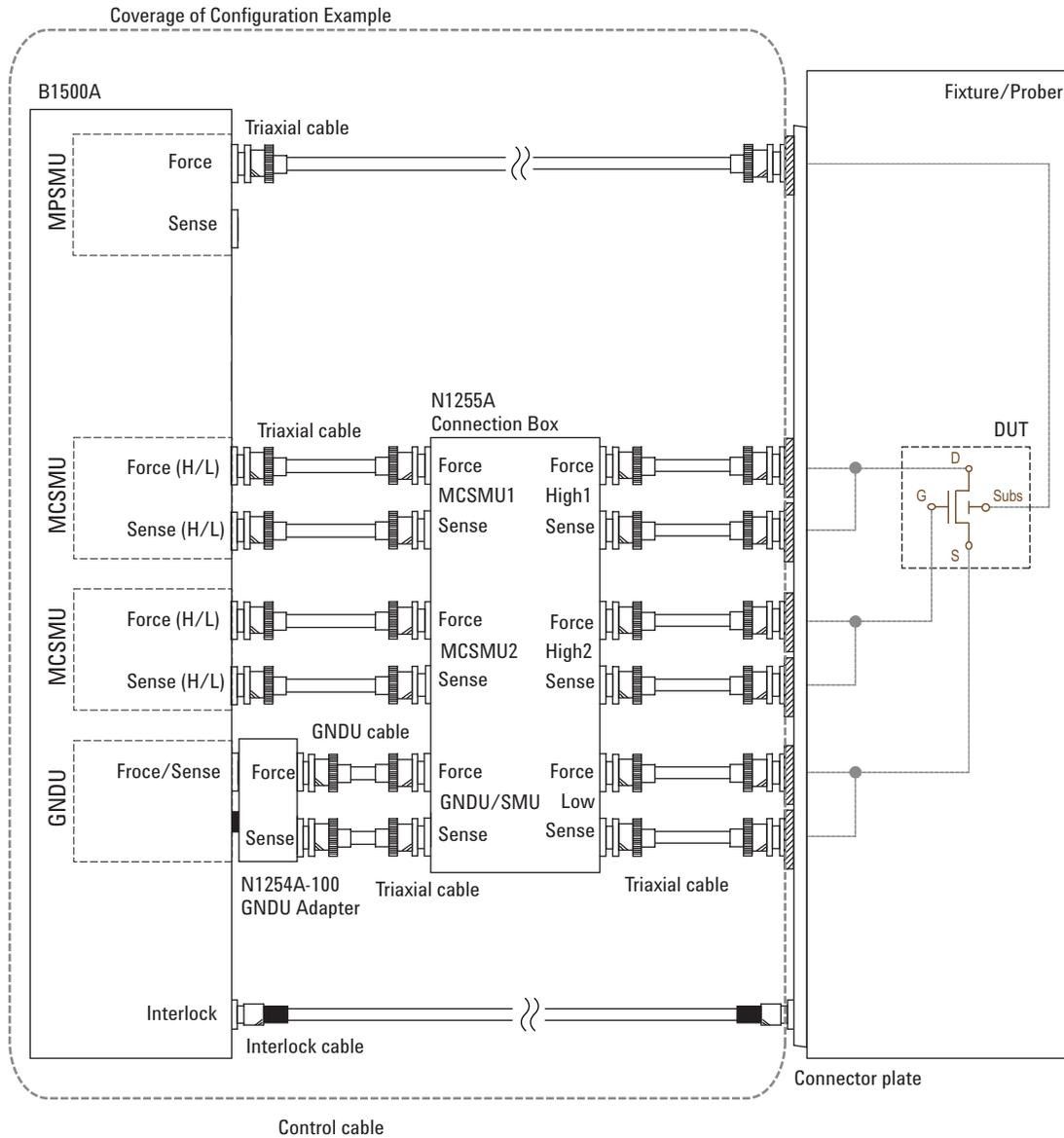


Table 4-28 Target device and application

Device	Application	Note
FET	I_d - V_d , V_{th} , BV_{dss} , I_d leak, I_g leak	

Table 4-29 Key specification

Item	Range	Note
Maximum I/V range	1 A / 30 V	Drain/Gate terminal by MCSMU
Maximum I/V range	100 mA / 100 V	Substrate terminal by MPSMU
Minimum I/V resolution	10 pA / 0.2 μ V	Drain/Gate terminal by MCSMU
Minimum I/V resolution	10 fA / 0.5 μ V	Substrate terminal by MPSMU
Minimum pulse width	50 μ s	Drain/Gate terminal by MCSMU
I_d fast sampling	2 μ s	Drain/Gate terminal by MCSMU

Table 4-30 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A00	Empty package for custom solution, contains no measurement module	1
B1500A-A11	MPSMU add-on package, adds one MPSMU and two triaxial cables	1
B1500A-A1B	MCSMU add-on package, adds two MCSMU, connection box and four triaxial cables	1
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1
16494A	Triaxial cable	6

4.2.8 Flash memory cell characterization (2 pulse channels)

Figure 4-11 Configuration for flash memory cell characterization

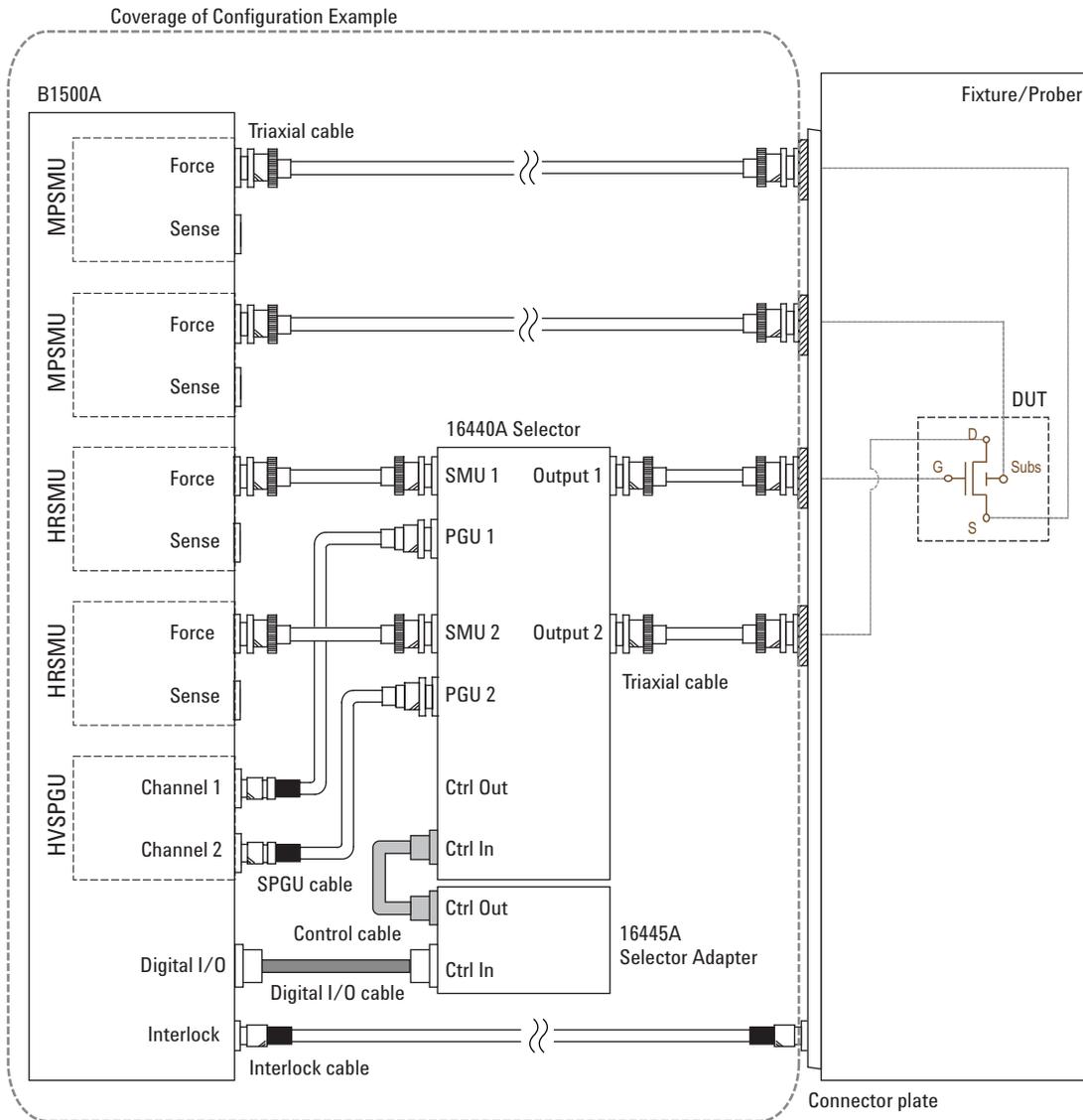


Table 4-31 Target device and application

Device	Application	Note
Memory	Endurance test, Erase and V_{th} test, Write and V_{th} test, Retention test, Word disturb test	Requires 2 pulse channels
FET	Charge pumping	

Table 4-32 Key specification

Item	Range	Note
Maximum I/V range	100 mA / 100 V	
Minimum I/V resolution	10 fA / 0.5 μ V	

Table 4-33 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A04	Flash memory cell measurement basic package	1
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1

4.2.9 Flash memory cell characterization (3 or 4 pulse channels)

Figure 4-12 Configuration for flash memory cell characterization

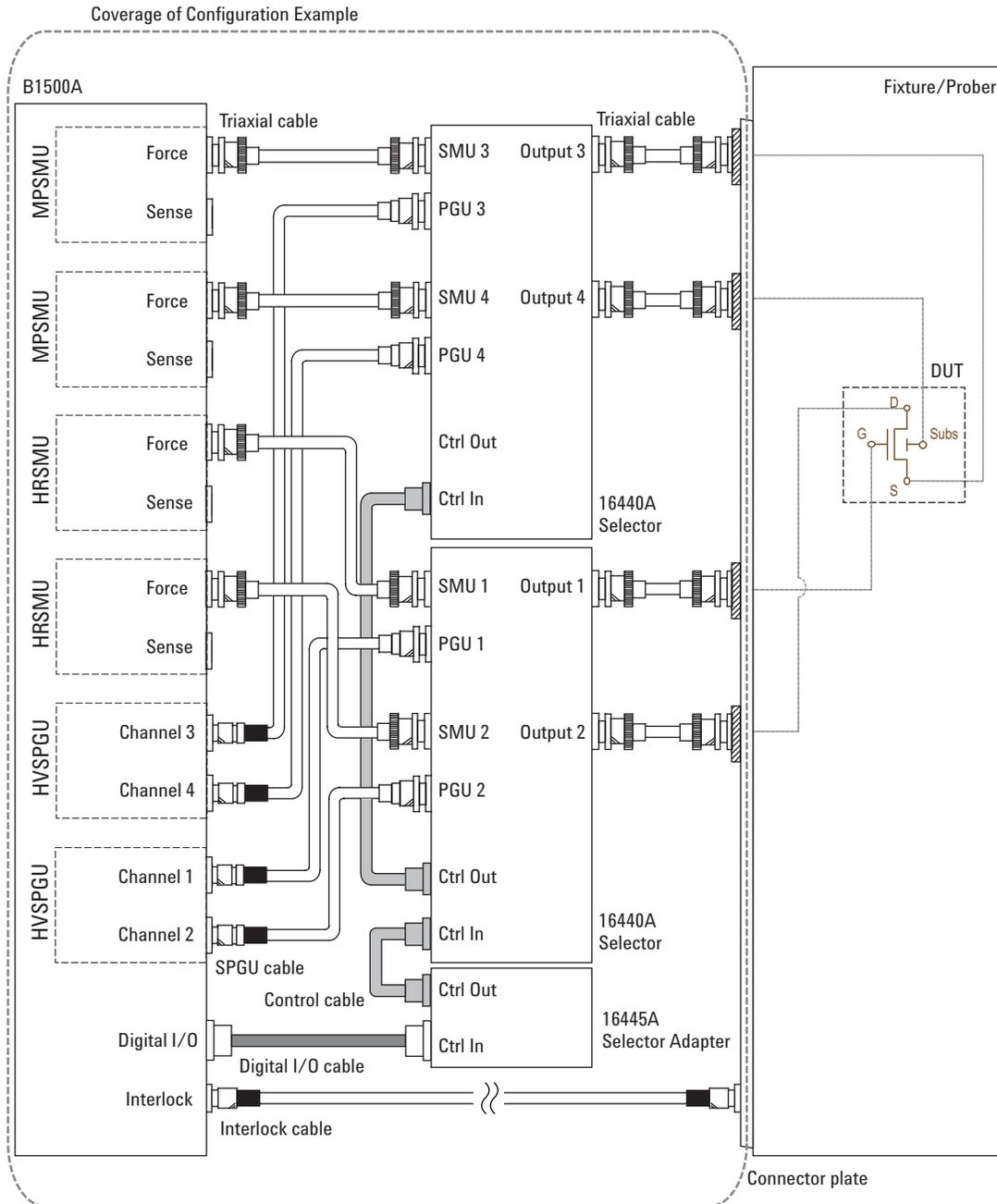


Table 4-34 Target device and application

Device	Application	Note
Memory	Endurance test, Erase and V_{th} test, Write and V_{th} test, Retention test, Word disturb test	Requires 2 or 3 pulse channels

Table 4-35 Key specification

Item	Range	Note
Maximum I/V range	100 mA / 100 V	
Minimum I/V resolution	10 fA / 0.5 μ V	

Table 4-36 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A04	Flash memory cell measurement basic package	1
B1500A-A25	HVSPGU add-on package, adds one HVSPGU and two SPGU cables	1
16440A	SMU/PGU pulse generator selector	1
16440A-003	Control cable, 40 cm for second selector	1
B1500A-A5F	Test fixture for packaged device measurement, adds one 16442B (Optional)	1

4.3 Configuration example of WGFMU

This chapter describes prober or Fixture connection and ordering example of Keysight B1500A Semiconductor Device Analyzer for NBTI characterization by WGFMU.

4.3.1 Ultra-fast 1 us NBTI characterization using the B1530A WGFMU module

Figure 4-13 Configuration for ultra-fast NBTI characterization

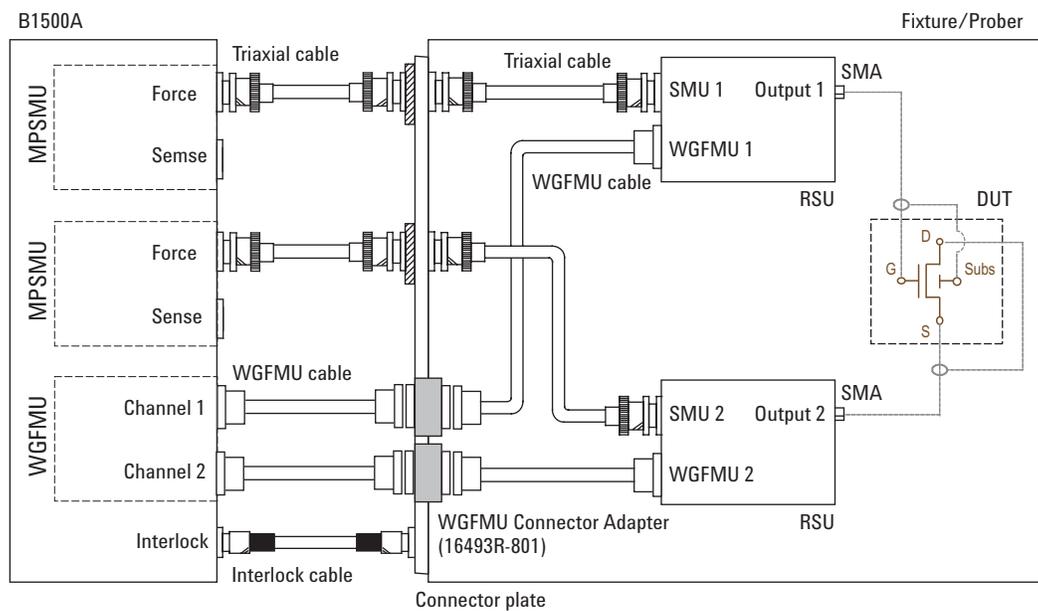


Table 4-37 Target device and application

Device	Application	Note
FET	NBTI, PBTI	

Table 4-38 Key specification

Item	Range	Note
I_d fast sampling	1 μ s	
I_d - V_g fast sweep	1 μ s per point	

Item	Range	Note
Stress	DC stress / AC stress	
Maximum DC I/V range	100 mA / 100 V	
Minimum I/V resolution	10 fA / 0.5 μ V	

Table 4-39 Configuration Example

Model option	Description	Qty
B1500A	Semiconductor Device Analyzer Mainframe	1
B1500A-015/030	1.5 m or 3 m length of bundled cables	1
B1500A-A00	Empty package for custom solution, contains no measurement module	1
B1500A-A11	MPSMU add-on package, adds one MPSMU and two triaxial cables	2
B1500A-A31	WGFMU add-on package with connector adapters	1
(B1500A-A30)	WGFMU add-on package, If you put RSU on external shield box.	1
B1500A-A3P	WGFMU probe cable kit	1

Connection and Ordering Examples
Configuration example of WGFMU

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Edition 10, November 2020



B1500-90090
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