

**Agilent B1505A
Power Device Analyzer/
Curve Tracer**

User's Guide



Agilent Technologies

Notices

© Agilent Technologies, Inc. 2009, 2010, 2011

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Agilent Technologies, Inc. as governed by United States and international copyright laws.

Manual Part Number

B1505-90000

Edition

Edition 1, June 2009
Edition 2, November 2009
Edition 3, June 2010
Edition 4, August 2010
Edition 5, June 2011

Agilent Technologies, Inc.
5301 Stevens Creek Blvd
Santa Clara, CA 95051 USA

Warranty

The material contained in this document is provided “as is,” and is subject to being changed, without notice, in future editions. Further, to the maximum extent permitted by applicable law, Agilent disclaims all warranties, either express or implied, with regard to this manual and any information contained herein, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Agilent shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any information contained herein. Should Agilent and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Restricted Rights Legend

If software is for use in the performance of a U.S. Government prime contract or subcontract, Software is delivered and licensed as “Commercial computer software” as defined in DFAR 252.227-7014 (June 1995), or as a “commercial item” as defined in FAR 2.101(a) or as “Restricted computer software” as defined in FAR 52.227-19 (June 1987) or any equivalent agency regulation or contract clause. Use, duplication or disclosure of Software is subject to Agilent Technologies’ standard commercial license terms, and non-DOD Departments and Agencies of the U.S. Government will

receive no greater than Restricted Rights as defined in FAR 52.227-19(c)(1-2) (June 1987). U.S. Government users will receive no greater than Limited Rights as defined in FAR 52.227-14 (June 1987) or DFAR 252.227-7015 (b)(2) (November 1995), as applicable in any technical data.



Agilent Technologies

DECLARATION OF CONFORMITY
According to EN ISO/IEC 17050-1:2004



Manufacturer's Name: Agilent Technologies Singapore (International) Pte. Ltd.
Manufacturer's Address: No. 1 Yishun Ave 7
SINGAPORE 768923
Singapore

Declares under sole responsibility that the product as originally delivered

Product Name: Power Device Analyzer/Curve Tracer
High Power Source/Monitor Unit Module,
High Current Source/Monitor Unit Module,
High Voltage Source/Monitor Unit Module,
Multi Frequency Capacitance Measurement Unit Module
Model Number: Agilent B1505A
Agilent B1510A, Agilent B1512A, Agilent B1513A,
Agilent B1520A
Product Options: This declaration covers all options of the above product(s)

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

Low Voltage Directive (2006/95/EC)
EMC Directive (2004/108/EC)

and conforms with the following product standards

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

Safety IEC 61010-1:2001 / EN 61010-1:2001
Canada: CAN/CSA-C22.2 No. 61010-1-04, C/US

Supplementary Information:

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

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

March 20, 2010

Date

川路 利行

Toshiyuki Kawaji

QA Manager
Agilent Technologies

For further information, please contact your local Agilent Technologies sales office, agent or distributor, or Agilent Technologies Deutschland GmbH, Herrenberger Straße 130, 71034 Böblingen, Germany.



Agilent Technologies

DECLARATION OF CONFORMITY
According to EN ISO/IEC 17050-1:2004



Manufacturer's Name: Agilent Technologies Singapore (International) Pte. Ltd.
Manufacturer's Address: No. 1 Yishun Ave 7
SINGAPORE 768923
Singapore

Declares under sole responsibility that the product as originally delivered

Product Name: Module Selector

Model Number: Agilent N1258A

Product Options: This declaration covers all options of the above product(s)

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

Low Voltage Directive (2006/95/EC)
EMC Directive (2004/108/EC)

and conforms with the following product standards

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

Safety IEC 61010-1:2001 / EN 61010-1:2001
Canada: CAN/CSA-C22.2 No. 61010-1-04, C/US

Supplementary Information:

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

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

March 20, 2010

Date

川路 利行

Toshiyuki Kawaji

QA Manager
Agilent Technologies

For further information, please contact your local Agilent Technologies sales office, agent or distributor, or Agilent Technologies Deutschland GmbH, Herrenberger Straße 130, 71034 Böblingen, Germany.



Agilent Technologies

DECLARATION OF CONFORMITY
According to EN ISO/IEC 17050-1:2004



Manufacturer's Name: Agilent Technologies Singapore (International) Pte. Ltd.
Manufacturer's Address: No. 1 Yishun Ave 7
SINGAPORE 768923
Singapore

Declares under sole responsibility that the product as originally delivered

Product Name: Test Fixture

Model Number: Agilent N1259A

Product Options: This declaration covers all options of the above product(s)

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

Low Voltage Directive (2006/95/EC)
EMC Directive (2004/108/EC)

and conforms with the following product standards

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

Safety IEC 61010-1:2001 / EN 61010-1:2001
Canada: CAN/CSA-C22.2 No. 61010-1-04, C/US

Supplementary Information:

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

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

March 20, 2010
Date

川路 利行

Toshiyuki Kawaji
QA Manager
Agilent Technologies

For further information, please contact your local Agilent Technologies sales office, agent or distributor, or Agilent Technologies Deutschland GmbH, Herrenberger Straße 130, 71034 Böblingen, Germany.

- **Herstellerbescheinigung**

GEÄUSCHEMISSION

Lpa < 70 dB

am Arbeitsplatz

normaler Betrieb

nach DIN 45635 T. 19

- **Manufacturer's Declaration**

ACOUSTIC NOISE EMISSION

Lpa < 70dB

operator position

normal operation

per ISO 7779

NOTE

This ISM device complies with Canadian ICES-001.

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

Safety Summary

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

Product manuals may be provided on CD-ROM or in printed form. Printed manuals are an option for many products. Manuals may also be available on the Web. Go to www.agilent.com and type the product model number in the Search field at the top of the page.

NOTE

Do not use this instrument in any manner not specified by the manufacturer. The protective features of this instrument may be impaired if it is used in a manner not specified in the operation instructions.

This instrument is an INDOOR USE product.

This instrument complies with INSTALLATION CATEGORY II for mains input and INSTALLATION CATEGORY I for measurement input terminals, and POLLUTION DEGREE 2 defined in IEC 61010-1.

If an instrument is marked CAT I (IEC Measurement Category I), or it is not marked with a measurement category, its inputs must not be connected to line-voltage mains.

- *DANGEROUS PROCEDURE WARNINGS*

Warnings, such as example below, shall be complied. Procedures throughout in this manual prevent you from potentially hazard. Their instructions contained in the warnings must be followed.

WARNING

Hazardous voltage of up to the instrument's maximum voltage may appear at Force, Guard, and Sense terminals if Interlock terminal is closed. Open the Interlock terminal when the Force, Guard, and Sense terminals are accessible. Voltage applied to the terminals will be limited up to ± 40 V or ± 42 V.

- ***BEFORE APPLYING POWER***

Verify that all safety precautions are taken. Make all connections to the instrument before applying power. Note the instrument's external markings described under "Safety Symbols".

- ***GROUND THE INSTRUMENT***

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

- ***DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE***

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

- ***KEEP AWAY FROM LIVE CIRCUITS***

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

- ***DO NOT SERVICE OR ADJUST ALONE***

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

- ***DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT***


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


- ***IN CASE OF DAMAGE***


Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.


Safety Symbols


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


 Direct current.

 Alternating current.


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


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


 Grounded terminal which indicates the earth potential.


 On supply.


 Off supply.


 Standby supply. The equipment will be marked with this symbol is not completely disconnected from AC mains when power switch is in the standby position.

 In position of a bi-stable push switch.

 Out position of a bi-stable push switch.

 Hazardous voltage and potential for electrical shock. Do not touch terminals that have this symbol when the equipment is on.

 Hot surface. Avoid contact. Surfaces are hot and may cause personal injury if touched.

 Instruction manual symbol. The equipment will be marked with this symbol when it is necessary for the user to refer to the instruction manual.

CAT I IEC Measurement Category I

WARNING

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

CAUTION

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

Power Supply and Measurement Safety

- Power Supply Safety

This instrument can output high currents and voltages. Make sure that the load or device under test can safely handle the output current and voltage. Also, make sure that the connection leads can safely withstand the expected currents and are insulated for the expected voltages.

The instrument outputs may be connected so as to float relative to earth ground. Isolation or floating voltage ratings are indicated on the instrument, near the output terminal or the Circuit Common terminal.

- Voltage/Current Measurement Safety

Multimeters and other instruments capable of measuring high voltages and currents are subject to specific safety concerns because of the circuits to which they may be connected. To safely use these instruments, you need to understand the markings on the instrument near the input terminals, which include the Protection Limits and the IEC Measurement Category.

- Protection Limits

Agilent multimeters and other voltage measurement instruments provide protection circuitry to prevent damage to the instrument and to protect against the danger of electric shock, provided the Protection Limits are not exceeded. To ensure safe operation of the instrument, do not exceed the Protection Limits shown on the input terminals.

- **Source/Monitor Terminals**

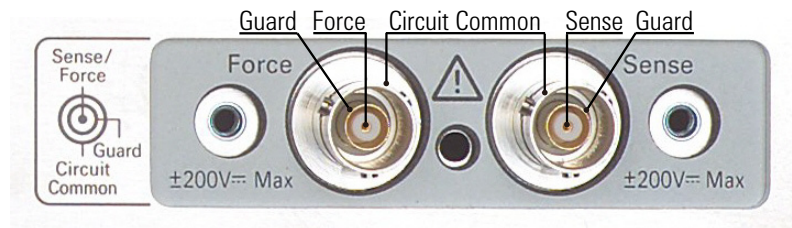
Source/monitor unit, SMU, can simultaneously perform DC voltage or current output and measurement. Typical SMU has the Force, Guard, Sense, and Circuit Common terminals as shown below. Normally the Force, Guard, and Sense terminals are the same potential. Voltage marked around the terminals indicates the Protection Limits.

Force and Sense must be connected to a terminal of a device under test for the Kelvin connection which is effective for high current measurement and low resistance measurement. For the non-Kelvin connection to ease the connections, connect Force only. Do not connect Sense. It must be opened.

Guard should be extended to around the device terminal for reducing leakage current caused by a coaxial cable used. Guard must be never connected to anything at the device side.

Circuit Common should be connected to shielding of the coaxial cable used.

The following image is the Kelvin triaxial connector of Agilent B1505A's HPSMU.



High Voltage Shock Hazard

Agilent B1505A can force dangerous voltages (± 3000 V for HVSMU and ± 200 V for HPSMU) at the force, guard, and sense terminals. To prevent electric shock hazard, the following safety precautions must be observed during the use of Agilent B1505A, N1259A, and N1258A.

- Use a three-conductor AC power cable to appliance coupler (inlet) and the instrument to an electric ground (safety ground).
- Prepare shielding box which covers interface to a device under test and equipped with interlock circuit that opens when the door is opened.
- Before performing measurement, connect the interlock circuit to the Interlock terminal of this instrument.
- Confirm periodically that the interlock function works normally.
- Before touching the connections of the Force, Guard, and Sense terminals, turn the instrument off and discharge any capacitors of the measurement path. If you do not turn the instrument off, complete “all” of the following items, regardless of any instrument’s settings.
 - Terminate measurement by pressing the Stop key, confirm that the Measurement status indicator is not lit.
 - Confirm that the High Voltage indicator is not lit.
 - Open the shielding box access door (open the Interlock terminal).
 - Discharge any capacitors if the capacitance is connected to an SMU.
- Warn workers in the vicinity of the instrument about hazardous conditions.

Gefahr durch Hochspannung

Von den Geräten Agilent B1505A können Spannungen an den Anschlüssen "Force, Guard und Sense" von bis zu 3000 V ausgehen. Um elektrischem Schlag vorzubeugen, ist bei der Benutzung der Geräte Agilent B1505A folgendes zu beachten.

- Verwenden Sie ein dreiphasiges AC-Stromkabel für die Gerätesteckvorrichtung (Eingang) und schließen Sie das Instrument an eine Erdung an (Sicherheitserdung).
- Bereiten Sie das Abschirmungsgehäuse vor, dass die Oberfläche eines zu testenden Geräts abdeckt und mit einem Verriegelungsstromkreis ausgestattet ist, der bei geöffneter Tür unterbrochen wird.
- Vor der Messung verbinden Sie den Verriegelungsstromkreis mit dem Interlock-Anschluss dieses Instruments.
- Prüfen Sie in regelmäßigen Abständen, dass die Verriegelungsfunktion ordnungsgemäß funktioniert.
- Bevor Sie die Verbindungen zu den Anschlüssen Force, Guard und Sense berühren, schalten Sie das Instrument aus und entladen alle Kondensatoren des Messwegs. Wenn Sie das Instrument nicht ausschalten, führen Sie, unabhängig von den Instrumenteinstellungen, alle folgenden Schritte durch.
 - Beenden Sie die Messung, indem Sie auf die Taste "Stop" drücken. Stellen Sie sicher, dass die Statusanzeige "Measurement" nicht leuchtet.
 - Stellen Sie sicher, dass die Anzeige "High Voltage" nicht leuchtet.
 - Öffnen Sie die Tür des Abschirmungsgehäuses (öffnen des Interlock-Anschlusses).
 - Entladen Sie alle Kondensatoren, wenn die Kapazität mit einer SMU verbunden ist.
- Warnen Sie Mitarbeiter in der Umgebung des Instruments vor den Gefahren.

Danger de choc dû à une haute tension

Une tension dangereuse (max. \pm pour HVSMU; 3000 Vdc, max. \pm pour HPSMU; 200 Vdc) émanant du dispositif Agilent B1505A peut être sortie aux bornes de force, d'appareil de protection ou de détection. Les précautions suivantes doivent être observées contre commotion électrique accidentelle.

- Utilisez un câble d'alimentation CA à trois conducteurs vers le coupleur secteur (entrée) et branchez l'instrument sur une mise électrique à la terre (prise de terre de sécurité).
- Préparez le boîtier de protection qui couvre l'interface avec le dispositif à tester et équipez-le d'un circuit de sécurité qui s'ouvre lors de l'ouverture d'une porte.
- Avant de procéder aux mesures, connectez le circuit de sécurité à la borne Interlock de l'instrument.
- Vérifiez régulièrement le bon fonctionnement de la fonction de sécurité.
- Avant de toucher les connexions des bornes Force, Guard et Sense, mettez l'instrument hors tension et déchargez tout condensateur du chemin de mesure. Si vous ne mettez pas l'instrument hors tension, effectuez « toutes » les opérations ci-dessous, quels que soient les paramètres de l'instrument.
 - Terminez les mesures en appuyant sur la touche Stop ; vérifiez que l'indicateur d'état Measurement est éteint.
 - Vérifiez que le témoin High Voltage est éteint.
 - Ouvrez la trappe d'accès au boîtier de protection (ouvrez la borne Interlock).
 - Déchargez les éventuels condensateurs si la capacité est connectée à une unité SMU.
- Informez les personnes travaillant à proximité de l'instrument des conditions.

高電圧感電注意

Agilent B1505A のフォース、ガード、センス端子には、危険電圧が出力されることがあります (HVSMU の場合は最大 ± 3000 Vdc、HPSMU の場合は最大 ± 200 Vdc)。感電事故防止のため、Agilent B1505A、N1259A、N1258A の使用時には必ず以下の事柄を守ってください。

- 3 極電源ケーブルを使用して本器を接地してください。
- ドアを開くことによって開放されるインターロック回路を装備し、被測定デバイスとのインタフェースを覆うことのできるシールド・ボックスを用意してください。
- 測定を開始する前にはインターロック回路を本器の Interlock 端子に接続してください。
- インターロック機能が正常であることを定期的に確認してください。
- Force、Guard、Sense 端子に繋がる接続部に触れる前には、本器の電源を切断してください。また、測定系のキャパシタを放電してください。電源を切らない場合は、以下の事項を全て実施してください。
 - Stop キーを押して Measurement インジケータが消灯したことを確認してください。
 - 高電圧警告 (High Voltage) インジケータが消灯していることを確認してください。
 - シールド・ボックスのドアを開けてください (Interlock 端子を開放してください)。
 - キャパシタが SMU に接続されているならば、キャパシタを放電してください。
- 周囲のほかの作業員に対しても、高電圧危険に対する注意を徹底してください。

Product Stewardship



- Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

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

Product Category: With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a "Monitoring and Control instrumentation" product.

Do not dispose in domestic household waste.

To return unwanted products, contact your local Agilent office or visit the following website for more information.

www.agilent.com/environment/product/

- LCD Fluorescent Lamp

Certain products sold by Agilent contain a liquid crystal display (LCD); backlighting for the LCD is provided by a fluorescent lamp which contains mercury, and must be managed, recycled, and/or disposed in accordance with all applicable laws, ordinances and regulations.

For information on how to recycle or dispose of the fluorescent lamp contained in your own product, visit the following website.

<http://www.agilent.com/environment/mercury.shtml>

If you live in the U.S., also visit the following websites.

<http://www.lamprecycle.org>

<http://www.eiae.org>

If you have additional questions, please visit the following website.

<http://www.agilent.com/go/contactus>

- Perchlorate Information

Perchlorate Material - special handling may apply. Visit the following website.

<http://www.dtsc.ca.gov/hazardouswaste/perchlorate/>

Equipment's real-time clock battery or coin cell battery may contain perchlorate and may require special handling when recycled or disposed of in California.

Precautionary Statement

Agilent B1505A Power Device Analyzer/Curve Tracer operates in the Microsoft Windows environment. Agilent B1505A requires Agilent EasyEXPERT software, a specially-designed Windows application program.

- About guarantee and support for Agilent B1505A

Agilent Technologies guarantees and supports the performance of Agilent B1505A for the same condition as the preload condition when shipped from the factory.

- About updating Agilent EasyEXPERT and the Windows Update

Agilent Technologies confirms the operation of Agilent EasyEXPERT patch programs and important Windows security patches, and provides recommended update information. Visit Agilent B1505A support site, download the patches, and perform the software update.

- About Windows application programs and peripherals (including driver)

Using commercial products on Agilent B1505A is your responsibility. Agilent Technologies cannot provide compatibility information for commercial products. If problems arise, perform Agilent B1505A system recovery.

- About servicing

Bench repair service is available at your nearest Agilent Technologies service center. Be aware that the B1505A configuration might be updated to the latest one without notice because of support issues.

The internal hard disk drive (HDD) might be initialized during servicing. If peripherals are connected, they will be removed.

When Agilent B1505A is returned, the internal HDD might be initialized. Peripherals will be returned separately.

- Other notes

- Back up the internal HDD to prevent loss of data by accident or failure.
- Protect Agilent B1505A from computer viruses.
- If you connect Agilent B1505A to the network, take care to protect it from computer virus.

Working in Comfort

To optimize your comfort and productivity, it is important that you set up your work area correctly and use your instrument properly. With that in mind, we have developed some set-up and use recommendations for you to follow based on established ergonomic principles. Improper and prolonged use of keyboards and input devices are among those tasks that have been associated with repetitive strain injury (RSI) to soft tissues in the hands and arms. If you experience discomfort or pain while using the instrument, discontinue use immediately and consult your physician as soon as possible. For more information on RSI you may wish to consult the *About Repetitive Strain Injury* section. Please study the recommendations described below. Included there are references to relevant parts of international standards, regulations and guidelines, such as ISO 9241 and the European Community Display Screen Equipment directive. You may also wish to consult your employer's human resources department or other relevant departments for guidance specific to your company.

About Repetitive Strain Injury

Because your comfort and safety are our primary concern, we strongly recommend that you use the instrument in accordance with established ergonomic principles and recommendations. Scientific literature suggests that there may be a relationship between injury to soft tissues -especially in the hands and arms- and prolonged improper use of keyboards or other equipment requiring repeated motions of the hands and forearms. This literature also suggests that there are many other risk factors that may increase the chance of such injury, commonly called Repetitive Strain Injury.

What is RSI?

Repetitive Strain Injury (RSI -also known as cumulative trauma disorder or repetitive motion injury) is a type of injury where soft tissues in the body, such as muscles, nerves, or tendons, become irritated or inflamed. RSI has been a reported problem for those who perform repetitive tasks such as assembly line work, meatpacking, sewing, playing musical instruments, and computer work. RSI also has been observed in those who frequently engage in activities such as carpentry, knitting, housework, gardening, tennis, windsurfing and lifting children.

What causes RSI?

The specific causes of RSI have not been established. Nevertheless, the incidence of RSI has been associated with a variety of risk factors, including:

- Too many uninterrupted repetitions of an activity or motion.

- Performing an activity in an awkward or unnatural posture.
- Maintaining static posture for prolonged periods.
- Failing to take frequent short breaks.
- Other environmental and psychosocial factors.

In addition, there have been reports associating the occurrence of RSI with the use of keyboards, mice, and other input devices. Also, certain medical conditions, such as rheumatoid arthritis, obesity and diabetes, may predispose some people to this type of injury.

What if I experience discomfort?

If you are experiencing any discomfort, seek professional medical advice immediately. Typically, the earlier a problem is diagnosed and treated, the easier it is to resolve.

Mice and Other Input Devices

Various aspects of using mice and other input devices may increase your risk of discomfort or injury. Observing the following recommendations may reduce that risk.

- Try to keep your hand, wrist, and forearm in a neutral position while using your mouse or other input device.
- If you use your thumb to rotate the ball on a trackball or spaceball, keep it in a relaxed, natural shape, and maintain a neutral posture in your hand, wrist, and forearm.
- Hold the mouse gently by draping your fingers over it. Keep your hand relaxed and fingers loose. Do not grip the mouse tightly.
- It takes very little pressure or force from your fingers to activate the buttons or scroll wheel on your mouse, scrolling mouse, trackball, or other input device. Using too much force can place unnecessary stress on the tendons and muscles in your hands, wrists, and forearms.
- If you are using a scrolling mouse, be sure to keep your fingers and hand in a relaxed, neutral position when activating the scroll wheel. Also, this type of mouse features software that can minimize the number of mouse movements or button clicks.
- When using a mouse, trackball, or other input device, position it as close to the keyboard as possible, and keep it at the same level as you do not have to stretch while using it.
- Be sure to keep your mouse and trackball clean. Regular removal of accumulated dust and dirt helps ensure proper tracking and reduces unnecessary hand and wrist motions.

In This Manual

This manual describes the product overview and installation information of Agilent Technologies B1505A. This manual consists of the following chapters:

- Chapter 1, “Getting Started”
This chapter describes basic operations of Agilent B1505A.
- Chapter 2, “Introduction”
This chapter describes basic features of Agilent B1505A.
- Chapter 3, “Installation”
This chapter describes installation and maintenance.
- Chapter 4, “Specifications and Options”
This chapter describes specifications and options of Agilent B1505A.

NOTE




To get the latest firmware/software/manuals/support information, go to www.agilent.com and type in B1505A in the Search field at the top of the page.

Contents

1. Getting Started

To Turn On/Off B1505A	1-3
To Turn B1505A On.....	1-4
To Turn B1505A Off.....	1-4
To Launch EasyEXPERT	1-6
If Only One Workspace Exists	1-7
To Create Workspace	1-8
To Select Workspace	1-9
To Use Tracer Test Mode	1-10
To Use Application Test Mode.....	1-12
To Use Classic Test Mode	1-14
To Perform Measurement	1-16
To Use Test Result Editor	1-17
To Use Analysis Tools.....	1-18

2. Introduction

Overview	2-3
Agilent EasyEXPERT Software.....	2-5
Front View.....	2-7
Rear View	2-10
	2-11
	2-12
	2-13
Measurement Modules	2-14
GNDU - Ground Unit.....	2-14
About SMU	2-15
HPSMU - High Power SMU	2-16
HCSMU - High Current SMU	2-19

Contents

HVSMU - High Voltage SMU	2-21
MFCMU - Multi Frequency CMU	2-23
Accessories	2-26
N1258A Module Selector	2-26
⚠	2-27
⚠	2-28
⚠	2-29
N1259A Test Fixture	2-30
⚠	2-30
⚠	2-31
⚠	2-32
⚠	2-34
⚠	2-36
⚠	2-37
⚠	2-39
N1260A High Voltage Bias-T	2-42
⚠	2-42
N1261A Protection Adapter	2-43
⚠	2-43
N1262A R-Box	2-45
⚠	2-45
16493S-010/011 HCSMU Adapter	2-46
⚠	2-46
16493S-020/021 Dual HCSMU Adapter	2-47
⚠	2-47
3. Installation	
⚠	3-2
Requirements	3-3
Power Requirements	3-3
Operating Environment	3-3

Contents

Storing/Shipping Environment	3-3
Installation Requirements	3-4
Power Cable	3-4
Inspection and Installation.....	3-6
To Inspect B1505A and Accessories	3-6
To Perform Initial Setup	3-7
To Change Windows Logon Setting	3-9
To Change GPIB Address.....	3-9
To Enable System Controller	3-10
Maintenance.....	3-11
Cleaning	3-11
Self-test and Diagnostics.....	3-11
⚠.....	3-11
Calibration	3-11
About Plug-in Modules	3-12
Module Type and Locations	3-13

4. Specifications and Options

Specifications	4-3
Specification Conditions.....	4-3
Mainframe.....	4-4
HPSMU	4-6
HCSMU	4-9
HVSMU	4-11
SMU Common Specifications	4-13
SMU Supplemental Characteristics.....	4-15
MFCMU	4-19
Accessories.....	4-24
Agilent EasyEXPERT Software.....	4-31
General Specifications	4-38

Contents

Accessories and Options 4-39

1

Getting Started

Getting Started

This chapter describes the basic operations of Agilent B1505A. Before learning the product details, let's try to use the B1505A briefly. The operations need the B1505A, power cable, and USB keyboard only (USB mouse and stylus pen are optional). Agilent B1505A also requires Agilent EasyEXPERT software as its graphical user interface.

During the operations, you will not connect device under test. Open all measurement terminal.

This chapter consists of the following sections.

- “To Turn On/Off B1505A”
- “To Launch EasyEXPERT”
- “To Use Tracer Test Mode”
- “To Use Application Test Mode”
- “To Use Classic Test Mode”
- “To Perform Measurement”
- “To Use Analysis Tools”

NOTE

If you use the B1505A at the first time

If this is the first time to turn Agilent B1505A on after the delivery, you need to perform the initial setup of the B1505A. See “Inspection and Installation” on page 3-6. After the initial setup and if no users are added, you can automatically logon as “Agilent B1500 User” account without password.

To Turn On/Off B1505A

NOTE

When turning the B1505A on

Open the measurement terminals at the device side when turning the B1505A on. Also disconnect the device from the measurement terminals and open the measurement terminals after the test. If you leave the connection with the device, the device may be damaged by unexpected operations or charge-up of measurement cables.

NOTE

If Start EasyEXPERT button is not displayed

Select All Programs > Start EasyEXPERT from the Start menu. The Start EasyEXPERT button will be displayed.

NOTE

Automatic start function

If the automatic start function is on, EasyEXPERT is launched within the B1505A boot up process. If the function is off, EasyEXPERT is not launched and the Start EasyEXPERT button is displayed.

To turn the automatic start function off, use the Start EasyEXPERT window displayed by the File > Exit menu on the EasyEXPERT main screen. And remove the check from the Option > Auto Start of EasyEXPERT menu.

NOTE

If EasyEXPERT does not run

Launch “Agilent Connection Expert” by using the icon on Windows taskbar. And check the USB0 connection status displayed in “Instrument I/O on this PC” area.

USB0 connection status display example:

```
USB0
+ B1500A (USB0::2391::1::0001::0::INSTR)
+ agb1500a
+ UsbDevice1
```

If “agb1500A” and “UsbDevice1” are not listed, add them by using “Add VISA Alias” in the right-button-menu on “B1500A (USB0::...::INSTR)”. If the problem still remains, perform Agilent B1500 system recovery. To perform recovery, see Agilent EasyEXPERT *User’s Guide*.

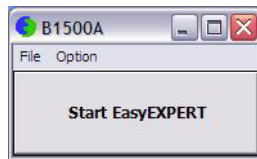
Getting Started

To Turn On/Off B1505A

To Turn B1505A On

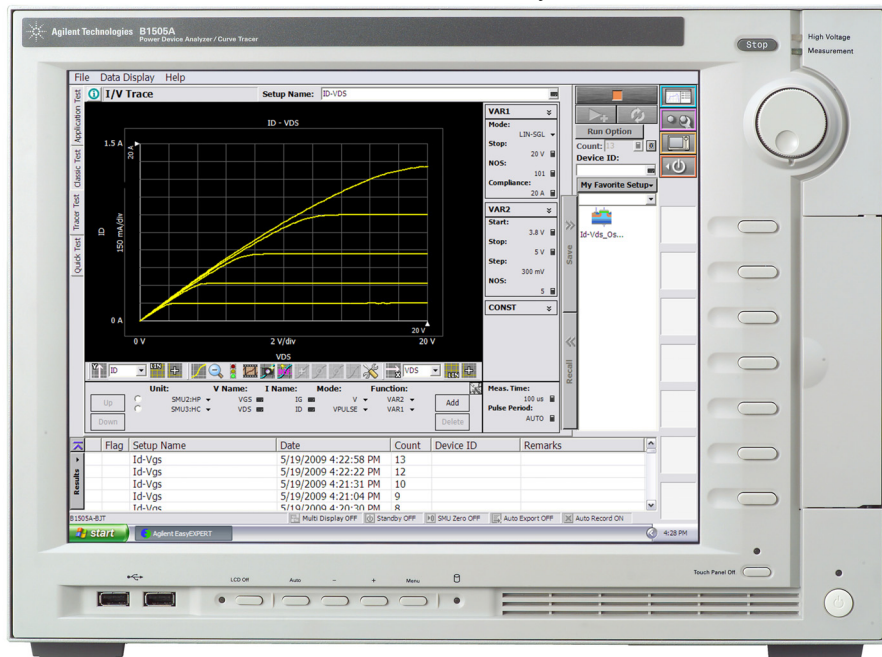
1. Connect the power cable from Agilent B1505A to an AC power outlet.
2. Connect the USB keyboard to the B1505A. Optionally, connect the USB mouse to the B1505A.
3. Press the Standby switch (lower right corner of the front panel). Windows, measurement module initialization, and self-calibration will start. For the Windows logon screen, log on Windows.

After logging on, the Start EasyEXPERT button will be displayed on the screen, or EasyEXPERT will be launched if the automatic start function is on.



To Turn B1505A Off

Press the Standby switch (lower right corner of the front panel). Windows will be shutdown and the B1505A will become the standby state.



NOTE

Agilent B1505A has the following front panel user interface.

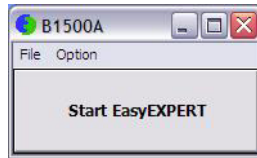
- Stop
Stops the present measurement or source output immediately.
- Rotary knob
Rotating the knob moves the marker on the graph window, or increases/decreases/changes the value in the active entry field.
Pressing the knob sets or enters the value.
- Softkeys
Seven softkeys are available. Used to select one for the entry field specified or the dialog box. They are also used to recall the test definitions (pre-defined test setups).
- Touch Panel Off
Enables or disables the touch screen operation.
- Standby switch
Turns the B1505A on. Pressing the button in the ON state makes the B1505A in the standby state.
- LCD Off
Enables or disables the LCD panel. LED lights when the LCD is disabled.
- Auto, -, +, Menu
Four keys are available for the display adjustment. Press Auto to perform adjustment automatically. Use -, +, and Menu to adjust manually.

Agilent B1505A also requires Agilent EasyEXPERT software as its graphical user interface. You can operate Agilent EasyEXPERT by using the touch panel. Use your fingers, stylus pen, and so on for the touch panel operation. The USB keyboard and the USB mouse are also available for operating the EasyEXPERT.

To remove USB devices from the B1505A, use “Safely Remove Hardware” on Windows taskbar. If it is not used, the B1505A may cause the internal USB communication error. If the error occurs, turn the B1505A off and disconnect the power cable from the B1505A. Leave it about 30 seconds before rebooting the B1505A, and connect the power cable again, and then turn the B1505A on.

To Launch EasyEXPERT

1. If the automatic start function is off, the Start EasyEXPERT button is displayed. Click the button and wait until the EasyEXPERT main screen or workspace selection screen is displayed.



NOTE

Workspace is the space created in Agilent B1505A's internal hard disk drive, and is used to store the test setup, test result data, and so on. The workspace can be created and allocated for each user.

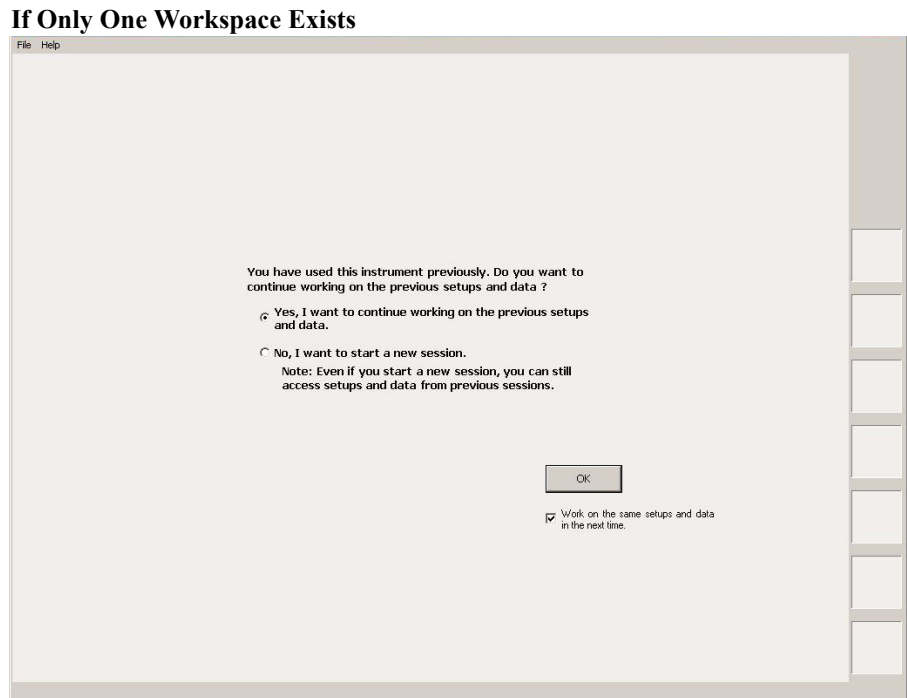
2. If this is the first time to start the EasyEXPERT, or if no workspace exists, a workspace will be created automatically.
Skip to "To Use Tracer Test Mode" on page 1-10, "To Use Application Test Mode" on page 1-12, or "To Use Classic Test Mode" on page 1-14.
3. If only one workspace exists, the B1505A displays the screen as shown in Figure 1-1.
Skip to "If Only One Workspace Exists" on page 1-7.
4. If two or more workspaces exist, the B1505A displays the screen as shown in Figure 1-3.
Skip to "To Select Workspace" on page 1-9.

If Only One Workspace Exists

For the screen as shown in Figure 1-1, perform the following steps.

1. If you do not want to create a workspace, select the Yes radio button and click OK.
Skip to “To Use Tracer Test Mode” on page 1-10, “To Use Application Test Mode” on page 1-12, or “To Use Classic Test Mode” on page 1-14.
2. If you want to create a workspace, select the No radio button and click Next. The B1505A displays the screen as shown in Figure 1-2.
Skip to “To Create Workspace” on page 1-8.

Figure 1-1



NOTE

Work on the same setups and data in the next time

If this check box is checked, the workspace selection screen will be skipped at the next startup and EasyEXPERT will be launched with the workspace used at the last operation. To perform this setup again, click the File > Close Workspace menu on the EasyEXPERT main screen.

To Create Workspace

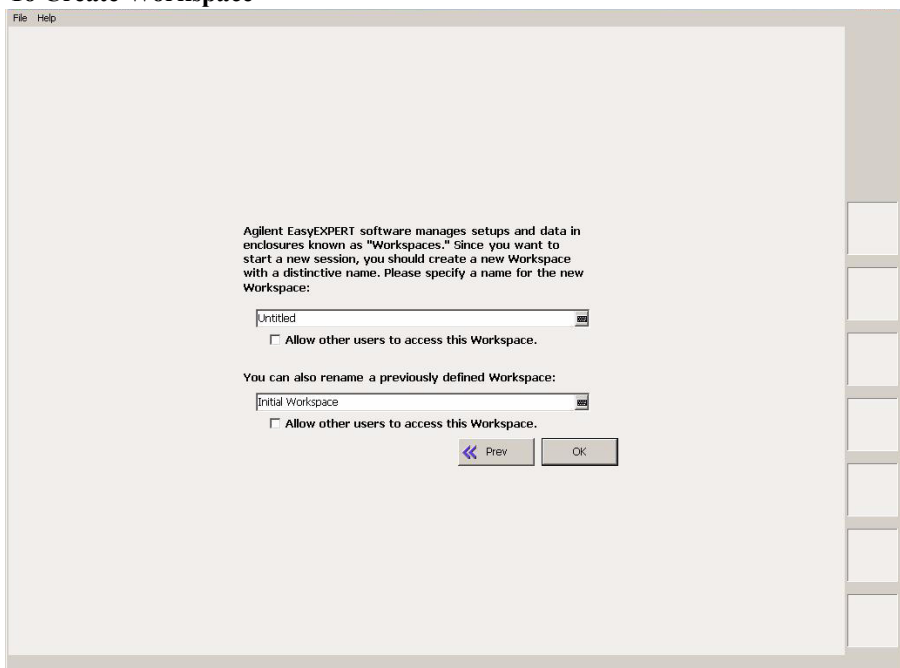
For the screen as shown in Figure 1-2, perform the following steps. To cancel creating workspace, click Prev.

1. Enter the name of the new workspace into the above-entry field.
Check *Allow other users to access this workspace* box if you want to create a public workspace that is opened for all users.
2. If you are the owner of the existing workspace, you can change the name of the existing workspace.
If you want to rename the existing workspace, enter the name into the below-entry field.
Check *Allow other users to access this workspace* box if you want to set it to a public workspace that is opened for all users.
3. Click OK.

Skip to “To Use Tracer Test Mode” on page 1-10, “To Use Application Test Mode” on page 1-12, or “To Use Classic Test Mode” on page 1-14.

Figure 1-2

To Create Workspace



To Select Workspace

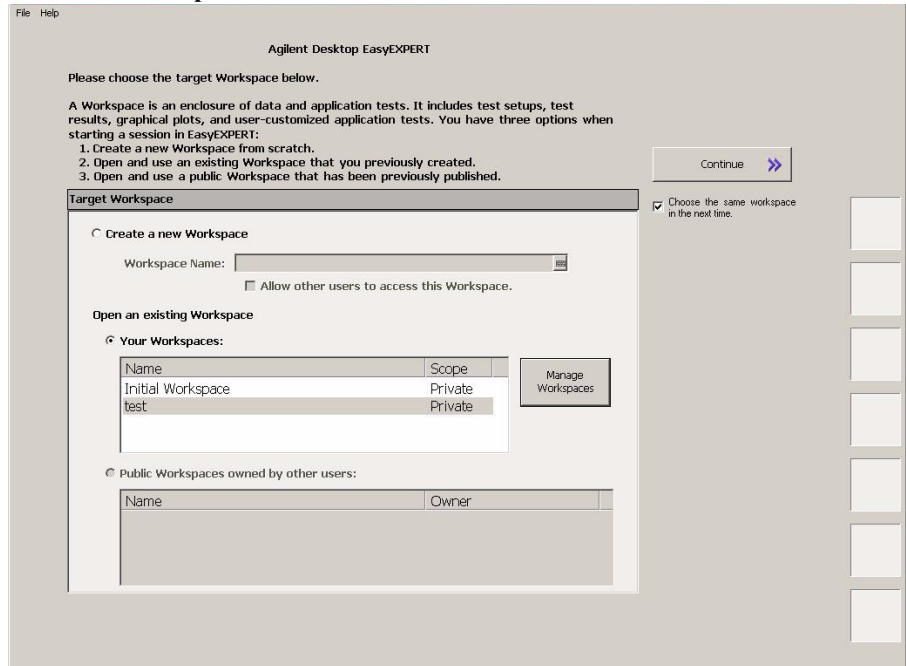
For the screen as shown in Figure 1-3, perform the following steps. This example selects the workspace named as *Demo Workspace* that is a public workspace that is opened for all users.

1. Select *Public Workspaces owned by other users* radio button.
2. Click *Demo Workspace* to select it.
3. Click Continue.

Skip to “To Use Tracer Test Mode” on page 1-10, “To Use Application Test Mode” on page 1-12, or “To Use Classic Test Mode” on page 1-14.

Figure 1-3

To Select Workspace



NOTE

Choose the same Workspace in the next time



If this check box is checked, the workspace selection screen will be skipped at the next startup and EasyEXPERT will be launched with the workspace used at the last operation. To perform this setup again, click the File > Close Workspace menu on the EasyEXPERT main screen.

To Use Tracer Test Mode

The following procedure performs the tracer test setup.

1. Click the Tracer Test tab on the main screen. The tab is in the leftmost column on the screen. The I/V Trace screen is displayed. See Figure 1-4.
2. Set the channels at the field below the graph as shown in Table 1-1.
3. Set the measurement condition at the right field of the graph as shown in Table 1-3.
4. Set the graph display condition at the field below the graph as shown in Table 1-2.

To enter the value, use the USB keyboard or the screen/numeric keyboard opened by clicking the right button of the entry field.

To start measurement, click  for the single measurement or  for the repeat measurement.

If the Stop field is highlighted, the range of measurement and graph display can be changed by using the rotary knob during the repeat measurement.

Table 1-1

I/V Trace Channel Setup

Unit	V Name	I Name	Mode ^a	Function
SMU1	V1	I1	V	VAR1
SMU2	V2	I2	V	CONST

- a. Channel output mode. Set I or IPULSE for the current output and voltage measurement. Set V or VPULSE for the voltage output and current measurement.

Table 1-2

I/V Trace Graph Setup

	Name	Scale			Name	Scale	
Y ↑	I1	LIN	±	→ X	V1	LIN	±

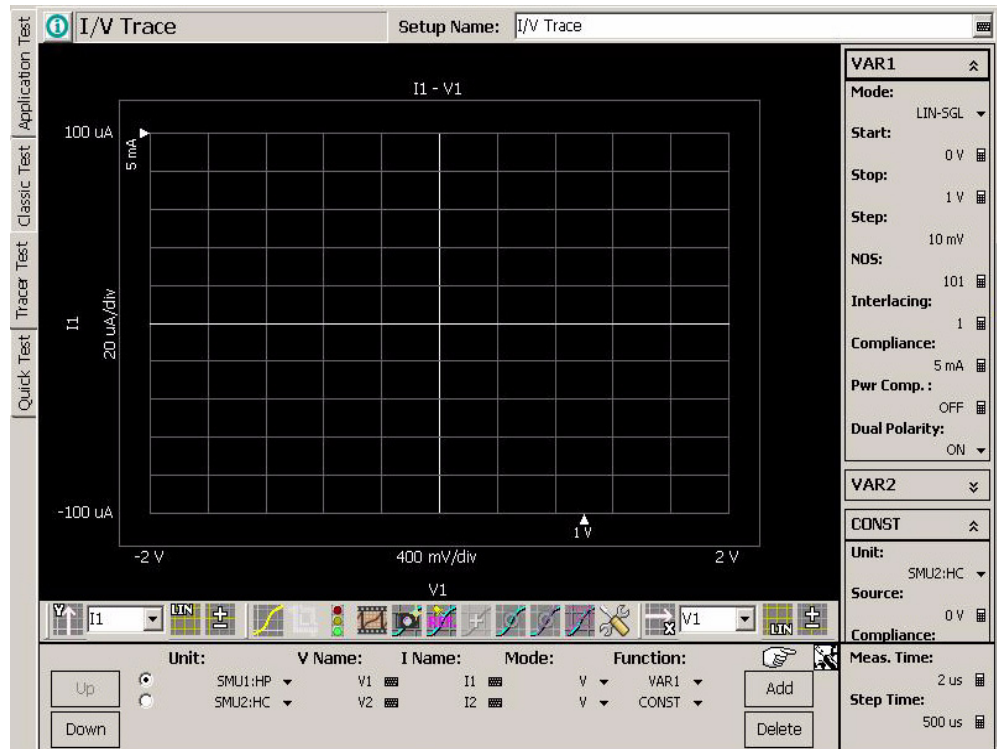
Table 1-3

I/V Trace Measurement Setup

VAR1		CONST	
Mode	LIN-SGL	Unit	SMU2
Start	0 V	Source	0 V
Stop	1 V	Compliance	5 mA
Step	10 mV		
NOS	101		
Interlacing	1		
Compliance	5 mA		
Pwr Comp.	OFF	Meas. Time	2 μ s
Dual Polarity	ON	Step Time	500 μ s

Figure 1-4

Display Example of I/V Trace Screen

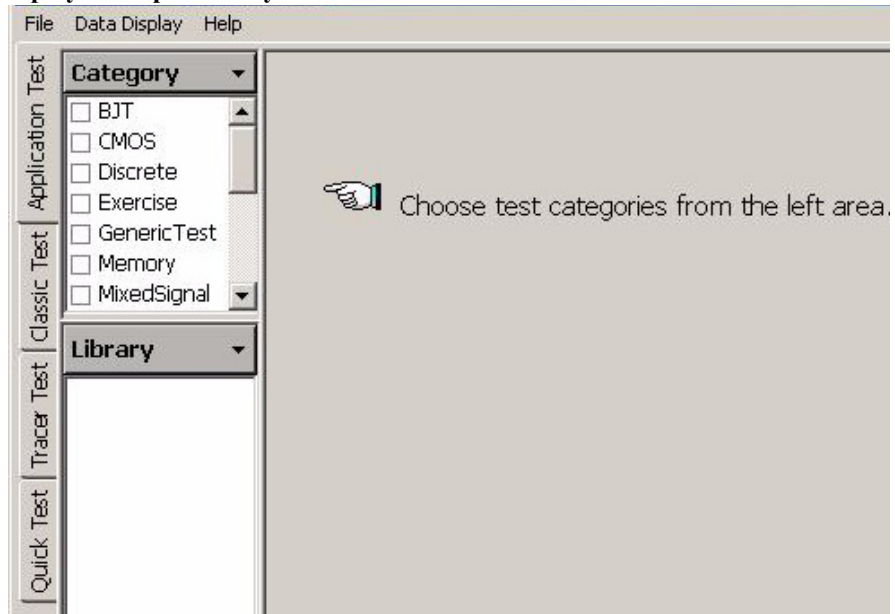


To Use Application Test Mode

For the screen as shown in Figure 1-5, perform the following procedure.

Figure 1-5

Display Example of EasyEXPERT Main Screen



1. Click the Application Test tab on the main screen. The tab is in the leftmost column on the screen.
2. Set the Category field. For example, check the PwrDevice only. The Library field lists the test definitions.
3. Select a test definition at the Library field. For example, click the *BVgso[3] PwrDevice* and *Select* button sequentially. The screen changes the display as shown in Figure 1-6.
4. Change the measurement conditions at the Test Parameters field.

The following example changes the gate stop voltage and the source channel.

- a. Set VgStop to -1.0 V.
- b. Set Source to SMU2.

To enter the value, use the USB keyboard or the screen/numeric keyboard opened by clicking the right button of the entry field.

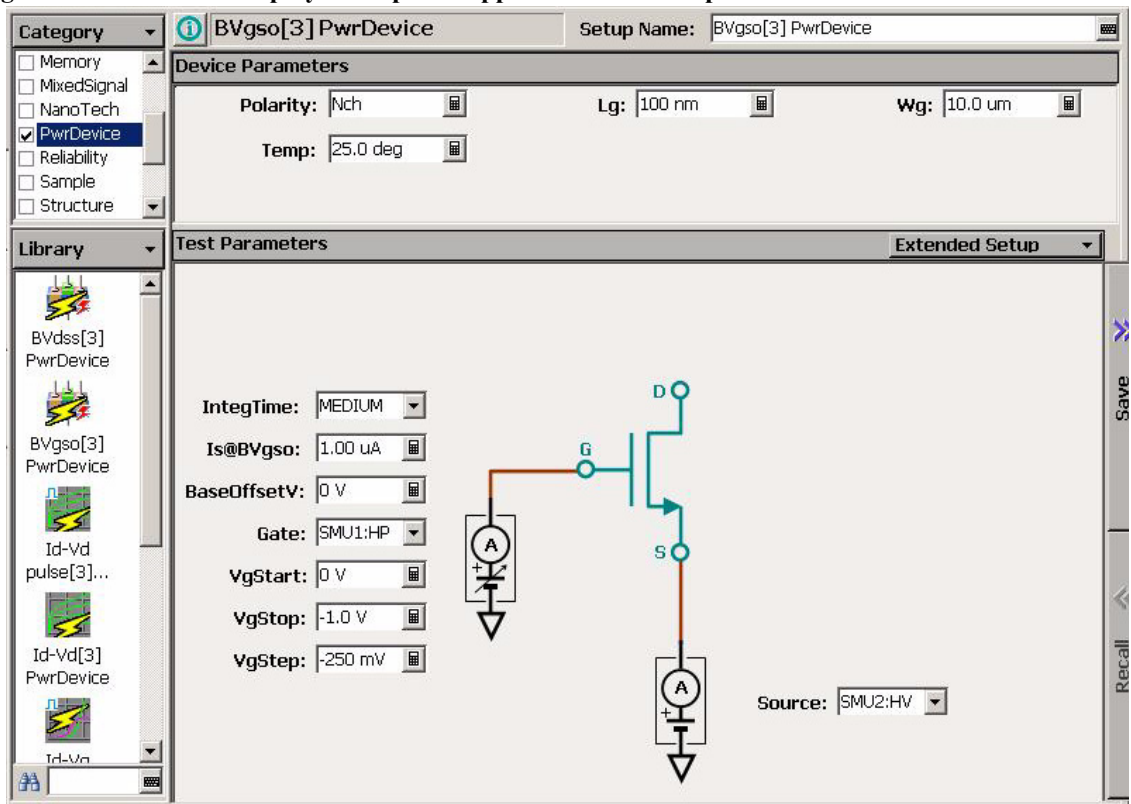
See “To Perform Measurement” on page 1-16 to start measurement.

NOTE

Test Definitions

Test definitions are the built-in test setups that have been defined and stored in the EasyEXPERT as the application library. The EasyEXPERT contains more than two hundred test definitions. You can execute the test without modifications. Also you can create your own test setup/definition by making any changes. All furnished test definitions are just sample. Agilent Technologies is NOT LIABLE for any damages caused by the samples.

Figure 1-6 Display Example of Application Test Setup Screen



To Use Classic Test Mode

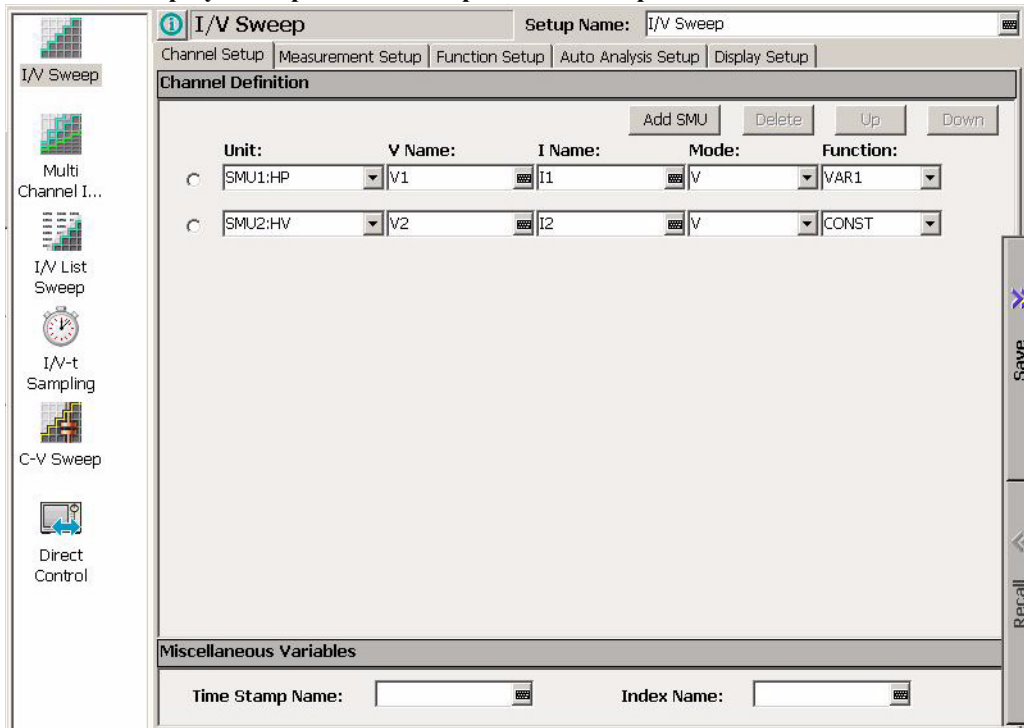
The following procedure performs the I/V Sweep classic test setup.

1. Click the Classic Test tab on the main screen. The tab is in the leftmost column on the screen.
2. Click I/V Sweep and Select button sequentially. The I/V Sweep Channel Setup screen is displayed. See Figure 1-7.
3. Set the Channel Setup parameters as shown in Table 1-4.
4. Click the Measurement Setup tab and set the parameters as shown in Table 1-5.
5. Click the Display Setup tab and set the parameters as shown in Table 1-6.

To enter the value, use the USB keyboard or the screen/numeric keyboard opened by clicking the right button of the entry field.

Figure 1-7

Display Example of I/V Sweep Channel Setup Screen



See “To Perform Measurement” on page 1-16 to start measurement.

Table 1-4 I/V Sweep Channel Setup

Unit	V Name	I Name	Mode ^a	Function
SMU1	V1	I1	V	VAR1
SMU2	V2	I2	V	CONST

a. Channel output mode. Set I or IPULSE for the current output and voltage measurement. Set V, VPULSE, or COMMON for the voltage output and current measurement.

Table 1-5 I/V Sweep Measurement Setup

VAR1		Timing		Constants	
Unit	SMU1	Hold	0 s	Unit	SMU2
Name	V1	Delay	0 s	V Name	V2
Direction	Single			I Name	I2
Linear/Log	LINEAR			Mode	V
Start	0 V			Source	0 V
Stop	1 V			Compliance	5 mA
Step	10 mV				
No of Step	101				
Compliance	5 mA				
Pwr Comp	OFF	Sweep	CONTINUE AT ANY	status	

Table 1-6 I/V Sweep Display Setup

	Name	Sharing	Scale	Min	Max
X	V1	(None)	Linear	0 V	1 V
Y1	I1	(None)	Linear	-5 mA	5 mA

To Perform Measurement

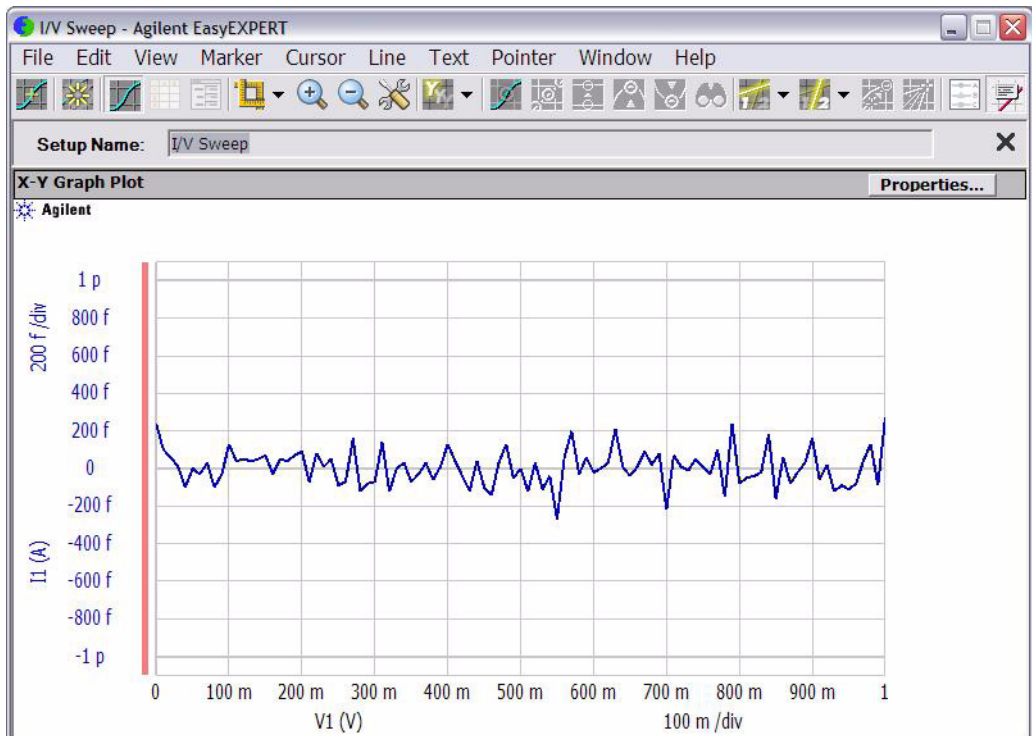
1. Click the Single button (upper right on the main screen) to start measurement. This opens the Data Display window and starts a single sweep measurement.



After the measurement, the measurement data is displayed on the Data Display window. For the measurement after performing “To Use Classic Test Mode” on page 1-14, you will have the test result as shown in Figure 1-8. This is the leakage current measurement result because all measurement terminal is opened for performing the procedures described in this chapter.

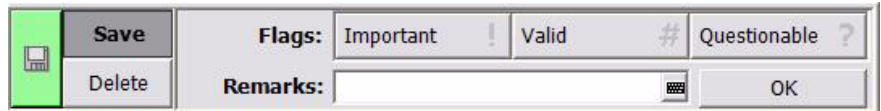
2. If the automatic data record function has been set to ON (Auto Record ON), Test Result Editor appears on the lower area of the screen when the measurement is completed. See “To Use Test Result Editor” on page 1-17.

Figure 1-8 Display Example of Data Display Window



To Use Test Result Editor

The Test Result Editor provides the following GUI to set a flag and remarks to the test result record.



- Save button and Delete button

Divides test records into groups, Save and Delete.

Test records in Save-group are always listed in the lower area of the EasyEXPERT main screen.

Test records in Delete-group can be listed when Results > Filter > Show Deleted Data is checked.

- Flags buttons

The following buttons are available. You can set one of the following flags.

- Important ! button

Sets the important flag (!) to the test result record.

- Valid # button

Sets the valid flag (#) to the test result record.

- Questionable ? button

Sets the questionable flag (?) to the test result record.

- Remarks field

You can enter characters into this field. The characters will be recorded as the Remarks value of the test result record.

- OK button

Applies the setup on the Test Result Editor, and closes this dialog box.

To Use Analysis Tools

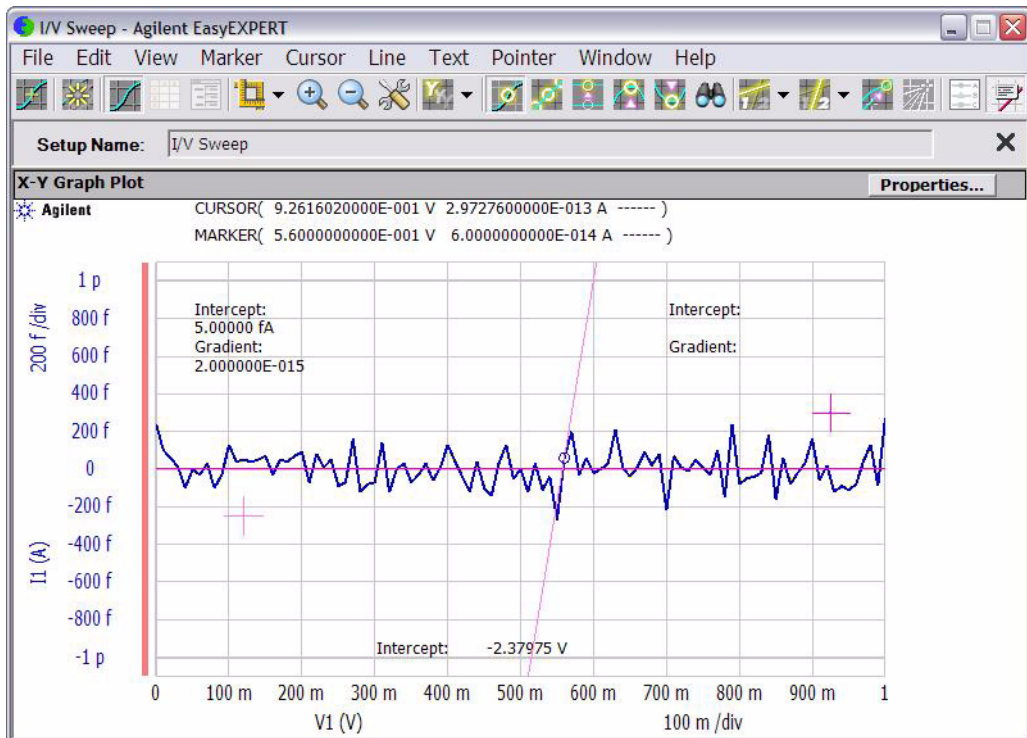
The Data Display window provides several analysis functions.

- View menu: used to adjust the graph scale.
- Marker menu: used to display and control the marker.
- Cursor menu: used to display and control the cursor.
- Line menu: used to display and control the lines.

When the marker, cursor, and lines are effective, their parameters are also displayed on the X-Y Graph Plot area.

Figure 1-9 is an example displaying marker, tangent line, and regression line on the test result graph shown in Figure 1-8. You can read position of the marker and the active cursor, and intercept and gradient of the active line.

Figure 1-9 Display Example of Analysis Tools



Introduction

This chapter describes the basic functions and features of Agilent B1505A Power Device Analyzer/Curve Tracer, and consists of the following sections:

- “Overview”
- “Front View”
- “Rear View”
- “Measurement Modules”
- “Accessories”

NOTE

Application Library

Agilent B1505A has installed Agilent EasyEXPERT software as the user interface. The EasyEXPERT contains an application library that is a set of test definitions. The application test can be performed by selecting a test definition and setting the test condition for the actual DUT (device under test).

All test definitions are just sample. If the samples damage your devices, Agilent Technologies is NOT LIABLE for the damage.

NOTE

Utility

The following utility programs (sample) are stored in the folder C:\Program Files\Agilent\B1500\EasyEXPERT\Utilities.

- Prober control programs
- 4155/4156 setup file converter
- sleep.exe program

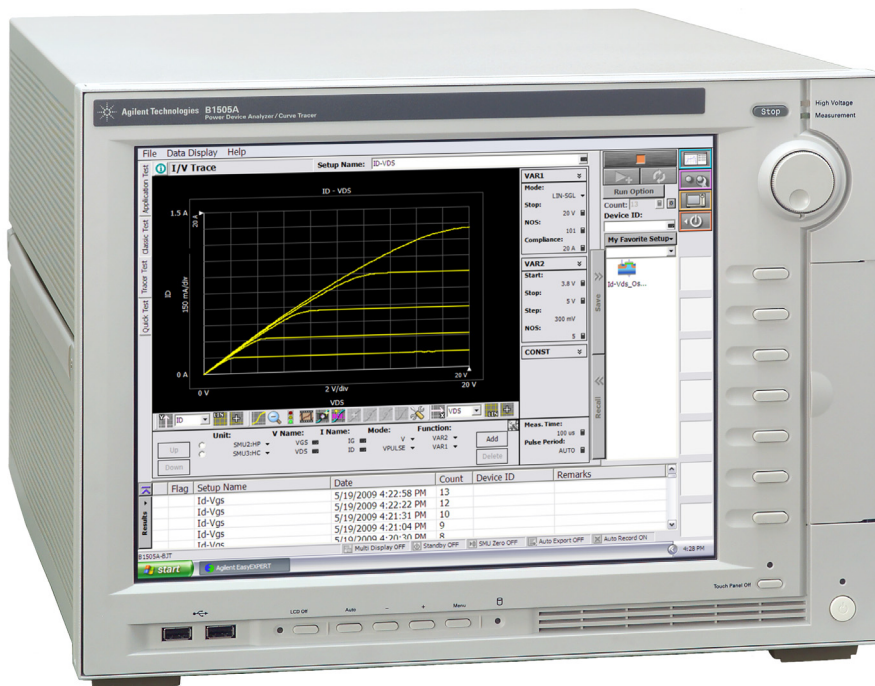
For more details, see Agilent EasyEXPERT User’s Guide.

Overview

Agilent B1505A Power Device Analyzer/Curve Tracer is the parameter analyzer supporting high voltage and high current and is the one box solution for the power device DC/AC parametric measurement and analysis application. Agilent B1505A 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.

Agilent B1505A 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.

Also, in the GPIB remote control mode, you can control the B1505A from an external computer by using Agilent FLEX command set that is the common language for Agilent semiconductor DC measurement instruments. So you can reuse the measurement program created for Agilent 4155/4156/B1500/E5260/E5270.



Introduction

Overview

- Agilent B1505A Power Device Analyzer/Curve Tracer
Mainframe that provides the ground unit (GNDU) and ten empty slots for the measurement facilities, and Agilent EasyEXPERT software for the operating environment. The EasyEXPERT is the GUI based measurement control and analysis software runs on the Windows.
The B1505A is equipped with the 15 inch LCD with touch panel, hard disk drive, DVD-ROM/CD-ROM/CD-RW drive, and USB/LAN/GP-IB interfaces. The USB keyboard, the USB mouse, and the stylus pen are available as option.
- HPSMU module
High power source/monitor unit module. Occupies two slots.
- HCSMU module
High current source/monitor unit module. Occupies two slots.
- HVSMU module
High voltage source/monitor unit module. Occupies two slots.
- MFCMU module
Multi frequency capacitance measurement unit module. Occupies one slot.
- Agilent N1258A Module selector
Used to switch the measurement resource connected to the device under test (DUT). The measurement resource will be HPSMU, HVSMU, or HCSMU. One selector provides one switching channel.
- Agilent N1259A Test fixture
Test fixture to support GNDU, HPSMU, HVSMU, and HCSMU. Can install the module selector for switching the measurement resource connected to the DUT, the high voltage R-box for reducing the risk of device breakdown, and the high voltage bias-T for performing the high voltage capacitance measurement. Protection adapters are initially installed.
- Agilent N1260A High voltage bias-T
Bias-T for applying up to 3000 Vdc to the DUT for the high voltage capacitance measurement.
- Agilent N1261A Protection adapter
Adapter for protecting GNDU or HPSMU from high voltage.

- Agilent N1262A High voltage R-box
Resistor box for reducing the risk of device breakdown or preventing SMU from oscillation. 1 k Ω (\pm 200 Vdc), 100 k Ω (\pm 3000 Vdc), or 1 M Ω (\pm 3000 Vdc)

Agilent EasyEXPERT Software

Agilent EasyEXPERT software is a specially-designed Windows application program for controlling Agilent B1500 series. The EasyEXPERT 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
- Module selector control
- Measurement/setup data management by workspace
- Graph display and analysis with markers, cursors, and lines; and auto analysis
- 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

The EasyEXPERT has the following measurement execution environments.

- Application test
- Classic test
- Tracer test
- Quick test

Application Test The EasyEXPERT 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 two hundred test definitions.

You can perform measurements by choosing the best one for your device under test (DUT) from the application libraries, and modifying and executing it. Modification is really simple. For example, it will be completed by changing the output voltage only to DUT terminals. And the setup with your modifications can be saved and recalled as your setup (*My Favorite Setup*).

Classic Test You can perform measurements by using the user interface similar to the semiconductor parameter analyzers such as Agilent 4156C. 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*). This measurement environment provides the following functions.

- I/V Sweep
- Multi Channel I/V Sweep
- I/V List Sweep
- I/V-t Sampling
- C-V Sweep
- SPGU Control
- Switching Matrix Control
- Direct Control

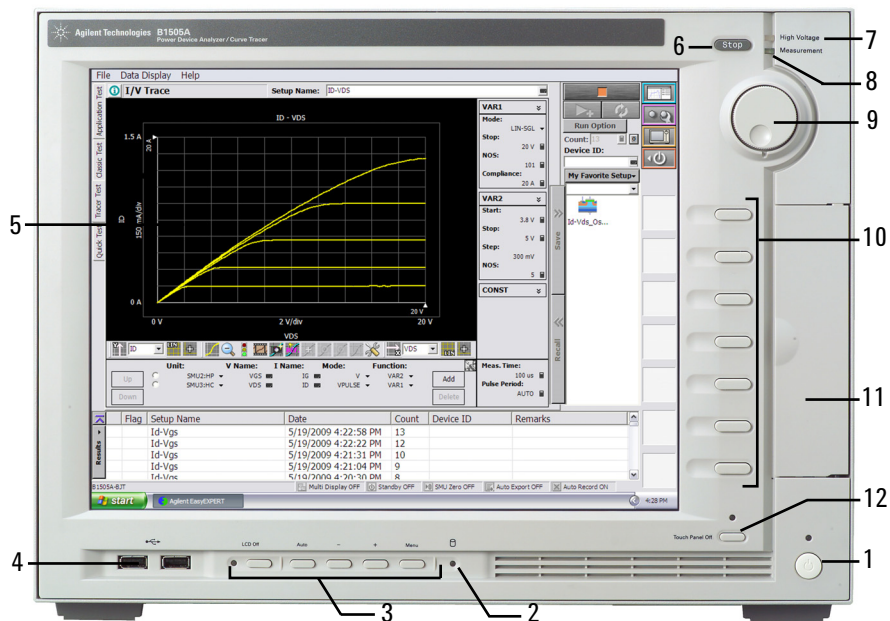
The Direct Control test mode is used to control the measurement modules directly by using the B1505A GPIB control commands and perform measurement. For the control commands, see *Programming Guide*.

Tracer Test 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.

Quick Test You can execute the test setups saved in a preset group (*My Favorite Setup*) sequentially.

Front View

This section describes the front view of Agilent B1505A.



1. Standby switch

Turns the B1505A on. Pressing the button in the ON state makes the B1505A in the standby state. The green LED lights when the B1505A is in the ON state.

NOTE

When turning the B1505A on

Open the measurement terminals at the device side when turning the B1505A on. Also disconnect the device from the measurement terminals and open the measurement terminals after the measurement. If you leave the connection with the device, the device may be damaged by unexpected operations or charge-up of measurement cables.

2. HDD access indicator

This green LED lights in the access status of HDD or DVD-ROM/CD-ROM/CD-RW drive. Do not turn the B1505A off during this LED lights.

Introduction

Front View

3. OSD buttons

LCD Off enables or disables the LCD panel. The green LED lights when the LCD is disabled.

Four keys are available for the display adjustment. Press Auto to perform adjustment automatically. Use -, +, and Menu to adjust manually.

4. USB interfaces

USB, 2 ports. For keyboard, mouse, and so on. USB keyboard and USB mouse are available as option.

To remove USB devices from the B1505A, use “Safely Remove Hardware” on Windows taskbar. If it is not used, the B1505A may cause the internal USB communication error. If the error occurs, turn the B1505A off and disconnect the power cable from the B1505A. Leave it about 30 seconds before rebooting the B1505A, and connect the power cable again, and then turn the B1505A on.

5. LCD panel

15 inch TFT XGA display, 1024 × 768 resolution. Displays the Windows screen, Agilent EasyEXPERT software window, and so on. Touch screen operation is available when the Touch Panel Off indicator does not light.

NOTE

About screen adjustment

If you find swinging or flickering in screen while you use this instrument, perform the screen adjustment. In most cases, the symptoms can be resolved by pressing the Auto button below the LCD panel. The Auto button is used to start the automatic screen adjustment. Also the manual screen adjustment is available by using the adjustment menu displayed by pressing the Menu button.

6. Stop key

Stops the present measurement or source output immediately.

7. High voltage status indicator

This red LED lights when a source channel applies more than ± 42 V.

8. Measurement status indicator

This green LED lights when a measurement channel performs measurement.

9. Rotary knob

Works on Agilent EasyEXPERT environment. Rotating the knob moves the marker on the graph window, or increases/decreases/changes the value in the active entry field. Pressing the knob sets or enters the value.

10. Softkeys

Seven softkeys are available for Agilent EasyEXPERT environment. Used to select an alternative for the entry field specified or the dialog box.

11. DVD-ROM/CD-ROM/CD-RW drive

For data backup, B1505A update, or data transfer.

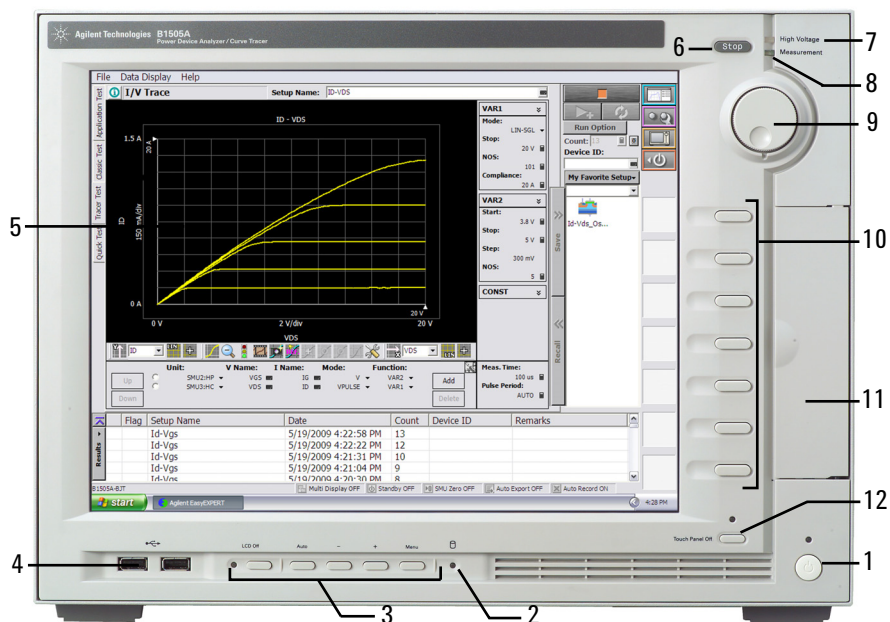
12. Touch Panel Off key

Works on Agilent EasyEXPERT environment. Enables or disables the touch screen operation. The green LED lights when the touch screen is disabled.

NOTE

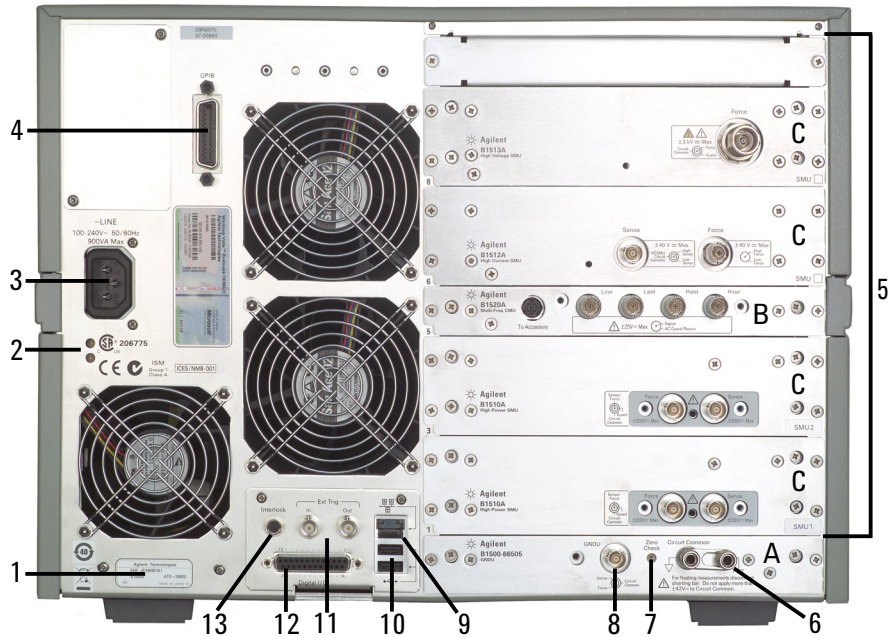
To disable the touch panel

Use Touch Panel Device Properties, and remove the check from the Enabled box on the Advanced tab screen. The Touch Panel Device Properties dialog box can be opened by selecting Gunzee TPDD > Adjust Settings from Windows program menu.



Rear View

This section describes the rear view of Agilent B1505A.



1. Serial number

You need this *serial number* when using Agilent Technologies telephone assistance program.

2. LED status indicator

For troubleshooting. Followings are some examples.

- Both LEDs turn off:
B1505A is in the standby state and Standby switch is OFF position.
- One LED turns green:
Power supply works normally.
- Both LEDs turn orange:
B1505A is in the standby state and Standby switch is ON position.

3. LINE input receptacle




AC power cable is connected to this receptacle.

4. GPIB interface

Use an Agilent 82357A USB/GPIB interface or Agilent 10833A/B/C/D GPIB cable to connect to an external computer or equipment.

5. Module slot

Ten slots are available for installing the modules. Several kinds of module can be installed in the B1505A. However, the allowable number to install is different by the module type. See “Measurement Modules” on page 2-14. Also, there is a rule for the installation order by the module type. See Chapter 3, “Installation.”

 6. Circuit Common () and frame ground () terminals

Normally, connect the terminals together by using the shorting bar. For floating measurement, remove the shorting bar.

WARNING

If the Circuit Common terminal is *not* connected to the frame ground terminal (for floating measurement), a potential shock hazard may present. Do not touch any of measurement circuit at any time while a floating measurement is in progress.

CAUTION

For floating measurement, do not apply voltage more than ± 42 V to the Circuit Common terminal. Failure to heed this caution may result in damage to the B1505A.

7. Zero Check terminal

Ground reference point of the B1505A.

CAUTION

The Zero Check terminal can be used for the service purpose only. For the B1505A normal operation, leave this terminal open and do not connect anything to this terminal. Connecting anything can damage the B1505A.

8. GNDU terminal

0 V constant voltage source. Used for the reference of measurement ground. Triaxial connector.

9. LAN interface

RJ45 connector.

10. USB interfaces

USB, 2 ports. For keyboard, mouse, or peripherals. USB keyboard and USB mouse are available as option.


To remove USB devices from the B1505A, use “Safely Remove Hardware” on Windows taskbar. If it is not used, the B1505A may cause the internal USB communication error. If the error occurs, turn the B1505A off and disconnect the power cable from the B1505A. Leave it about 30 seconds before rebooting the B1505A, and connect the power cable again, and then turn the B1505A on.

11. Ext Trig terminals

Two BNC connectors, one for trigger input, and one for trigger output. For details about the trigger function, see *Programming Guide*.

12. Digital I/O terminal

DSUB 25 pin connector. Can be used for the trigger input/output terminals or an interface to control an external relay circuit and so on. For details, see *Programming Guide*. This connector is also used to connect Agilent N1258A module selector or N1259A test fixture.

 13. Interlock terminal

Used in conjunction with the interlock function of the B1505A. If the Interlock terminal is open, maximum SMU output is limited to ± 42 V. Be sure to connect this terminal to the interlock circuit of the N1259A test fixture or the prober station before performing measurement.

To verify the interlock function, perform the interlock open/close test on the Main Frame tab screen of the EasyEXPERT Configuration window.

WARNING

Dangerous voltage of up to the maximum voltage of SMUs may appear at force, guard, and sense terminals if the Interlock terminal is closed.

 A. GNDU/ADC

Ground unit and A/D converter module. Always installed in the B1505A.

 B. MFCMU module

The multi frequency capacitance measurement unit (MFCMU) has four coaxial connectors, Lcur, Lpot, Hpot, and Hcur, for the four-terminal pair connection. The Hcur and Hpot have to be connected together at a terminal of the device under test (DUT). Also the Lcur and Lpot have to be connected together at the other terminal of the DUT. Then, the guard lines of four-terminal pair must be connected together.

CAUTION

Do not apply voltage more than ± 25 V to the MFCMU input terminals. Failure to heed this caution may result in damage to the module.

 C. HPSMU, HCSMU, HVSMU module

These modules occupy two slots.

The high power source/monitor unit (HPSMU) has two triaxial connectors, force and sense, for the Kelvin connections.

The high current source/monitor unit (HCSMU) has the force coaxial connector and the sense triaxial connector, for the Kelvin connections.

The high voltage source/monitor unit (HVSMU) has the force connector.

In the EasyEXPERT operation mode, the SMUs can be specified by the SMU number. SMU1 is assigned to the SMU at the lowest position. And the following SMU numbers are assigned to the upper SMUs in sequence. Use the SMU number label furnished with the B1505A or equivalent to identify the SMU number.

WARNING

There are potentially hazardous voltages (± 3000 Vdc for HVSMU and ± 200 Vdc for HPSMU) present at the Force, Sense, and Guard terminals of Agilent B1505A. To prevent electrical shock, the following safety precautions must be observed during the use of the B1505A, N1259A, and N1258A.

1. Use a three-conductor AC power cable to connect the cabinet (if used) and the B1505A to an electrical ground (safety ground).
2. If you do *not* use the N1259A test fixture, you must install and connect an interlock circuit that opens the Interlock terminal when the shielding box access door is opened.
3. Confirm periodically that the interlock function works normally.
4. Before touching the connections on the Force, Guard, and Sense terminals, turn the B1505A off and discharge any capacitors. If you do *not* turn the B1505A off, complete *all* of the following items, regardless of the B1505A settings.
 - Press the Stop key to set the module output off.
 - Confirm that the High Voltage indicator is not lit.
 - Open the shielding box access door (open the Interlock terminal).
 - Discharge any capacitors connected to an SMU.
5. Warn persons working around the B1505A about dangerous conditions.

To avoid electrical shock and instrument damage, do not remove any cable from the module during operation.

Measurement Modules

Agilent B1505A can be equipped with the following measurement modules.

- “GNDU - Ground Unit”
- “HPSMU - High Power SMU”
- “HVSMU - High Voltage SMU”
- “HCSMU - High Current SMU”
- “MFCMU - Multi Frequency CMU”

See Agilent EasyEXPERT *User's Guide* for the functions available for Agilent EasyEXPERT software. See *Programming Guide* for the functions available for the GPIB remote mode.

NOTE

Do not put any conductor on the HCSMU Low Force and Low Sense terminals, outer conductor of the coaxial connectors. Putting conductor of circuit common, chassis ground, or any potential on causes the measurement error.

CAUTION

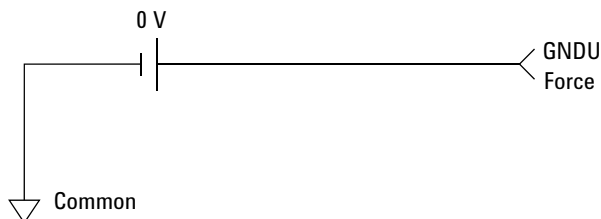
Never connect the HVSMU Force and Guard terminals to any output, including circuit common, chassis ground, or any other module terminal. Connecting other module may damage the connected module.

GNDU - Ground Unit

Agilent B1505A is equipped with the ground unit (GNDU). The GNDU is a 0 V constant voltage source, and used for the reference of measurement ground. Also the GNDU can sink up to ± 4.2 A, so it is effective for using the HPSMU (high power SMU). And when the HCSMU is used, the GNDU must be connected to the HCSMU Low side. Figure 2-1 is a simplified circuit diagram of GNDU.

Figure 2-1

Simplified GNDU Circuit Diagram



About SMU

Source/monitor unit (SMU) can apply DC voltage or current, and can measure DC current or voltage. Figure 2-2 is a simplified SMU circuit diagram. The SMU can perform the following operations:

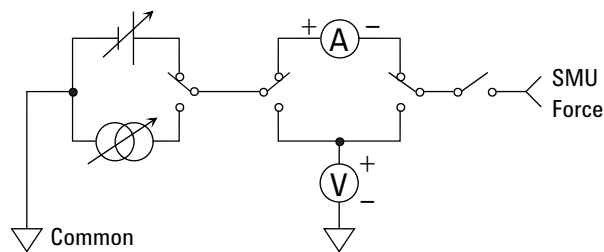
- Apply voltage and measures current
- Apply current and measures voltage
- Apply voltage and measures voltage
- Apply current and measures current

NOTE

To select the SMU operation mode in the GPIB remote condition, enter the CMM command.

Figure 2-2

Simplified SMU Circuit Diagram



Compliance

The SMU has a compliance feature that limits output voltage or current to prevent damage to the device under test. When the SMU applies voltage, you can specify current compliance. When the SMU applies current, you can specify voltage compliance. For details about the compliance, see *Agilent EasyEXPERT User's Guide*.

HPSMU - High Power SMU

This section describes typical specification of the high power source/monitor unit (HPSMU). Maximum four modules can be installed in one mainframe. The mainframe does not support the 4-HPSMU plus 1-HCSMU configuration and the 3-HPSMU plus 2-HCSMU configuration.

- Maximum voltage, current, output power: ± 200 V, ± 1 A, 20 W
- Minimum range: 2 V, 1 nA
- Output/measurement value and resolution: see Table 2-1 to Table 2-4.

Figure 2-3

HPSMU Output and Measurement Ranges

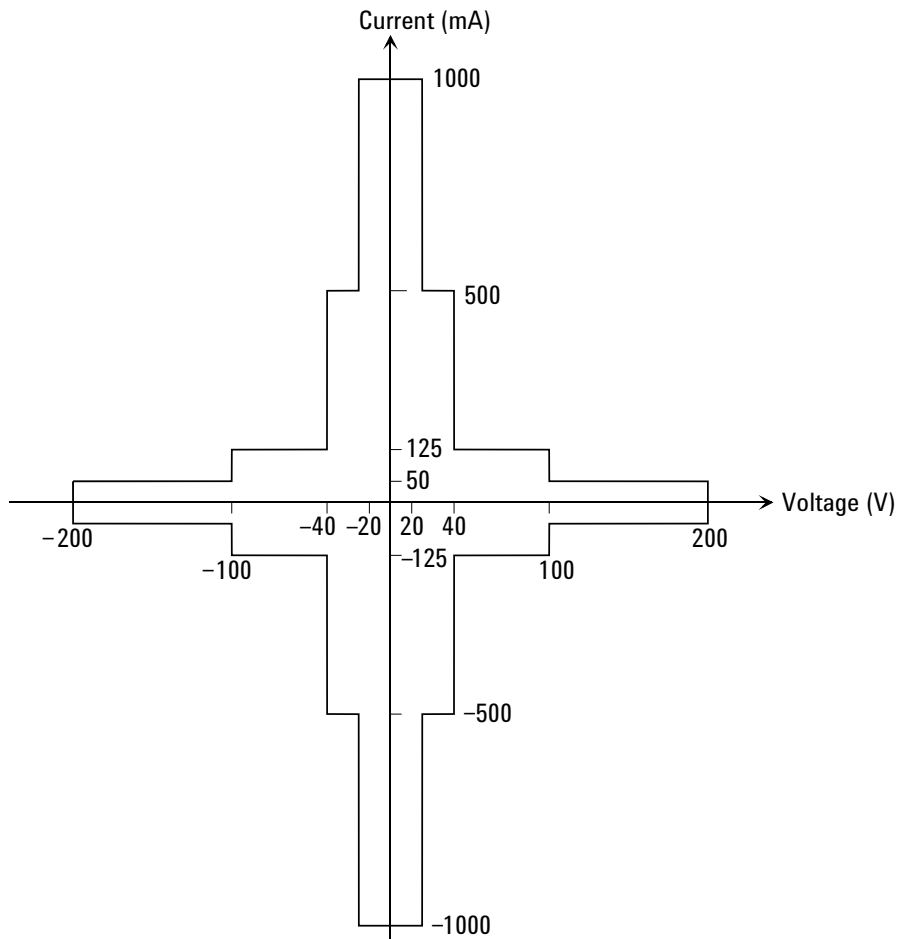


Table 2-1 HPSMU Output Voltage Ranges and Resolutions

Range	Output Value	Setting Resolution	Maximum Current
2 V	$0 \leq V \leq 2 \text{ V}$	100 μV	$\pm 1000 \text{ mA}$
20 V	$0 \leq V \leq 20 \text{ V}$	1 mV	$\pm 1000 \text{ mA}$
40 V	$0 \leq V \leq 40 \text{ V}$	2 mV	$\pm 500 \text{ mA}$
100 V	$0 \leq V \leq 100 \text{ V}$	5 mV	$\pm 125 \text{ mA}$
200 V	$0 \leq V \leq 200 \text{ V}$	10 mV	$\pm 50 \text{ mA}$

Table 2-2 HPSMU Output Current Ranges and Resolutions

Range	Output Value	Setting Resolution	Maximum Voltage
1 nA	$0 \leq I \leq 1.15 \text{ nA}$	50 fA	$\pm 200 \text{ V}$
10 nA	$0 \leq I \leq 11.5 \text{ nA}$	500 fA	$\pm 200 \text{ V}$
100 nA	$0 \leq I \leq 115 \text{ nA}$	5 pA	$\pm 200 \text{ V}$
1 μA	$0 \leq I \leq 1.15 \mu\text{A}$	50 pA	$\pm 200 \text{ V}$
10 μA	$0 \leq I \leq 11.5 \mu\text{A}$	500 pA	$\pm 200 \text{ V}$
100 μA	$0 \leq I \leq 115 \mu\text{A}$	5 nA	$\pm 200 \text{ V}$
1 mA	$0 \leq I \leq 1.15 \text{ mA}$	50 nA	$\pm 200 \text{ V}$
10 mA	$0 \leq I \leq 11.5 \text{ mA}$	500 nA	$\pm 200 \text{ V}$
100 mA	$0 \leq I \leq 50 \text{ mA}$	5 μA	$\pm 200 \text{ V}$
	$50 \text{ mA} < I \leq 115 \text{ mA}$	5 μA	$\pm 100 \text{ V}$
1 A	$0 \leq I \leq 50 \text{ mA}$	50 μA	$\pm 200 \text{ V}$
	$50 \text{ mA} < I \leq 125 \text{ mA}$	50 μA	$\pm 100 \text{ V}$
	$125 \text{ mA} < I \leq 500 \text{ mA}$	50 μA	$\pm 40 \text{ V}$
	$500 \text{ mA} < I \leq 1 \text{ A}$	50 μA	$\pm 20 \text{ V}$

Table 2-3 HPSMU Measurement Voltage Values and Resolutions

Range	Measurement Value ^a	Measurement Resolutions	
		High Speed ADC	High Resolution ADC
2 V	$0 \leq V \leq 2.2 \text{ V}$	100 μV	2 μV
20 V	$0 \leq V \leq 22 \text{ V}$	1 mV	20 μV
40 V	$0 \leq V \leq 44 \text{ V}$	2 mV	40 μV
100 V	$0 \leq V \leq 110 \text{ V}$	5 mV	100 μV
200 V	$0 \leq V \leq 200 \text{ V}$	10 mV	200 μV

Table 2-4 HPSMU Measurement Current Values and Resolutions

Range	Measurement Value ^a	Measurement Resolutions	
		High Speed ADC	High Resolution ADC
1 nA	$0 \leq I \leq 1.15 \text{ nA}$	50 fA	10 fA
10 nA	$0 \leq I \leq 11.5 \text{ nA}$	500 fA	10 fA
100 nA	$0 \leq I \leq 115 \text{ nA}$	5 pA	100 fA
1 μA	$0 \leq I \leq 1.15 \text{ }\mu\text{A}$	50 pA	1 pA
10 μA	$0 \leq I \leq 11.5 \text{ }\mu\text{A}$	500 pA	10 pA
100 μA	$0 \leq I \leq 115 \text{ }\mu\text{A}$	5 nA	100 pA
1 mA	$0 \leq I \leq 1.15 \text{ mA}$	50 nA	1 nA
10 mA	$0 \leq I \leq 11.5 \text{ mA}$	500 nA	10 nA
100 mA	$0 \leq I \leq 115 \text{ mA}$	5 μA	100 nA
1 A	$0 \leq I \leq 1 \text{ A}$	50 μA	1 μA

a. This column is applied to the auto ranging or the limited auto ranging. For fixed ranging, maximum measurement value is **Range** column value.

HCSMU - High Current SMU

This section describes typical specification of the high current source/monitor unit (HCSMU). Maximum two modules can be installed in one mainframe. Using two modules (DHCSMU, dual HCSMU) can expand the maximum current up to ± 40 A (pulse), ± 2 A (DC). The mainframe does not support the 4-HPSMU plus 1-HCSMU configuration and the 3-HPSMU plus 2-HCSMU configuration.

- Maximum current by one module: ± 20 A (pulse), ± 1 A (DC)
- Maximum voltage by one module: ± 40 V ($\leq \pm 1$ A), ± 20 V ($> \pm 1$ A, pulse)
- Maximum output power by one module: 40 W
- Minimum range: 0.2 V, 10 μ A
- Minimum pulse width: 50 μ s
- Output/measurement value and resolution: see Table 2-5 and Table 2-6.

NOTE

Do not put any conductor on the HCSMU Low Force and Low Sense terminals, outer conductor of the coaxial connectors. Putting conductor of circuit common, chassis ground, or any potential on causes the measurement error.

Figure 2-4

HCSMU Output and Measurement Ranges by One Module

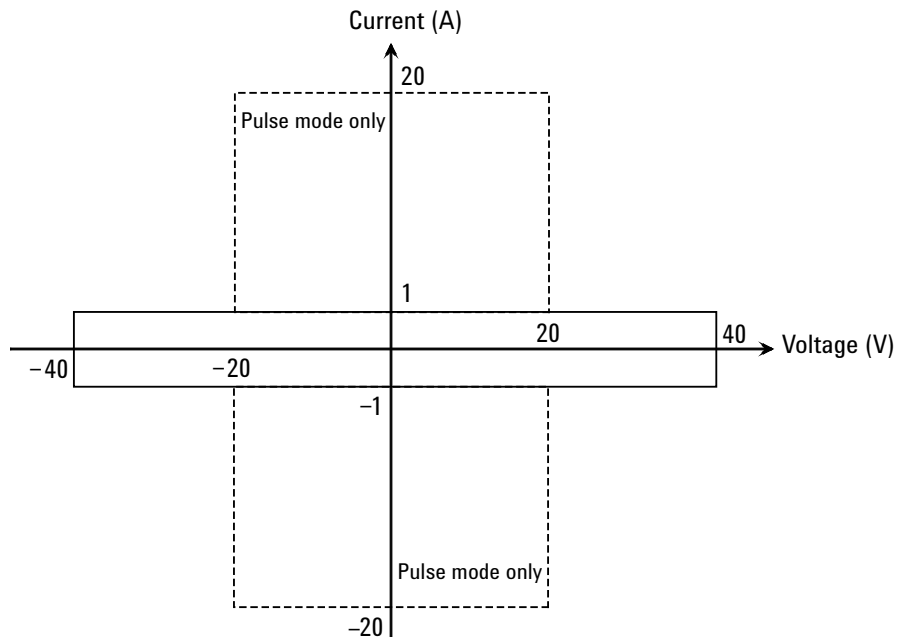


Table 2-5 HCSMU Voltage Ranges and Resolutions (HCSMU / Dual HCSMU)

Range	Output Value	Measurement Value	Setting/ Measurement Resolution	Maximum Current	Maximum Pulse Base Value
0.2 V	$0 \leq V \leq 0.2 \text{ V}$	$0 \leq V \leq 0.23 \text{ V}$	200 nV	$\pm 20 \text{ A} / \pm 40 \text{ A}$	$\pm 0.2 \text{ V}$
2 V	$0 \leq V \leq 2 \text{ V}$	$0 \leq V \leq 2.3 \text{ V}$	2 μV	$\pm 20 \text{ A} / \pm 40 \text{ A}$	$\pm 2 \text{ V}$
20 V	$0 \leq V \leq 20 \text{ V}$	$0 \leq V \leq 23 \text{ V}$	20 μV	$\pm 20 \text{ A} / \pm 40 \text{ A}$	$\pm 20 \text{ V}$
40 V	$0 \leq V \leq 40 \text{ V}$	$0 \leq V \leq 40 \text{ V}$	40 μV	$\pm 1 \text{ A} / \pm 2 \text{ A}$	$\pm 40 \text{ V}$

Table 2-6 HCSMU Current Ranges and Resolutions

Range	Output Value	Measurement Value	Setting/ Measurement Resolution	Maximum Voltage	Maximum Pulse Base Value
10 μA	$0 \leq I \leq 10 \mu\text{A}$	$0 \leq I \leq 11.5 \mu\text{A}$	10 pA	$\pm 40 \text{ V}$	$\pm 10 \mu\text{A}$
100 μA	$0 \leq I \leq 100 \mu\text{A}$	$0 \leq I \leq 115 \mu\text{A}$	100 pA	$\pm 40 \text{ V}$	$\pm 100 \mu\text{A}$
1 mA	$0 \leq I \leq 1 \text{ mA}$	$0 \leq I \leq 1.15 \text{ mA}$	1 nA	$\pm 40 \text{ V}$	$\pm 1 \text{ mA}$
10 mA	$0 \leq I \leq 10 \text{ mA}$	$0 \leq I \leq 11.5 \text{ mA}$	10 nA	$\pm 40 \text{ V}$	$\pm 10 \text{ mA}$
100 mA	$0 \leq I \leq 100 \text{ mA}$	$0 \leq I \leq 115 \text{ mA}$	100 nA	$\pm 40 \text{ V}$	$\pm 100 \text{ mA}$
1 A	$0 \leq I \leq 1 \text{ A}$	$0 \leq I \leq 1.15 \text{ A}$	1 μA	$\pm 40 \text{ V}$	$\pm 1 \text{ A}$
2 A	$0 \leq I \leq 2 \text{ A}$	$0 \leq I \leq 2.30 \text{ A}$	2 μA	$\pm 40 \text{ V}$	$\pm 2 \text{ A}$
20 A	$0 \leq I \leq 20 \text{ A}$	$0 \leq I \leq 20 \text{ A}$	20 μA	$\pm 20 \text{ V}$	$\pm 100 \text{ mA}$
40 A	$0 \leq I \leq 40 \text{ A}$	$0 \leq I \leq 40 \text{ A}$	40 μA	$\pm 20 \text{ V}$	$\pm 200 \text{ mA}$

NOTE 40 A range and 2 A range

The 40 A range and the 2 A range are available when two HCSMU modules are installed in the B1505A and connected to the 16493S-020 Dual HCSMU Kelvin combination adapter or the 16493S-021 Dual HCSMU combination adapter. Two HCSMU modules can be a SMU which supports $\pm 40 \text{ A}$ (pulse), $\pm 2 \text{ A}$ (DC). Then the 20 A range is not supported.

When the compliance value is set to $> 1 \text{ A}$ or $< -1 \text{ A}$, the current measurement range is fixed to the compliance range.

HVSMU - High Voltage SMU

This section describes typical specification of the high voltage source/monitor unit (HVSMU). Only one module can be installed in one mainframe.

- Maximum voltage/current: 3000 V/4 mA, -3000 V/-4 mA, 1500 V/8 mA, or -1500 V/-8 mA
- Maximum output power: 12 W
- Minimum range: 200 V, 1 nA
- Output/measurement value and resolution: see Table 2-7 and Table 2-8.

CAUTION

Never connect the HVSMU Force and Guard terminals to any output, including circuit common, chassis ground, or any other module terminal. Connecting other module may damage the connected module.

Figure 2-5 HVSMU Output and Measurement Ranges

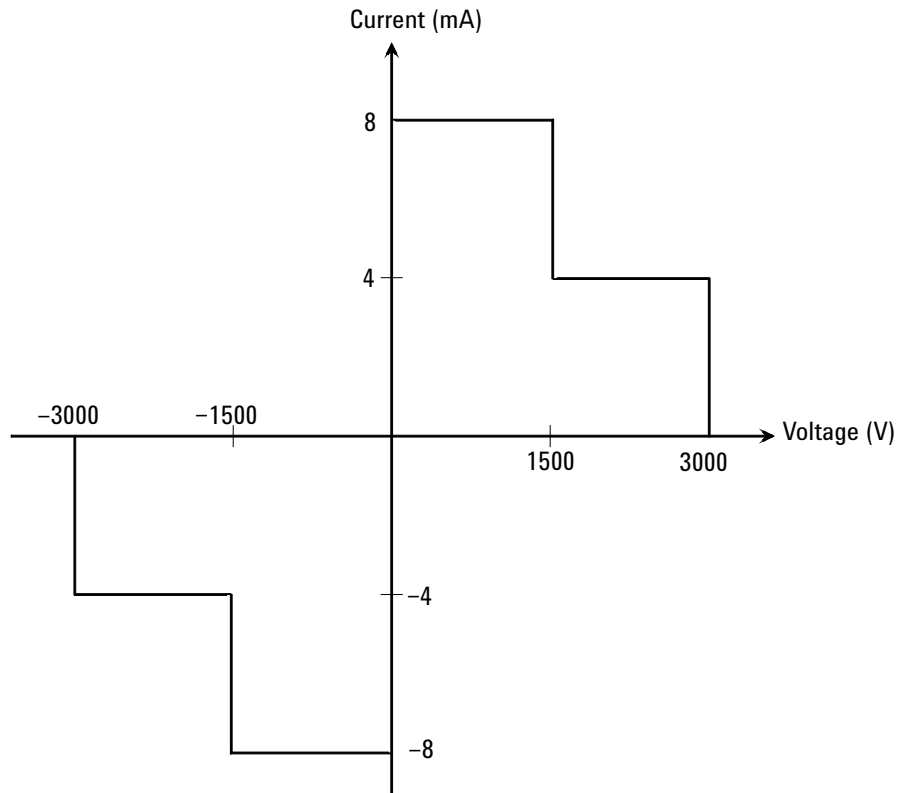


Table 2-7 HVSMU Voltage Ranges and Resolutions

Range	Output Value	Measurement Value	Setting/ Measurement Resolution	Maximum Current
200 V	$0 \leq V \leq 200 \text{ V}$	$0 \leq V \leq 230 \text{ V}$	200 μV	8 mA
500 V	$0 \leq V \leq 500 \text{ V}$	$0 \leq V \leq 575 \text{ V}$	500 μV	8 mA
1500 V	$0 \leq V \leq 1500 \text{ V}$	$0 \leq V \leq 1575 \text{ V}$	1.5 mV	8 mA
3000 V	$0 \leq V \leq 3000 \text{ V}$	$0 \leq V \leq 3000 \text{ V}$	3 mV	4 mA

Table 2-8 HVSMU Current Ranges and Resolutions

Range	Output Value	Measurement Value	Setting/ Measurement Resolution	Maximum Voltage
1 nA	$0 \leq I \leq 1 \text{ nA}$	$0 \leq I \leq 1.15 \text{ nA}$	10 fA	3000 V
10 nA	$0 \leq I \leq 10 \text{ nA}$	$0 \leq I \leq 11.5 \text{ nA}$	100 fA	3000 V
100 nA	$0 \leq I \leq 100 \text{ nA}$	$0 \leq I \leq 115 \text{ nA}$	100 fA	3000 V
1 μA	$0 \leq I \leq 1 \mu\text{A}$	$0 \leq I \leq 1.15 \mu\text{A}$	1 pA	3000 V
10 μA	$0 \leq I \leq 10 \mu\text{A}$	$0 \leq I \leq 11.5 \mu\text{A}$	10 pA	3000 V
100 μA	$0 \leq I \leq 100 \mu\text{A}$	$0 \leq I \leq 115 \mu\text{A}$	100 pA	3000 V
1 mA	$0 \leq I \leq 1 \text{ mA}$	$0 \leq I \leq 1.15 \text{ mA}$	1 nA	3000 V
10 mA	$0 \leq I \leq 8 \text{ mA}$	$0 \leq I \leq 8 \text{ mA}$	10 nA	1500 V

MFCMU - Multi Frequency CMU

This section describes typical specification of the multi frequency capacitance measurement unit (CMU) for Agilent B1505A. The CMU performs the impedance measurement and returns the specified measurement data such as Cp-G. Only one module can be installed in one mainframe.

- Measurement parameters: See Table 2-9.
- AC signal, output frequency:
1 kHz to 5 MHz
Setting resolution: 1 mHz (1 kHz to), 10 mHz (10 kHz to), 0.1 Hz (100 kHz to), or 1 Hz (1 MHz to 5 MHz)
- AC signal, output level:
10 mVrms to 250 mVrms, 1 mV resolution
- DC bias:
0 to ± 25 V, using MFCMU internal DC bias
0 to ± 3000 V, using HVSMU and high voltage bias-T
- Measurement range:
For the fixed ranging mode, measurement range (impedance range) must be specified to perform measurement. Table 2-10 shows the available measurement ranges and the corresponding impedance value. And Figure 2-6 shows the calculation example of the impedance vs frequency characteristics of a capacitive load. Use these information to decide the measurement range.

Impedance Z is calculated by the following formula.

$$Z = 1 / (2\pi f C)$$

where f is frequency (Hz) and C is capacitance (F).

Table 2-9

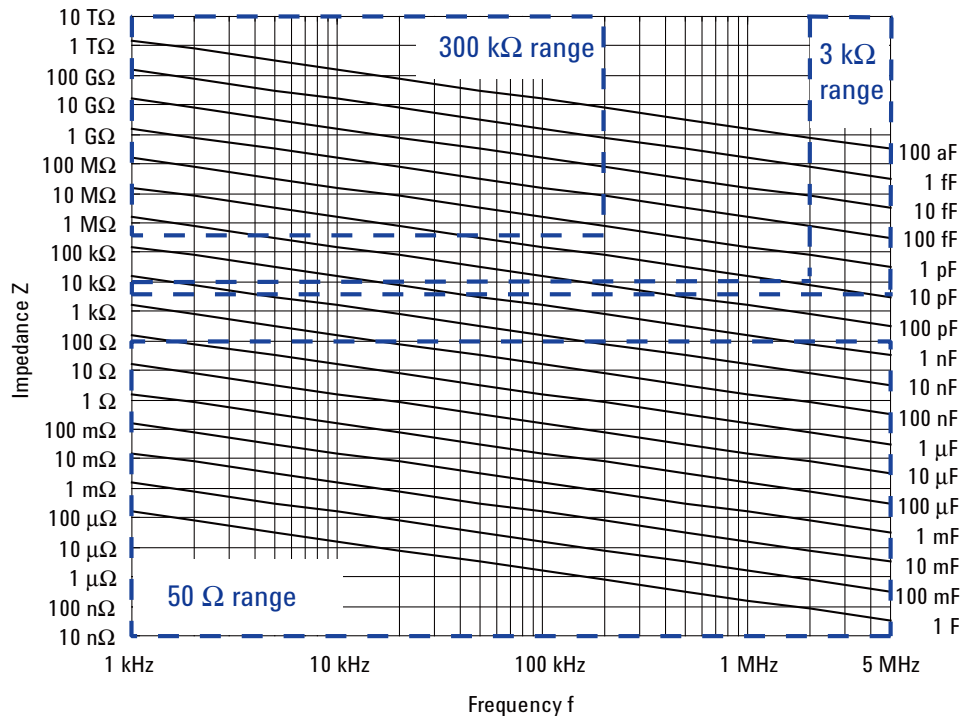
Measurement Parameters

Primary Parameter	Secondary Parameter
R (resistance, Ω)	X (reactance, Ω)
G (conductance, S)	B (susceptance, S)
Z (impedance, Ω)	θ (phase, radian)
Z (impedance, Ω)	θ (phase, degree)
Y (admittance, S)	θ (phase, radian)
Y (admittance, S)	θ (phase, degree)
Cp (parallel capacitance, F)	G (conductance, S)
Cp (parallel capacitance, F)	D (dissipation factor)
Cp (parallel capacitance, F)	Q (quality factor)
Cp (parallel capacitance, F)	Rp (parallel resistance, Ω)
Cs (series capacitance, F)	Rs (series resistance, Ω)
Cs (series capacitance, F)	D (dissipation factor)
Cs (series capacitance, F)	Q (quality factor)
Lp (parallel inductance, H)	G (conductance, S)
Lp (parallel inductance, H)	D (dissipation factor)
Lp (parallel inductance, H)	Q (quality factor)
Lp (parallel inductance, H)	Rp (parallel resistance, Ω)
Ls (series inductance, H)	Rs (series resistance, Ω)
Ls (series inductance, H)	D (dissipation factor)
Ls (series inductance, H)	Q (quality factor)

Table 2-10 Measurement Range for Fixed Ranging Mode

Impedance Z	Measurement range (impedance range)		
	$1 \text{ kHz} \leq f \leq 200 \text{ kHz}$	$200 \text{ kHz} < f \leq 2 \text{ MHz}$	$2 \text{ MHz} < f \leq 5 \text{ MHz}$
$0 \leq Z < 100 \Omega$	50 Ω	50 Ω	50 Ω
$100 \Omega \leq Z < 300 \Omega$	100 Ω	100 Ω	100 Ω
$300 \Omega \leq Z < 1 \text{ k}\Omega$	300 Ω	300 Ω	300 Ω
$1 \text{ k}\Omega \leq Z < 3 \text{ k}\Omega$	1 $\text{k}\Omega$	1 $\text{k}\Omega$	1 $\text{k}\Omega$
$3 \text{ k}\Omega \leq Z < 10 \text{ k}\Omega$	3 $\text{k}\Omega$	3 $\text{k}\Omega$	3 $\text{k}\Omega$
$10 \text{ k}\Omega \leq Z < 30 \text{ k}\Omega$	10 $\text{k}\Omega$	10 $\text{k}\Omega$	
$30 \text{ k}\Omega \leq Z < 100 \text{ k}\Omega$	30 $\text{k}\Omega$	30 $\text{k}\Omega$	
$100 \text{ k}\Omega \leq Z < 300 \text{ k}\Omega$	100 $\text{k}\Omega$		
$300 \text{ k}\Omega \leq Z$	300 $\text{k}\Omega$		

Figure 2-6 Impedance vs Frequency Characteristics of Capacitive Load, Calculation Example



Accessories

The following accessories are available for Agilent B1505A.

- “N1258A Module Selector”
- “N1259A Test Fixture”
- “N1260A High Voltage Bias-T”
- “N1261A Protection Adapter”
- “N1262A R-Box”
- “16493S-010/011 HCSMU Adapter”
- “16493S-020/021 Dual HCSMU Adapter”

N1258A Module Selector

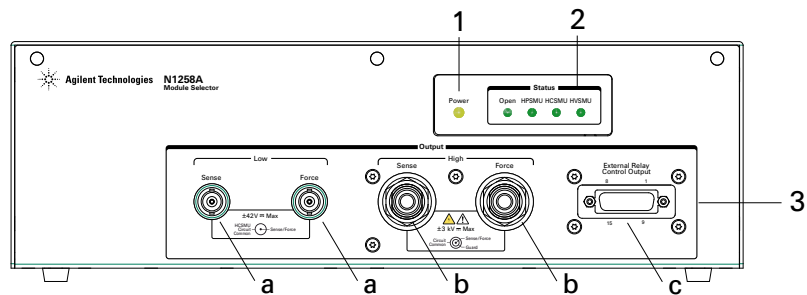
Module selector is used to switch the measurement resource connected to the device under test (DUT) automatically. The measurement resource will be GNDU, HPSMU, HVSMU, HCSMU, or dual HCSMU (DHCSMU). One selector provides one switching channel. Also the selector installs the GNDU protection adapter and the HPSMU protection adapter. The N1258A is used with a DUT interface such as your own test fixture and prober station, not the N1259A fixture.

Table 2-11

Status Indicator and Connection Path

Status indicator	Module Selector Output			
	High Sense	High Force	Low Sense	Low Force
Open	Open	Open	HCSMU Low Sense + GNDU Force + GNDU Sense	HCSMU Low Force
HPSMU	HPSMU Sense	HPSMU Force		
HCSMU	HCSMU High Sense	HCSMU High Force		
HVSMU	HVSMU Force	Open		
	HVSMU Force + Series resistor			

Front Panel



1. Power indicator

This LED turns yellow when the AC power is applied to the module selector.

This LED turns green when the module selector is ready to use.

2. Status indicator

A green LED lights to indicate the present connection path of the module selector. See Table 2-11 for the status indicator and the connection path.

3. Output

a. Low Force and Sense output connectors

BNC connectors. See Table 2-11 for the status indicator and the connection path.

Force and Sense must be extended to and connected together at a low terminal of a device under test (DUT) via the DUT interface. Then use high voltage cable with BNC(m) connector, manipulators, and such.



b. High Force and Sense output connectors

HV(jack) connectors. See Table 2-11 for the status indicator and the connection path.

Force and Sense must be extended to and connected together at a high terminal of the DUT via the DUT interface. Then use high voltage cable with HV(plug) connector, manipulators, and such.

Guard must be opened but should be extended as close as possible to the device terminal for reducing the leakage current of the extension cable.

WARNING

To avoid electrical shock and instrument damage, do not connect or disconnect measurement cable during operation. Hazardous voltage, SMU maximum output voltage may appear at the Force, Guard, and Sense terminals.

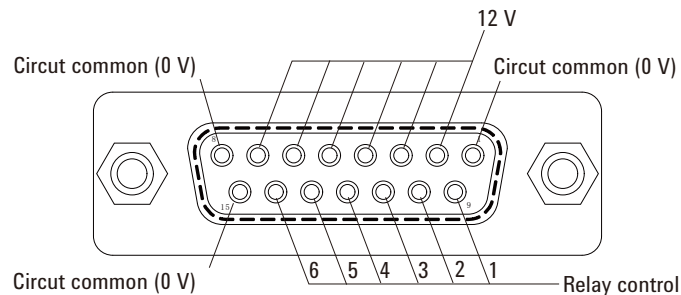
c. External Relay Control Output connector

D-sub 15 pin connector. See Figure 2-7 for pin assignment. Relay control 1 to 6 are used to control an external relay and controlled by using the FLEX command. See *Programming Guide* for the FLEX command.

Relay control signal level: 0 V or 12 V, normally 0 V (circuit common)

Figure 2-7

External Relay Control Output Connector



Rear Panel



1. Input

WARNING

To avoid electrical shock and instrument damage, do not connect or disconnect measurement cable or connector cap during operation.

The connector cap must be connected to the unused input connectors.

NOTE

Do not put any conductor on the HCSMU Low Force and Low Sense terminals, outer conductor of the coaxial connectors. Putting conductor of circuit common, chassis ground, or any potential on causes the measurement error.

a. Digital I/O connector

For connecting 16493G cable from the Digital I/O connector of B1505A.

b. HCSMU input connectors

Force BNC connector and Sense triaxial connector. For connecting 16493S HCSMU cable or 16493S-021 Dual HCSMU combination adapter from the high current source/monitor unit installed in B1505A. Maximum current must be ± 30 A to prevent the module selector from performance degradation and failure.

c. HPSMU input connectors

Force and Sense triaxial connectors. For connecting 16493K Kelvin triaxial cable or 16494A triaxial cable from the high power source/monitor unit installed in B1505A.

d. GNDU input connector




GNDU triaxial connector. For connecting 16493L GNDU cable from the ground unit installed in B1505A.

e. HVSMU input connector

HV(jack) connector. For connecting 16493T HVSMU cable from the high voltage source/monitor unit installed in B1505A.

2. LINE input receptacle

AC power cable is connected to this receptacle.

 3. Circuit Common () and frame ground () terminals

Normally, connect the terminals together by using the shorting bar.

Removing the shorting bar may be effective for reducing external noise caused by the ground loop. Then do not break the connection between the B1505A's Circuit Common and the prober station's frame ground.

WARNING

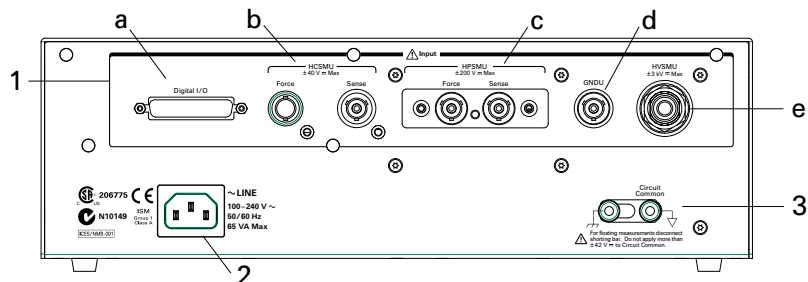
If the Circuit Common terminal is *not* connected to the frame ground terminal (for floating measurement), a potential shock hazard may present. Do not touch any of measurement circuit at any time while a floating measurement is in progress.

CAUTION

For floating measurement, do not apply voltage more than ± 42 V to the Circuit Common terminal. Failure to heed this caution may result in damage to the N1258A.

NOTE

Module selector may emit a noise sound during operation. However it is not abnormal status.



N1259A Test Fixture

Test fixture is used for measurements of packaged devices. The N1259A can be connected to GNDU, MFCMU, HPSMU, HVSMU, and HCSMU or dual HCSMU (DHCSMU). And the fixture initially installs the GNDU protection adapter and the HPSMU protection adapter. Also the fixture can install the module selector for switching the measurement resource connected to the DUT, the high voltage R-box for reducing the risk of device breakdown, and the high voltage bias-T for performing the high voltage capacitance measurement.

Front Panel

1. Power indicator

This LED turns yellow when the AC power is applied to the test fixture.

This LED turns green when the test fixture is ready to use.

2. Status indicator

A green LED lights to indicate the present connection path of the module selector. See Table 2-12 for the status indicator and the connection path.



3. Hazardous voltage status indicator

This red LED lights when a source channel applies greater than ± 42 V. This indicator is connected to the B1505A via the Interlock connector and works with the High Voltage indicator on the B1505A's front panel.

Warning labels written in French, German, and Japanese are furnished. Attach the label to the front panel of the fixture if you need.

WARNING

The red light indicates that hazardous voltage (maximum ± 3000 Vdc) may appear at measurement terminals. Check this indicator before accessing.

4. Fixture cover

The fixture cover should be closed to avoid electrical shock by touching measurement terminals and to prevent a device under test from external noise.

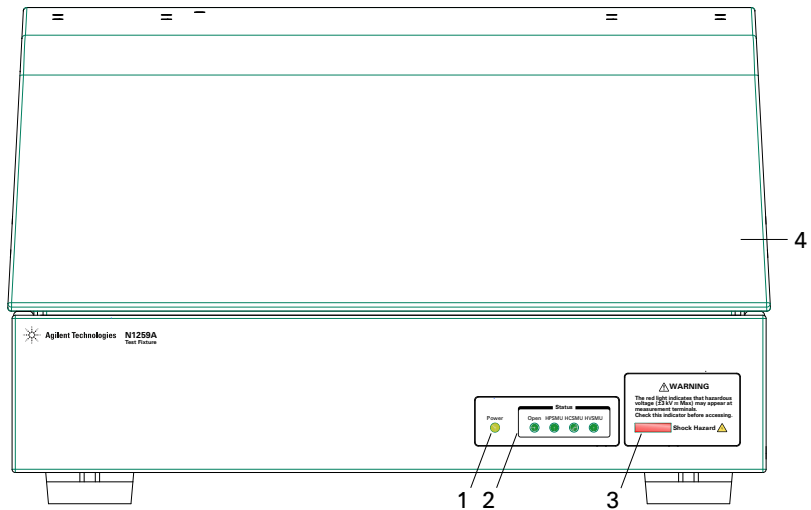
When the fixture cover is open, maximum SMU output is limited to ± 42 V.

WARNING

Hazardous voltage, SMU maximum output voltage may appear at the Force, Guard, and Sense terminals if the fixture cover is closed.

WARNING

Make sure that the cover is closed properly before starting measurement. Do not perform the measurement when a wire is protruding from the fixture cover.



Rear Panel

⚠ 1. Input

WARNING

To avoid electrical shock and instrument damage, do not connect or disconnect measurement cable or connector cap during operation.

The connector cap must be connected to the unused input connectors.

- AUX1 and AUX2 input connectors
BNC connectors. For connecting MFCMU or external instruments.
- HPSMU1 and HPSMU2 input connectors
Force and Sense triaxial connectors. For connecting 16493K Kelvin triaxial cable or 16494A triaxial cable from the high power source/monitor unit installed in B1505A.
- HVSMU1 input connector
HV(jack) connector. For connecting 16493T HVSMU cable from the high voltage source/monitor unit installed in B1505A.
- GNDU1 input connector
GNDU triaxial connector. For connecting 16493L GNDU cable from the ground unit installed in B1505A.

Introduction

Accessories

- HCSMU1 and HCSMU2 input connectors

Force BNC connector and Sense triaxial connector. For connecting 16493S HCSMU cable or 16493S-021 Dual HCSMU combination adapter from the high current source/monitor unit installed in B1505A.

2. Interlock connector

Interlock connector. For connecting 16493J interlock cable from B1505A.

3. MF CMU Input connectors Hcur, Hpot, Lpot, and Lcur (N1259A-020)

BNC connectors. For connecting N1300A cable from the multi frequency capacitance measurement unit installed in B1505A.



4. Module Selector Input (N1259A-300)

WARNING

To avoid electrical shock and instrument damage, do not connect or disconnect measurement cable or connector cap during operation.

The connector cap must be connected to the unused input connectors.

- HPSMU3 input connectors

Force and Sense triaxial connectors. For connecting 16493K Kelvin triaxial cable or 16494A triaxial cable from the high power source/monitor unit installed in B1505A.

- HVSMU2 input connector

HV(jack) connector. For connecting 16493T HVSMU cable from the high voltage source/monitor unit installed in B1505A.

- GNDU2 input connector

GNDU triaxial connector. For connecting 16493L GNDU cable from the ground unit installed in B1505A.

- HCSMU3 input connectors

Force BNC connector and Sense triaxial connector. For connecting 16493S HCSMU cable or 16493S-021 Dual HCSMU combination adapter from the high current source/monitor unit installed in B1505A. Maximum current must be ± 30 A to prevent the module selector from performance degradation and failure.

NOTE

Do not put any conductor on the HCSMU Low Force and Low Sense terminals, outer conductor of the coaxial connectors. Putting conductor of circuit common, chassis ground, or any potential on causes the measurement error.

5. Digital I/O connector (N1259A-300)

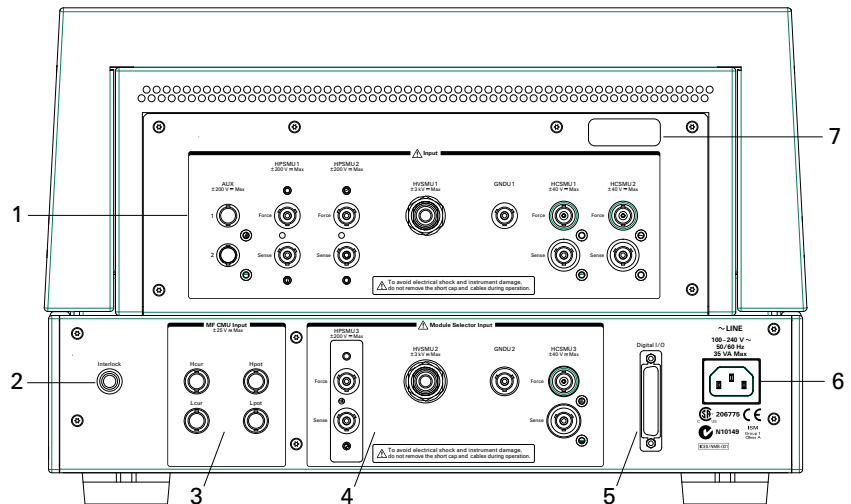
For connecting 16493G cable from the Digital I/O connector of B1505A.

6. LINE input receptacle (N1259A-300)

AC power cable is connected to this receptacle.

7. Serial number

You need this *serial number* when using Agilent Technologies telephone assistance program.



Output Terminal Panel

1. HCSMU1 and HCSMU2

Output terminals internally connected to the HCSMU1 and HCSMU2 input connectors. High Force and Sense terminals and Low Force and Sense terminals for each HCSMU.

High Force and Sense must be connected to the high terminal of a device under test (DUT).

Low Force and GNDU Force must be connected to the same terminal, and Low Sense and GNDU Sense must be connected to the same terminal. And they must be connected to the low terminal of the DUT.

 2. HPSMU1 and HPSMU2

Output terminals internally connected to the HPSMU1 and HPSMU2 input connectors. Force, Sense, and Guard terminals for each HPSMU.

Force must be connected to a terminal of a DUT.

Guard must be opened. You may extend it as close as possible to a DUT terminal for reducing the leakage current of the extension cable.

Force and Sense should be connected together at the device end for making the Kelvin connection effective for low resistance and high current measurements.

WARNING

Hazardous voltage, maximum ± 200 Vdc, may appear at the Force, Guard, and Sense terminals if the fixture cover is closed.



3. HVSMU1

Output terminals internally connected to the HVSMU1 input connector. Force and Guard terminals.

Force must be connected to a terminal of a DUT.

Guard must be opened. You may extend it as close as possible to a DUT terminal for reducing the leakage current of the extension cable.

CAUTION

Never connect the HVSMU Force and Guard terminals to any output, including circuit common, chassis ground, or any other module terminal. Connecting other module may damage the connected module.

WARNING

Hazardous voltage, maximum ± 3000 Vdc, may appear at the Force and Guard terminals if the fixture cover is closed.

4. GNDU1

Output terminals internally connected to the GNDU1 input connector. Force and Sense terminals. Force and Sense must be connected together at the device end.

For using the HCSMU, the GNDU1 Force and Sense terminals and the HCSMU1 or HCSMU2 Low Force and Sense terminals must be connected together at the device end.



5. AUX1 and AUX2

Output terminals internally connected to the AUX1 and AUX2 input connectors. Signal and frame ground terminals for each AUX. Signal must be connected to a terminal of a DUT.

Frame ground may be connected to the ground terminal of the DUT.

WARNING

Hazardous voltage, maximum ± 200 Vdc, may appear at the Signal terminal if the fixture cover is closed.

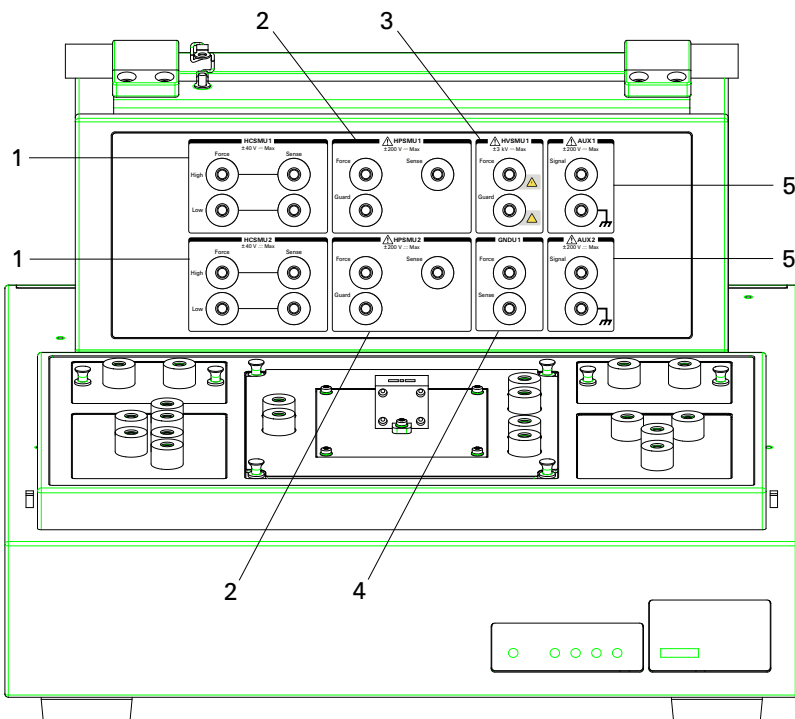


Table 2-12

Status Indicator and Module Selector Connection Path

Status indicator	Module Selector Output			
	High Sense	High Force	Low Sense	Low Force
Open	Open	Open	HCSMU3 Low Sense + GNDU2 Force + GNDU2 Sense	HCSMU3 Low Force
HPSMU	HPSMU3 Sense	HPSMU3 Force		
HCSMU	HCSMU3 High Sense	HCSMU3 High Force		
HVSMU	HVSMU2 Force	Open		
	HVSMU2 Force + Series resistor			

Socket Panel

- ⚠ 1. Module Selector Output (N1259A-300)
 - a. Low Force and Sense output terminals
See Table 2-12 for the status indicator and the connection path.
Force and Sense must be connected together at the low terminal of a DUT.
 - b. High Force, Sense, and Guard output terminals
See Table 2-12 for the status indicator and the connection path.
Force and Sense must be connected together at the high terminal of a DUT.
Guard must be opened. You may extend it as close as possible to a DUT terminal for reducing the leakage current of the extension cable.

NOTE

Module selector may emit a noise sound during operation. However it is not abnormal status.

WARNING

To avoid electrical shock and instrument damage, do not connect or disconnect measurement cable during operation. Hazardous voltage, SMU maximum output voltage may appear at the Force, Guard, and Sense terminals if the fixture cover is closed.

- ⚠ 2. 100 k Ω series resistor (N1259A-022)
For reducing damage of DUT or preventing SMU from oscillation. The resistor is internally connected between the terminals 1 and 2. Connect the resistor between a source output terminal and a terminal of the DUT.
- ⚠ 3. 1 M Ω series resistor (N1259A-021)
For reducing damage of DUT or preventing SMU from oscillation. The resistor is internally connected between the terminals 1 and 2. Connect the resistor between a source output terminal and a terminal of the DUT.
- ⚠ 4. 1 k Ω series resistor (N1259A-030)
For reducing damage of DUT or preventing SMU from oscillation. Used to the gate terminal. The resistor is internally connected between the terminals 1 and 2. Connect the resistor between a source output terminal and a terminal of the DUT.

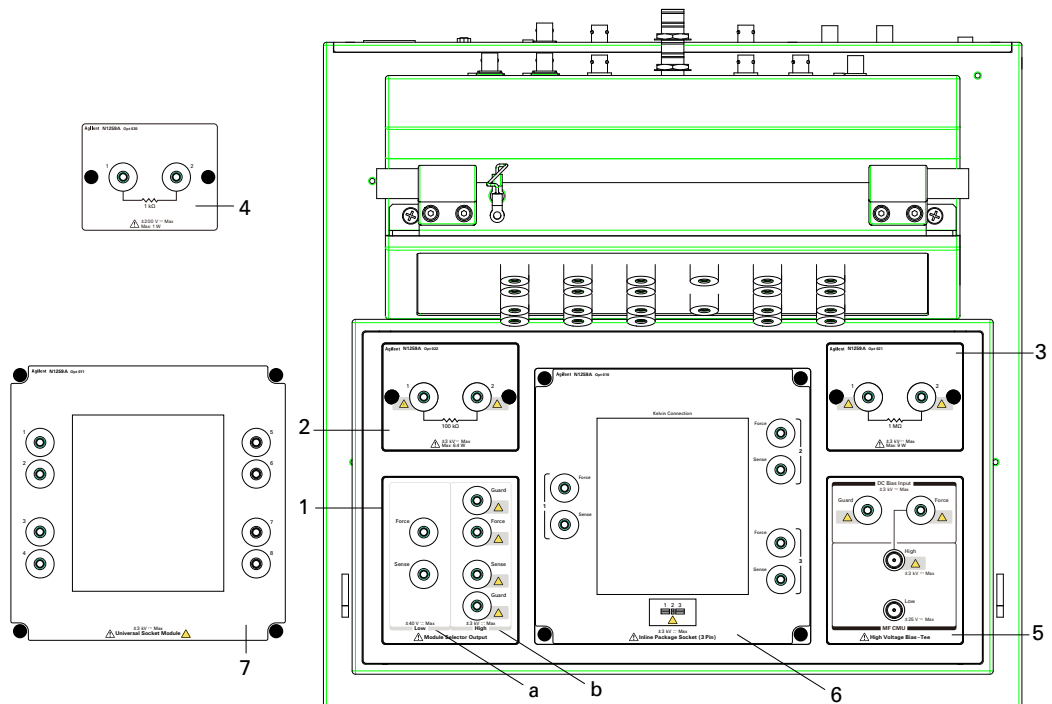
 5. High Voltage Bias-Tee (N1259A-020)

MF CMU High and Low terminals are internally connected to the MF CMU Input connectors. High and Low must be connected to the high and low terminals of a DUT respectively. Use SHV(plug)-SHV(plug) test lead (N1254A-512) and SHV(jack)-banana adapter (N1254A-513) for connection.

To get DC bias, connect the DC Bias Input Force and Guard terminals to the Force and Guard terminals of HVSMU or HPSMU. Use connection wire (N1254A-508 or 509) for connection.

NOTE

SMU is used for the DC bias source. MFCMU built-in DC bias source cannot be used.



 6. Inline Package Socket module (N1259A-010)

This module provides a socket used for connecting three-terminal inline packaged device and three couples of the Force and Sense terminals. Terminals 1, 2, and 3 of the socket are internally connected to the associated couple of the Force and Sense terminals.

Short bar is furnished with the module. It is used for performing the short correction before the impedance measurement. Set the short bar before the short correction and remove it after the correction.

To use this module, see the following simple instruction. For the component locations and dimensions, see Figure 2-8.

- a. Attach the socket module to the test fixture.
- b. Connect wires (N1254A-508 or 509) between the socket module terminals and the fixture output terminals.

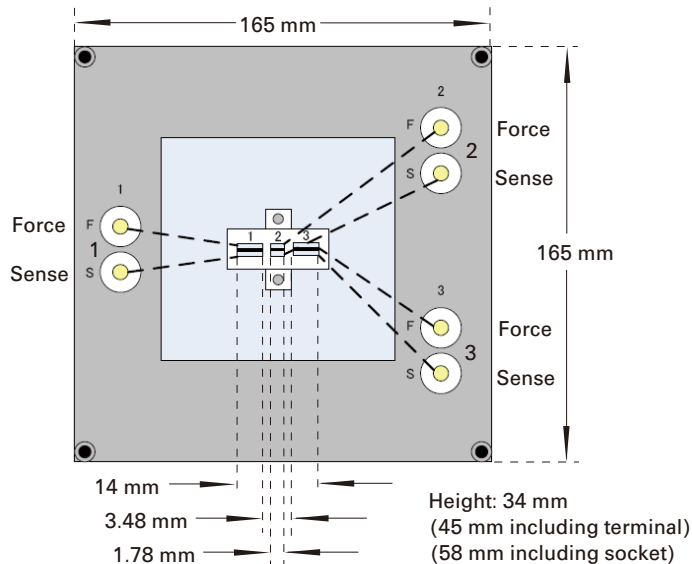
To make the connection easy, connect Force only.

For making the Kelvin connection, Force and Sense must be connected to Force and Sense of the socket module respectively.

If HCSMU or DHCSMU is used, High Force and Sense must be connected to Force and Sense used for the high terminal of a device under test (DUT), respectively. Low Force and GNDU Force must be connected to Force used for the low terminal of the DUT, and Low Sense and GNDU Sense must be connected to Sense used for the low terminal of the DUT.

- c. Set the DUT on the socket.
- d. Close the fixture cover and perform measurement.

Figure 2-8 **Inline Package Socket Module**



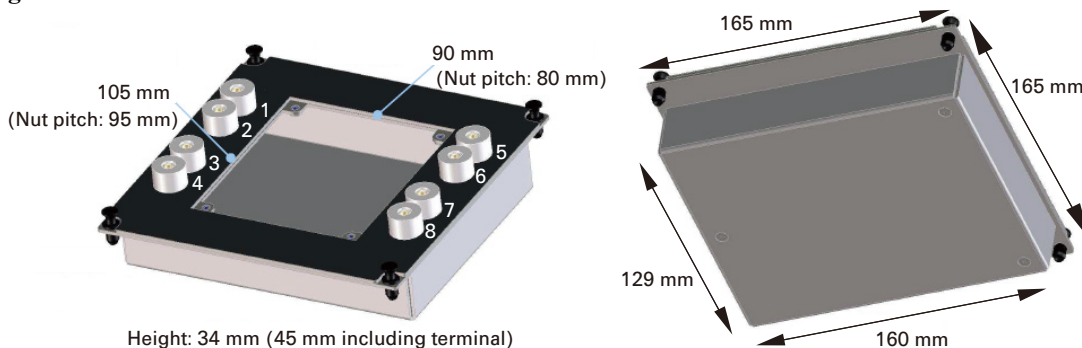
 7. Universal Socket Module (N1259A-011)

This is a blank module, kind of a do-it-yourself kit for supporting variety of packaged devices. This module can be used by mounting your desired socket or packaged device and making connections same as the N1259A-010 Inline Package Socket Module.

To use this module, see the following simple instruction. For the component locations and dimensions, see Figure 2-9. Also see “Inline Package Socket module (N1259A-010)” on page 2-37 to perform measurement.

- a. Prepare the following parts.
 - blank board suitable for mounting the socket or packaged device
 - screw M3, 4 ea., for fixing the blank board on the socket module
 - wire, adequate length and quantity, for making connections
 - socket, if you use
 - packaged device under test (DUT)
- b. Cut the blank board in 105 mm × 90 mm square.
- c. Make four screw holes on the board. The holes should be 5 mm inside from the edge.
- d. Fix the board to the blank module.
- e. Remove the cover bottom of the blank module.
- f. Mount the socket or DUT on the board and solder wire between its terminals and the blank module terminals 1 to 8.
- g. Replace the cover.

Figure 2-9 Universal Socket Module



[Introduction](#)
[Accessories](#)

8. Blank Teflon Board (N1259A-012)

This is an insulation board used for placing a DUT.

To use this board, see the following simple instruction.

- a. Prepare a DUT, wire (N1254A-508 or 509), and dolphin clip adapter (N1254A-510) or cable lag adapter (N1254A-511).
- b. Attach the blank teflon board to the test fixture.
- c. Connect adapters directly to the DUT and put it on the blank Teflon board.
- d. Connect wires between the adapters and the fixture output terminals.

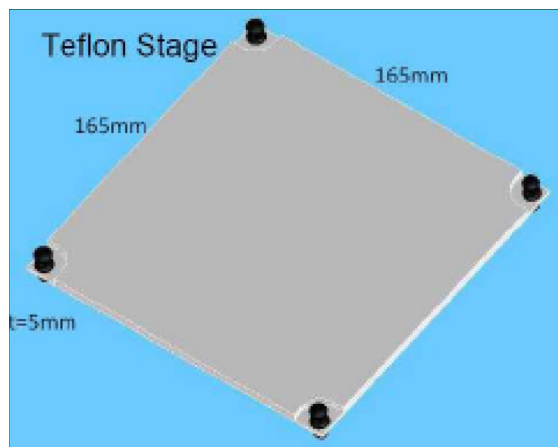
To make the connection easy, connect Force only.

For making the Kelvin connection, Force and Sense must be connected together at the device terminal.

If HCSCMU or DHSCMU is used, High Force and Sense must be connected to the high terminal of a device under test (DUT). Low Force and GNDU Force must be connected to the same terminal, and Low Sense and GNDU Sense must be connected to the same terminal. And they must be connected to the low terminal of the DUT.

- e. Make sure the DUT location. The DUT must be placed on the blank Teflon board properly.
- f. Close the fixture cover and perform measurement.

Figure 2-10 Blank Teflon Board



9. Curve Tracer Test Adapter Socket Module (N1259A-013)

This module provides a socket available for connecting a test adapter designed for Tektronix 370B/371B curve tracers and three couples of the Force and Sense terminals, Collector/Drain, Emitter/Source, and Base/Gate. Terminals 1 to 6 of the socket are internally connected to the Force and Sense terminals as shown in Figure 2-11.

To use this module, see the following simple instruction.

- a. Attach the socket module to the test fixture.
- b. Connect your test adapter to the socket.
- c. Connect wires (N1254A-508 or 509) between the socket module terminals and the fixture output terminals.

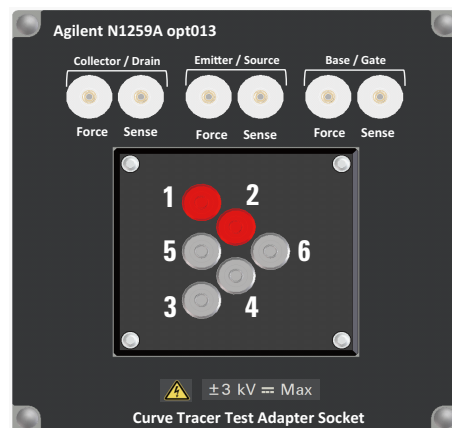
To make the connection easy, connect Force only.

For making the Kelvin connection, Force and Sense must be connected to Force and Sense of the socket module respectively.

If HCSMU or DHCSMU is used, High Force and Sense must be connected to Force and Sense used for the high terminal of a device under test (DUT), respectively. Low Force and GNDU Force must be connected to Force used for the low terminal of the DUT, and Low Sense and GNDU Sense must be connected to Sense used for the low terminal of the DUT.

- d. Set the DUT on your test adapter.
- e. Close the fixture cover and perform measurement.

Figure 2-11 Curve Tracer Test Adapter Socket Module



- Internal connection
- 1: Collector/Drain Force
 - 2: Collector/Drain Source
 - 3: Emitter/Source Force
 - 4: Emitter/Source Source
 - 5: Base/Gate Force
 - 6: Base/Gate Source

N1260A High Voltage Bias-T

High voltage bias-T is used to perform the high voltage C-V measurement. The C-V measurement up to 3000 Vdc can be realized by using the bias-T, MFCMU, and HVSMU. The N1260A is used with a DUT interface such as your own test fixture and prober station, not the N1259A test fixture.

NOTE

HVSMU is used for the DC bias source. MFCMU built-in DC bias source cannot be used.

WARNING



To avoid electrical shock and instrument damage, do not connect or disconnect measurement cable during operation.

- From HVSMU
HV(jack) connector. For connecting 16493T HVSMU cable from the high voltage source/monitor unit installed in B1505A.
- From MFCMU Hcur, Hpot, Lpot, and Lcur
BNC connectors. For connecting N1300A cable from the multi frequency capacitance measurement unit installed in B1505A.
- Output Low and High
SHV(jack) connector. Low and High must be extended to the low and high terminals of a DUT respectively. For making the connection, use high voltage cable with SHV(plug) connector, manipulators, and such.
- AC Guard
SHV(jack) connector. Provides the AC guard (circuit common) signal of MFCMU. For the 3-terminal device measurement, the AC Guard must be extended to the device terminal which is not connected to Low or High. For making the connection, use cable with SHV(plug) connector, manipulator, and such.

CAUTION

Never connect the HVSMU Force and Guard terminals to any output, including circuit common, chassis ground, or any other module terminal. Connecting other module may damage the connected module.

N1261A Protection Adapter

Adapter for protecting GNDU or HPSMU module from high voltage. The N1261A is used with a DUT interface such as your own test fixture and prober station, not the N1259A test fixture.

N1261A-001: HPSMU protection adapter with Triaxial(f) output connectors

N1261A-002: GNDU protection adapter with BNC(f) output connectors

N1261A-003: HPSMU protection adapter with HV(jack) output connectors

N1261A-004: GNDU protection adapter with SHV(jack) output connectors

WARNING

To avoid electrical shock and instrument damage, do not connect or disconnect measurement cable during operation.

- From HPSMU of N1261A-001 and 003

Force and Sense triaxial connectors. For connecting 16493K Kelvin triaxial cable or 16494A triaxial cable from the high power source/monitor unit installed in B1505A.

- Output of N1261A-001

Triaxial connectors. Force must be extended to a terminal of a DUT. Guard must be opened but should be extended as close as possible to the device terminal for reducing the leakage current of the extension cable. For making the connection, use high voltage cable with Triaxial(m) connector, manipulators, and such.

Sense should be also extended to the DUT terminal. And Force and Sense should be connected together at the device end for making the Kelvin connection effective for low resistance and high current measurements.

- Output of N1261A-003

HV(jack) connectors. Force must be extended to a terminal of a DUT. Guard must be opened but should be extended as close as possible to the device terminal for reducing the leakage current of the extension cable. For making the connection, use high voltage cable with HV(plug) connector, manipulators, and such.

Sense should be also extended to the DUT terminal. And Force and Sense should be connected together at the device end for making the Kelvin connection effective for low resistance and high current measurements.

Introduction

Accessories

- From GNDU of N1261A-002 and 004
GNDU triaxial connector. For connecting 16493L GNDU cable from the ground unit installed in B1505A.
- Output of N1261A-002
BNC connectors. Force and Sense must be extended to a terminal of a DUT. And they must be connected together at the device end. For making the connection, use high voltage cable with BNC(m) connector, manipulators, and such.
- Output of N1261A-004
SHV(jack) connectors. Force and Sense must be extended to a terminal of a DUT. And they must be connected together at the device end. For making the connection, use high voltage cable with SHV(plug) connector, manipulators, and such.

CAUTION

Never connect the HVSMU Force and Guard terminals to any output, including circuit common, chassis ground, or any other module terminal. Connecting other module may damage the connected module.

N1262A R-Box

Resistor box for reducing the risk of device breakdown or preventing SMU from oscillation. 1 k Ω (\pm 200 Vdc), 1 k Ω (\pm 3000 Vdc), 100 k Ω (\pm 3000 Vdc), or 1 M Ω (\pm 3000 Vdc). The N1262A is used with a DUT interface such as your own test fixture and prober station, not the N1259A test fixture.

N1262A-001: 1 M Ω (\pm 3000 Vdc) resistor with SHV(jack) output connector

N1262A-002: 100 k Ω (\pm 3000 Vdc) resistor with SHV(jack) output connector

N1262A-010: 1 k Ω (\pm 200 Vdc) resistor with Triaxial(f) output connector

N1262A-011: 1 k Ω (\pm 3000 Vdc) resistor with SHV(jack) output connector

WARNING

To avoid electrical shock and instrument damage, do not connect or disconnect measurement cable during operation.

- From HVSMU of N1262A-001 and 002
HV(jack) connector. For connecting 16493T HVSMU cable from the high voltage source/monitor unit installed in B1505A.
- From SMU of N1262A-010
Triaxial connector. For connecting 16494A triaxial cable from the Force connector of the high power source/monitor unit installed in B1505A directly or via the N1261A-001 protection adapter.
- From SMU of N1262A-011
HV(jack) connector. For connecting 16493T HVSMU cable from the N1261A-003 protection adapter connected to the high power source/monitor unit installed in B1505A.
- Output of N1262A-001, 002, and 011
SHV(jack) connector. Signal must be extended to a terminal of a DUT. For making the connection, use high voltage cable with SHV(plug) connector, manipulators, and such.
- Output of N1262A-010
Triaxial connector. Signal must be extended to a terminal of a DUT. For making the connection, use cable with Triaxial(m) connector, manipulators, and such.

16493S-010/011 HCSMU Adapter

Adapters for HCSMU. The adapters are used with a DUT interface such as your own test fixture and prober station, not the N1259A test fixture.

16493S-010: Adapter for making the Kelvin connection of HCSMU path

16493S-011: Adapter for making the non-Kelvin connection of HCSMU path

WARNING

To avoid electrical shock and instrument damage, do not connect or disconnect measurement cable during operation.

- From HCSMU
Triaxial connector (Sense) and BNC connector (Force). For connecting 16493S HCSMU cable from the high current source/monitor unit installed in B1505A.
- Output of 16493S-010
 - High Force/Sense
BNC connectors. Force and Sense must be extended to the high terminal of a DUT and they must be connected together at the device end. For making the connection, use high voltage cable with BNC(m) connector, manipulators, and such.
 - Low Force/Sense
BNC connectors. Force and Sense must be extended to the low terminal of the DUT and they must be connected together at the device end. For making the connection, use high voltage cable with BNC(m) connector, manipulators, and such.
The DUT's low terminal must be also connected to Force and Sense of the ground unit. Use the N1261A-002/004 GNDU protection adapter.
- Output of 16493S-011
BNC connectors. High Force must be extended to the high terminal of a DUT. Low Force must be extended to the low terminal of the DUT. For making the connection, use high voltage cable with BNC(m) connector, manipulators, etc.
The DUT's low terminal must be also connected to Force and Sense of the ground unit. Use the N1261A-002/004 GNDU protection adapter.

NOTE

Do not put any conductor on the HCSMU Low Force and Low Sense terminals, outer conductor of the coaxial connectors. Putting conductor of circuit common, chassis ground, or any potential on causes the measurement error.

16493S-020/021 Dual HCSMU Adapter

Adapters for dual HCSMU operation. The adapters are used to connect two HCSMU modules installed in one B1505A. Using two modules can expand the B1505A maximum current up to ± 40 A (pulse), ± 2 A (DC).

16493S-020: Dual HCSMU Kelvin combination adapter

This adapter is used with a DUT interface such as your own test fixture and prober station, not the N1259A test fixture. The N1258A module selector cannot be used.

16493S-021: Dual HCSMU combination adapter

This adapter is used with the N1259A test fixture, the N1258A module selector, or the 16493S-010/011 HCSMU adapter.

CAUTION

If dual HCSMU (DHCSMU) is used with the N1258A or N1259A-300 module selector, the maximum current must be ± 30 A to prevent the module selector from performance degradation and failure.

WARNING



To avoid electrical shock and instrument damage, do not connect or disconnect measurement cable during operation.

- Output of 16493S-020
 - High Force/Sense
HV(jack) connectors. Force and Sense must be extended to the high terminal of a DUT and they must be connected together at the device end. For making the connection, use high voltage cable with HV(plug) connector, manipulators, and such.
 - Low Force/Sense
BNC connectors. Force and Sense must be extended to the low terminal of the DUT and they must be connected together at the device end. For making the connection, use high voltage cable with BNC(m) connector, manipulators, and such.
- Output of 16493S-021
Triaxial connector (Sense) and BNC connector (Force). For connecting the dedicated cable, 30 cm, furnished, to the HCSMU input connectors of the N1259A test fixture, the N1258A module selector, or the 16493S-010/011 HCSMU adapter.

[Introduction](#)
[Accessories](#)

- Input HCSMU (16493S-020) or From HCSMU (16493A-021)
Triaxial connector (Sense) and BNC connector (Force). For connecting 16493S HCSMU cable from the high current source/monitor unit installed in B1505A.
 - Master Force/Sense
Must be connected to Force/Sense of HCSMU used as the master.
 - Slave Force/Sense
Must be connected to Force/Sense of HCSMU used as the slave.
- Input GNDU (16493S-020)
GNDU triaxial connector. For connecting 16493L GNDU cable from the ground unit installed in B1505A.

NOTE

Do not put any conductor on the HCSMU Low Force and Low Sense terminals, outer conductor of the coaxial connectors. Putting conductor of circuit common, chassis ground, or any potential on causes the measurement error.

3

Installation

Installation

This chapter describes how to install Agilent B1505A and accessories.

- “Requirements”
- “Inspection and Installation”
- “Maintenance”
- “About Plug-in Modules”

To change the GPIB address of the B1505A, see “To Change GPIB Address” on page 3-9.

To control external GPIB devices from the B1505A/EasyEXPERT, see “To Enable System Controller” on page 3-10.

WARNING



There are potentially hazardous voltages (± 3000 V for HVSMU and ± 200 V for HPSMU) present at the Force, Sense, and Guard terminals of Agilent B1505A. To prevent electrical shock, the following safety precautions must be observed during the use of the B1505A.

- **Use a three-conductor AC power cable to connect the cabinet (if used) and the B1505A to an electrical ground (safety ground).**
- **If you do *not* use the N1259A test fixture, you must install and connect an interlock circuit that opens the circuit when the shielding box access door is open.**
- **Confirm periodically that the interlock function works normally.**
- **Before touching the connections on the Force, Guard, and Sense terminals, turn the B1505A off and discharge any capacitors. If you do *not* turn the B1505A off, complete *all* of the following items, regardless of the B1505A settings.**
 - **Press the Stop key to set the module output off.**
 - **Confirm that the High Voltage indicator is not lit.**
 - **Open the shielding box access door (open the Interlock terminal).**
 - **Discharge any capacitors connected to an SMU.**
- **Warn persons working around the B1505A about dangerous conditions.**

Requirements

This section contains information on:

- “Power Requirements”
- “Operating Environment”
- “Storaging/Shipping Environment”
- “Installation Requirements”
- “Power Cable”

Power Requirements

The B1505A can operate from any single-phase AC power source supplying 90 to 264 V at 47 to 63 Hz. The maximum power consumption is 900 VA.

Operating Environment

The B1505A is specified to operate within the following environmental conditions:

Temperature: 5 °C to 40 °C

Humidity: 20 % to 70 % RH, non-condensing

Altitude: 0 to 2,000 m (6,561 ft.)

Storaging/Shipping Environment

The B1505A is specified to store/ship within the following environmental conditions:

Temperature: -20 °C to 60 °C

Humidity: 20 % to 90 % RH, non-condensing

Altitude: 0 to 4,600 m (15,092 ft.)

Installation Requirements

The B1505A has cooling fans. To ensure adequate airflow, make sure that there is sufficient clearance around the cooling fans: 6 inches (150 mm) behind, 3 inches (70 mm) on the sides, and 0.5 inch (12 mm) above and below.

If the airflow is restricted, the internal operating temperature will be higher. This may reduce the instrument's reliability, or cause the thermal-protection circuits to turn the instrument off.

Also make sure that there is enough space for connecting/disconnecting the power cable easily.

Power Cable

CAUTION

Before applying AC line power to the B1505A, ensure that the correct power cable is used.

In accordance with international safety standards, this instrument is equipped with a three-prong power cable. When connected to an appropriate AC power outlet, this cable grounds the instrument frame. The type of power cable shipped with each instrument depends on the country of destination. Refer to PN in the following table for Agilent part numbers of the power cables available.


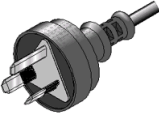
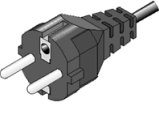
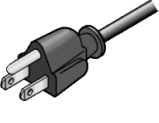

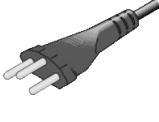
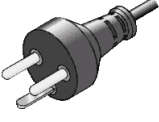
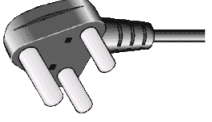
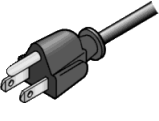
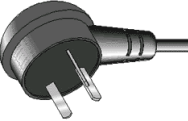
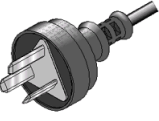
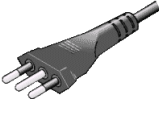
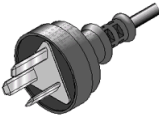
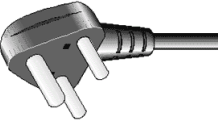
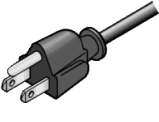
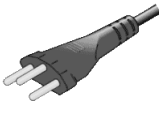
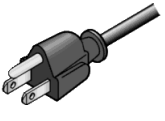
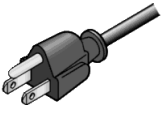
If the plug on the cable does not fit the power outlet, or the cable is to be attached to a terminal block, cut the cable at the plug end and re-wire it. This work should be performed by a qualified electrician, observing all local electrical codes.

The color coding used in the cable will depend on the cable supplied. If a new plug is to be connected, it must meet local safety requirements and include the following features:

- adequate load-carrying capacity (see “Specifications” on page 4-3.)
- ground connection
- cable clamp

WARNING

For protection from electrical shock, do *not* interrupt the power cable ground.

 <ul style="list-style-type: none"> • Plug: BS 1363/A, 250 V, 10 A • PN: 8120-4420 	 <ul style="list-style-type: none"> • Plug: AS 3112, 250 V, 10 A • PN: 8120-4419 	 <ul style="list-style-type: none"> • Plug: CEE 7 sheet VII, 250 V, 10 A • PN: 8120-4519 	 <ul style="list-style-type: none"> • Plug: NEMA 5-15P, 125 V, 10 A • PN: 8120-6825
 <ul style="list-style-type: none"> • Plug: NEMA 6-15P, 250 V, 10 A • PN: 8120-3996, 8120-0698 	 <ul style="list-style-type: none"> • Plug: SEV 1011, 250 V, 10 A • PN: 8120-2104 	 <ul style="list-style-type: none"> • Plug: SR 107-2-D1, 250 V, 10 A • PN: 8120-2956 	 <ul style="list-style-type: none"> • Plug: IS 1293 and IS 6538, 250 V, 10 A • PN: 8120-4211
 <ul style="list-style-type: none"> • Plug: JIS C 8303, 125 V, 12 A • PN: 8121-0743 	 <ul style="list-style-type: none"> • Plug: Israel SI 32, 250 V, 10 A • PN: 8120-5182 	 <ul style="list-style-type: none"> • Plug: IRAM 2073-10A, 250 V, 10 A • PN: 8120-6870 	 <ul style="list-style-type: none"> • Plug: CEI 23-16, 250 V, 10 A • PN: 8120-6978
 <ul style="list-style-type: none"> • Plug: GB 1002 figure 3, 250 V, 10 A • PN: 8120-8376 	 <ul style="list-style-type: none"> • Plug: SANS 164-1, 250 V, 10 A • PN: 8120-4211, 8121-0564 	 <ul style="list-style-type: none"> • Plug: TISI 166, 250 V, 10 A • PN: 8121-1866 	 <ul style="list-style-type: none"> • Plug: NBR 14136, 250 V, 10 A • PN: 8121-1809
 <ul style="list-style-type: none"> • Plug: CNS 10917-2, 125 V, 10 A • PN: 8120-6825, 8121-1635 	 <ul style="list-style-type: none"> • Plug: CS 0017:2003, 250 V, 10 A • PN: 8120-8871, 8121-1638 		

Inspection and Installation

This section describes what to do when you receive the B1505A and accessories.

1. Inspect the shipment. See “To Inspect B1505A and Accessories”.
2. Verify the B1505A operation and perform initial setup. See “To Perform Initial Setup”.
3. Install the B1505A in the appropriate place. See “Requirements” on page 3-3.

To use the B1505A briefly, see “Getting Started” on page 1-1.

To change the Windows logon setting, see “To Change Windows Logon Setting” on page 3-9.

To change the GPIB address of the B1505A, see “To Change GPIB Address” on page 3-9.

To allow the B1505A/EasyEXPERT to control external GPIB devices, see “To Enable System Controller” on page 3-10.

To Inspect B1505A and Accessories

Perform the following inspections when the B1505A and accessories arrive at your site.

1. Before unpacking any components, inspect all boxes for any signs of damage that might have occurred during shipment, such as:
 - dents
 - scratches
 - cuts
 - water marks

If you suspect any damage, notify your local Agilent Technologies sales or service office.

2. When you open the boxes that contain the B1505A and accessories, check the components against the contents lists attached to the boxes.

If anything is missing, notify your local Agilent Technologies sales or service office.

To Perform Initial Setup

After you receive the B1505A, perform the following setup.

For the users available just after the initial setup, see Table 3-1.

1. Make sure that the Standby switch is set to off.
2. On the B1505A rear panel, connect the Circuit Common terminal to the frame ground terminal by using a shorting-bar.
3. If you use Agilent 16444A-001 USB keyboard and/or the 16444A-002 USB mouse, connect it to an USB port of the B1505A.
4. Connect the power cable from the B1505A to an AC power outlet.
5. Open the measurement terminals and press the Standby switch to turn on the B1505A.

If the B1505A is operating correctly, the power-on self-test is automatically performed. If problems arise, see *Agilent EasyEXPERT User's Guide*.

6. Follow the Windows setup wizard and complete the initial setup.
 - a. Set the system display language to English. The language must be English. If you set another language, you must perform the system recovery of the B1505A. See *Agilent EasyEXPERT User's Guide* for the system recovery.
 - b. Set Country or region, Time and currency, and Keyboard layout.
If you use the 16444A-001 USB keyboard, the Keyboard layout must be US.
 - c. Accept the End User License Agreement.
 - d. Set Time zone, date and time.

If the B1505A has been already connected to your site LAN, you can proceed the network connection setup.

NOTE

Other Windows setup

You can set other setup of Windows after the initial setup. It is your responsibility.

If you connect the B1505A to the network, take care to protect it from computer virus.

Table 3-1 **Users Available Just After the Initial Setup**

User Account	Description
Agilent B1500 User	Account for automatic logon. Password is not set to this account.
AgilentOnly	Account for Agilent service personnel. Do not delete this account. This account is password protected.
Administrator	Administrator. Password is not set to this account.

You can add users after the initial setup. Add users as you need.

NOTE

Agilent Technologies cannot guarantee the performance and provide compatibility information for all B1505As under several conditions. If problems arise, perform Agilent B1505A system recovery.

To perform recovery, see Agilent EasyEXPERT *User's Guide*.

To Change Windows Logon Setting

Agilent B1505A initially enables Windows automatic logon. If you want to change this setting, select *All Programs > Control Auto Logon* from the Start menu. Control Auto Logon is displayed on the browser. Then click one of the following buttons on the browser and follow the setup script.

- Enable Auto Logon
- Disable Auto Logon

NOTE

If you set a password for the user account *Agilent B1500 User*, disable the automatic logon.

To Change GPIB Address

When Agilent B1505A is shipped from the factory, the GPIB address is set to 17. To change the GPIB address, perform the following procedure.

1. If the EasyEXPERT software is running, terminate it as shown below:
 - a. Select the menu function *File > Exit* on the EasyEXPERT main screen.
 - b. Click [x] at the upper right corner of the Start EasyEXPERT button.
2. Select *All Programs > Agilent IO Libraries Suite > Agilent Connection Expert* from the Start menu. Agilent Connection Expert window appears.
3. At the *Instrument I/O on this PC* area, select GPIB0, and click the Change Properties... button. Agilent 82350 PCI GPIB Interface - GPIB0 window appears.
4. Change the GPIB Address value.
5. Remove the check from the *Auto-discover instruments connected to this interface* box.
6. Click the OK button on Agilent 82350 PCI GPIB Interface - GPIB0 window.
7. On the Reboot Required dialog box, click the Reboot Now button, and reboot the B1505A.

To Enable System Controller

To allow Agilent B1505A/EasyEXPERT to control external GPIB devices, perform the following procedure.

1. If the EasyEXPERT software is running, terminate it as shown below:
 - a. Select the menu function *File > Exit* on the EasyEXPERT main screen.
 - b. Click [x] at the upper right corner of the Start EasyEXPERT button.
2. Select *All Programs > Agilent IO Libraries Suite > Agilent Connection Expert* from the Start menu. Agilent Connection Expert window appears.
3. At the *Instrument I/O on this PC* area, select GPIB0, and click the *Change Properties...* button. Agilent 82350 PCI GPIB Interface - GPIB0 window appears.
4. Set the GPIB Address value to 21 that is the typical address number for the system controller.
5. Check the *System Controller* box.
6. Remove the check from the *Auto-discover instruments connected to this interface* box.

This disables the automatic device detection. So the Connection Expert cannot detect the instruments connected to the GPIB interface by itself.
7. Click the OK button on Agilent 82350 PCI GPIB Interface - GPIB0 window.
8. On the Reboot Required dialog box, click the Reboot Now button, and reboot the B1505A.

NOTE

To Disable System Controller

If the B1505A is the system controller, you cannot control the B1505A by using an external computer. To disable the system controller, change the steps 4 and 5 for setting the GPIB Address value to *not* 21 and removing the check from the *System Controller* box, and perform the procedure to the step 8.

Maintenance

Maintenance should be performed periodically to keep Agilent B1505A in good condition.

Cleaning

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

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

Self-test and Diagnostics

Agilent B1505A provides the following functions to check the operation. Perform the following functions as necessary. Open the measurement terminals to perform self-test, self-calibration, or diagnostics.

- Self-test
- Self-calibration
- Diagnostics

If problems arise, contact Agilent Technologies. For details, see Agilent EasyEXPERT *User's Guide*.

NOTE



Interlock Open/Close test and High Voltage LED test

Interlock function limits the SMU maximum output voltage to ± 42 V when the measurement terminal is touchable. For safety, this function must be checked before using the B1505A after power on at least once a day by performing the diagnostics.

Calibration

Calibration and adjustments must be performed periodically so that the instruments satisfy the specifications, and keep a good condition. It is recommended to perform the calibration once a year at least. For the calibration and adjustments, contact Agilent Technologies. Trained service personnel will perform the calibration and adjustments. Also see Agilent EasyEXPERT *User's Guide*.

About Plug-in Modules

Agilent Technologies is responsible for the module installation of Agilent B1505A. Contact Agilent Technologies for the module installation. Then send the following equipment and accessories to Agilent Technologies.

- B1505A
- Plug-in modules to be installed

WARNING

To prevent electrical shock, turn off Agilent B1505A and remove the power cable before removing the connection cables.

NOTE

Module locations after servicing

After the module installation, upgrade, and so on, the B1505A will be returned with the module configuration decided by the rule shown in Table 3-2. If you want to change the module locations, consult the service personnel before servicing.

Module Type and Locations

Module locations when the B1505A is shipped from the factory are shown in Table 3-2. This table shows the relative locations by the module types.

The HPSMU 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, one MFCMU, one HCSCMU, and one HVSMU, the B1505A will be shipped with the HPSMU of the slots 1 to 4, the MFCMU of the slot 5, the HCSCMU of the slots 6 to 7, the HVSMU of the slots 8 to 9, and the blank panel of the slot 10.

Table 3-2

Module Installation Rule

Slot Number and Location		Module Type
10	top	B1513A High Voltage SMU (HVSMU)
:	:	B1512A High Current SMU (HCSCMU)
:	:	B1520A Multi Frequency CMU (MFCMU)
:	:	B1510A High Power SMU (HPSMU)
1	:	
0	bottom	GNDU/ADC (always installed)

Installation
About Plug-in Modules

Specifications and Options

This chapter describes the specifications and the options of Agilent B1505A Power Device Analyzer/Curve Tracer.

- “Specifications”
- “Accessories and Options”

Specifications

This section lists specifications and supplemental characteristics for the B1505A and its associated modules. The specifications are the standards against which the B1505A and its associated modules are tested. When the B1505A or any of its associated modules are shipped from the factory, they meet the specifications. The “supplemental” characteristics described in the following specifications are not guaranteed, but provide useful information about the functions and performance of the instrument.

NOTE

Agilent Technologies is responsible for removing, installing, and replacing the B1505A modules. Contact your nearest Agilent Technologies to install and calibrate the B1505A modules.

- “Specification Conditions”
- “Mainframe”
- “HPSMU”
- “HCSMU”
- “HVSMU”
- “SMU Common Specifications”
- “SMU Supplemental Characteristics”
- “MFCMU”
- “Accessories”
- “Agilent EasyEXPERT Software”
- “Furnished Software”
- “General Specifications”

Specification Conditions

The measurement and output accuracy are specified under the conditions listed below. Note: The SMU measurement and output accuracies are specified at the SMU connector terminals, using the Zero Check terminal as a reference.

1. Temperature: $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$

Specifications and Options

Specifications

- Humidity: 20 % to 70 %
- Self-calibration after a 40 minute warm-up is required.
- Ambient temperature change less than ± 1 °C after self-calibration execution. (Note: This does not apply to the MFCMU).
- Measurement made within one hour after self-calibration execution. (Note: This does not apply to the MFCMU).
- Calibration period: 1 year
- SMU integration time setting: 1 PLC (1 nA to 1 A range, voltage range), 200 μ s (20 A range)
Averaging of high-speed ADC: 128 samples per 1 PLC
- SMU filter: ON (for HPSMU)
- SMU measurement terminal connection: Kelvin connection (for HPSMU, HCSMU), non-Kelvin (for HVSMU)

Mainframe

- Supported plug-in modules

The B1505A supports ten slots for plug-in modules. See Table 4-1.

- Maximum current sourcing/measurement range

Dual HCSMU (DHCSMU) configuration is available if two HCSMU modules are installed in one B1505A and connected to the 16493S-020 Dual HCSMU Kelvin combination adapter or the 16493S-021 Dual HCSMU combination adapter. This configuration expands the maximum current up to ± 40 A (pulse), ± 2 A (DC).

- Maximum module configuration

The B1505A can contain several combinations of modules; up to four dual-slot HPSMU modules, up to two dual-slot HCSMU modules, one dual-slot HVSMU, and one single-slot MFCMU. The total power consumption of all modules cannot exceed 84 W. The B1505A cannot support the 4-HPSMU plus 1-HCSMU configuration and the 3-HPSMU plus 2-HCSMU configuration.

The installation order of the modules is: HPSMU, MFCMU, HCSMU, and HVSMU starting from the bottom of the mainframe.

- Maximum voltage between common and ground

$\leq \pm 42$ V

- Ground unit (GNDU) specifications
The GNDU is furnished with the mainframe.
 - Output voltage: $0\text{ V} \pm 100\ \mu\text{V}$
 - Maximum sink current: $\pm 4.2\text{ A}$
 - Output terminal/connection: Triaxial connector, Kelvin (remote sensing)
- GNDU supplemental characteristics
 - Load capacitance: $1\ \mu\text{F}$
 - Cable resistance:
 - For $I_s \leq 1.6\text{ A}$: Force line $R < 1\ \Omega$
 - For $1.6\text{ A} < I_s \leq 2.0\text{ A}$: Force line $R < 0.7\ \Omega$
 - For $2.0\text{ A} < I_s \leq 4.2\text{ A}$: Force line $R < 0.35\ \Omega$
 - For all cases: Sense line $R \leq 10\ \Omega$
 where I_s is the current being sunk by the GNDU.

Table 4-1 **Supported plug-in modules**

Module	Slots occupied	Range of operation	Measurement resolution
B1510A HPSMU ^a	2	-200 V to 200 V, -1 A to 1 A	2 μV , 10 fA
B1512A HCSMU ^b	2	-40 V to 40 V, -1 A to 1 A -20 V to 20 V, -20 A to 20 A (Pulse only)	200 nV, 10 pA
B1513A HVSMU ^c	2	-3000 V to 3000 V, -4 mA to 4 mA -1500 V to 1500 V, -8 mA to 8 mA	200 μV , 10 fA
B1520A MFCMU ^d	1	1 kHz to 5 MHz	0.035 fFrms ^e

- a. High power source/monitor unit
- b. High current source/monitor unit
- c. High voltage source/monitor unit
- d. Multi frequency capacitance measurement unit
- e. Valid when connecting a 10 pF capacitor to the measurement terminals under the following measurement conditions: a frequency of 1 MHz, a signal level of 250 mV AC, and a measurement time of 1 PLC. The display resolution is 0.000001 fF at 1 fF order by 6 digits display.

HPSMU

High Power Source/Monitor Unit

- Voltage range, resolution, and accuracy
See Table 4-4 for high resolution ADC and Table 4-6 for high speed ADC.
- Current range, resolution, and accuracy
See Table 4-5 for high resolution ADC and Table 4-7 for high speed ADC.
- Power consumption
See Table 4-2 for voltage source mode and Table 4-3 for current source mode.

Table 4-2 HPSMU power consumption in voltage source mode

Voltage range (V)	Power ^a (W)
2	$I_c \times 20$
20	$I_c \times 20$
40	$I_c \times 40$
100	$I_c \times 100$
200	$I_c \times 200$

a. I_c is the current compliance setting.

Table 4-3 HPSMU power consumption in current source mode

Voltage compliance ^a (V)	Power ^b (W)
$V_c \leq 20$	$I_o \times 20$
$20 < V_c \leq 40$	$I_o \times 40$
$40 < V_c \leq 100$	$I_o \times 100$
$100 < V_c \leq 200$	$I_o \times 200$

a. V_c is the voltage compliance setting.

b. I_o is the output current.

Table 4-4 HPSMU voltage range, resolution, and accuracy (high resolution ADC)

Range	Force resolution	Measurement resolution	Force accuracy $\pm(\%+mV)^a$	Measurement accuracy $\pm(\%+mV)^a$	Maximum current
± 2 V	100 μ V	2 μ V	$\pm(0.018 + 0.4)$	$\pm(0.01 + 0.14)$	1 A
± 20 V	1 mV	20 μ V	$\pm(0.018 + 3)$	$\pm(0.01 + 0.14)$	1 A
± 40 V	2 mV	40 μ V	$\pm(0.018 + 6)$	$\pm(0.01 + 1)$	500 mA
± 100 V	5 mV	100 μ V	$\pm(0.018 + 15)$	$\pm(0.012 + 2.5)$	125 mA
± 200 V	10 mV	200 μ V	$\pm(0.018 + 30)$	$\pm(0.014 + 2.8)$	50 mA

a. $\pm(\%$ of reading value + fixed offset)

Table 4-5 HPSMU current range, resolution, and accuracy (high resolution ADC)

Range	Force resolution	Measurement resolution	Force accuracy $\pm(\%+A+A)^a$	Measurement accuracy $\pm(\%+A+A)^a$	Maximum voltage
± 1 nA	50 fA	10 fA	$\pm(0.1+3E-13+V_o \times 1E-15)$	$\pm(0.1+3E-13+V_o \times 1E-15)$	200 V
± 10 nA	500 fA	10 fA	$\pm(0.1+3E-12+V_o \times 1E-14)$	$\pm(0.1+25E-13+V_o \times 1E-14)$	200 V
± 100 nA	5 pA	100 fA	$\pm(0.05+3E-11+V_o \times 1E-13)$	$\pm(0.05+25E-12+V_o \times 1E-13)$	200 V
± 1 μ A	50 pA	1 pA	$\pm(0.05+3E-10+V_o \times 1E-12)$	$\pm(0.05+1E-10+V_o \times 1E-12)$	200 V
± 10 μ A	500 pA	10 pA	$\pm(0.05+3E-9+V_o \times 1E-11)$	$\pm(0.04+2E-9+V_o \times 1E-11)$	200 V
± 100 μ A	5 nA	100 pA	$\pm(0.035+15E-9+V_o \times 1E-10)$	$\pm(0.03+3E-9+V_o \times 1E-10)$	200 V
± 1 mA	50 nA	1 nA	$\pm(0.04+15E-8+V_o \times 1E-9)$	$\pm(0.03+6E-8+V_o \times 1E-9)$	200 V
± 10 mA	500 nA	10 nA	$\pm(0.04+15E-7+V_o \times 1E-8)$	$\pm(0.03+2E-7+V_o \times 1E-8)$	200 V
± 100 mA	5 μ A	100 nA	$\pm(0.045+15E-6+V_o \times 1E-7)$	$\pm(0.04+6E-6+V_o \times 1E-7)$	b
± 1 A	50 μ A	1 μ A	$\pm(0.4+3E-4+V_o \times 1E-6)$	$\pm(0.4+15E-5+V_o \times 1E-6)$	

a. $\pm(\%$ of reading value + fixed offset + proportional offset), V_o is the output voltage in V.

b. 200 V ($I_o \leq 50$ mA), 100 V (50 mA $< I_o \leq 125$ mA), 40 V (125 mA $< I_o \leq 500$ mA), 20 V (500 mA $< I_o \leq 1$ A), I_o is the output current.

Specifications and Options
Specifications

Table 4-6 HPSMU voltage range, resolution, and accuracy (high speed ADC)

Range	Force resolution	Measurement resolution	Force accuracy $\pm(\%+mV)^a$	Measurement accuracy $\pm(\%+mV)^a$	Maximum current
± 2 V	100 μ V	100 μ V	$\pm(0.018 + 0.4)$	$\pm(0.01 + 0.7)$	1 A
± 20 V	1 mV	1 mV	$\pm(0.018 + 3)$	$\pm(0.01 + 4)$	1 A
± 40 V	2 mV	2 mV	$\pm(0.018 + 6)$	$\pm(0.015 + 8)$	500 mA
± 100 V	5 mV	5 mV	$\pm(0.018 + 15)$	$\pm(0.02 + 20)$	125 mA
± 200 V	10 mV	10 mV	$\pm(0.018 + 30)$	$\pm(0.035 + 40)$	50 mA

a. $\pm(\%$ of reading value + fixed offset)

Table 4-7 HPSMU current range, resolution, and accuracy (high speed ADC)

Range	Force resolution	Measurement resolution	Force accuracy $\pm(\%+A+A)^a$	Measurement accuracy $\pm(\%+A+A)^a$	Maximum voltage
± 1 nA	50 fA	50 fA	$\pm(0.1+3E-13+V_o \times 1E-15)$	$\pm(0.25+3E-13+V_o \times 1E-15)$	200 V
± 10 nA	500 fA	500 fA	$\pm(0.1+3E-12+V_o \times 1E-14)$	$\pm(0.25+2E-12+V_o \times 1E-14)$	200 V
± 100 nA	5 pA	5 pA	$\pm(0.05+3E-11+V_o \times 1E-13)$	$\pm(0.1+2E-11+V_o \times 1E-13)$	200 V
± 1 μ A	50 pA	50 pA	$\pm(0.05+3E-10+V_o \times 1E-12)$	$\pm(0.1+2E-10+V_o \times 1E-12)$	200 V
± 10 μ A	500 pA	500 pA	$\pm(0.05+3E-9+V_o \times 1E-11)$	$\pm(0.05+2E-9+V_o \times 1E-11)$	200 V
± 100 μ A	5 nA	5 nA	$\pm(0.035+15E-9+V_o \times 1E-10)$	$\pm(0.05+2E-8+V_o \times 1E-10)$	200 V
± 1 mA	50 nA	50 nA	$\pm(0.04+15E-8+V_o \times 1E-9)$	$\pm(0.04+2E-7+V_o \times 1E-9)$	200 V
± 10 mA	500 nA	500 nA	$\pm(0.04+15E-7+V_o \times 1E-8)$	$\pm(0.04+2E-6+V_o \times 1E-8)$	200 V
± 100 mA	5 μ A	5 μ A	$\pm(0.045+15E-6+V_o \times 1E-7)$	$\pm(0.1+2E-5+V_o \times 1E-7)$	b
± 1 A	50 μ A	50 μ A	$\pm(0.4+3E-4+V_o \times 1E-6)$	$\pm(0.5+3E-4+V_o \times 1E-6)$	

a. $\pm(\%$ of reading value + fixed offset + proportional offset), V_o is the output voltage in V.

b. 200 V ($I_o \leq 50$ mA), 100 V (50 mA $< I_o \leq 125$ mA), 40 V (125 mA $< I_o \leq 500$ mA), 20 V (500 mA $< I_o \leq 1$ A), I_o is the output current.

HCSMU

High Current Source/Monitor Unit

- Voltage range, resolution, and accuracy
See Table 4-10.
- Current range, resolution, and accuracy
See Table 4-11.
- Power consumption
See Table 4-8 for voltage source mode and Table 4-9 for current source mode.
- Maximum current sourcing/measurement range

Dual HCSMU (DHCSMU) configuration is available if two HCSMU modules are installed in one B1505A and connected to the 16493S-020 Dual HCSMU Kelvin combination adapter or the 16493S-021 Dual HCSMU combination adapter. This configuration expands the maximum current up to ± 40 A (pulse), ± 2 A (DC).

Table 4-8

HCSMU power consumption in voltage source mode

Voltage range (V)	Power ^a (W)
0.2	$I_c \times 40$
2	$I_c \times 40$
40	$I_c \times 40$

a. I_c is the current compliance setting. For pulse, $I_c = \text{duty} \times I_{\text{pulse}}$

Table 4-9

HCSMU power consumption in current source mode

Voltage compliance ^a (V)	Power ^b (W)
$V_c \leq 0.2$	$I_o \times 40$
$0.2 < V_c \leq 2$	$I_o \times 40$
$2 < V_c \leq 40$	$I_o \times 40$

a. V_c is the voltage compliance setting.

b. I_o is the output current. For pulse, $I_o = \text{duty} \times I_{\text{pulse}}$

Specifications and Options
Specifications

Table 4-10 HCSMU voltage range, resolution, and accuracy

Range	Force resolution	Measurement resolution	Force accuracy $\pm(\%+mV+mV)^a$	Measurement accuracy $\pm(\%+mV+mV)^a$	Maximum current
± 0.2 V	200 nV	200 nV	$\pm(0.06+0.14+I_o \times 0.05)$	$\pm(0.06+0.14+I_o \times 0.05)$	20 A
± 2 V	2 μ V	2 μ V	$\pm(0.06+0.6+I_o \times 0.5)$	$\pm(0.06+0.6+I_o \times 0.5)$	20 A
± 20 V	20 μ V	20 μ V	$\pm(0.06+3+I_o \times 5)$	$\pm(0.06+3+I_o \times 5)$	20 A
± 40 V	40 μ V	40 μ V	$\pm(0.06+3+I_o \times 10)$	$\pm(0.06+3+I_o \times 10)$	1 A

a. $\pm(\%$ of reading value + fixed offset + proportional offset), I_o is the output current in A.

Table 4-11 HCSMU current range, resolution, and accuracy

Range	Force resolution	Measurement resolution	Force accuracy $\pm(\%+A+A)^a$	Measurement accuracy $\pm(\%+A+A)^a$	Maximum voltage
± 10 μ A	10 pA	10 pA	$\pm(0.06+2E-9+V_o \times 1E-10)$	$\pm(0.06+2E-9+V_o \times 1E-10)$	40 V
± 100 μ A	100 pA	100 pA	$\pm(0.06+2E-8+V_o \times 1E-9)$	$\pm(0.06+2E-8+V_o \times 1E-9)$	40 V
± 1 mA	1 nA	1 nA	$\pm(0.06+2E-7+V_o \times 1E-8)$	$\pm(0.06+2E-7+V_o \times 1E-8)$	40 V
± 10 mA	10 nA	10 nA	$\pm(0.06+2E-6+V_o \times 1E-7)$	$\pm(0.06+2E-6+V_o \times 1E-7)$	40 V
± 100 mA	100 nA	100 nA	$\pm(0.06+2E-5+V_o \times 1E-6)$	$\pm(0.06+2E-5+V_o \times 1E-6)$	40 V
± 1 A	1 μ A	1 μ A	$\pm(0.4+2E-4+V_o \times 1E-5)$	$\pm(0.4+2E-4+V_o \times 1E-5)$	40 V
± 20 A ^b	20 μ A	20 μ A	$\pm(0.4+2E-3+V_o \times 1E-4)$	$\pm(0.4+2E-3+V_o \times 1E-4)$	20 V

a. $\pm(\%$ of reading value + fixed offset + proportional offset), V_o is the output voltage in V.

b. Pulse mode only.

HVSMU

High Voltage Source/Monitor Unit

- Voltage range, resolution, and accuracy
See Table 4-14.
- Current range, resolution, and accuracy
See Table 4-15.
- Power consumption
See Table 4-12 for voltage source mode and Table 4-13 for current source mode.

Table 4-12

HVSMU power consumption in voltage source mode

Current compliance ^a (A)	Power (W)
$I_c \leq 0.004$	$I_c \times 3000$
$0.004 < I_c \leq 0.008$	$I_c \times 1500$

a. I_c is the current compliance setting.

Table 4-13

HVSMU power consumption in current source mode

Voltage compliance ^a (V)	Power ^b (W)
$V_c \leq 1500$	$I_o \times 1500$
$1500 < V_c \leq 3000$	$I_o \times 3000$

a. V_c is the voltage compliance setting.

b. I_o is the output current.

Specifications and Options
Specifications

Table 4-14 HVSMU voltage range, resolution, and accuracy

Range	Force resolution	Measurement resolution	Force accuracy $\pm(\%+mV)^a$	Measurement accuracy $\pm(\%+mV)^a$	Maximum current
± 200 V	200 μ V	200 μ V	$\pm(0.03+40)$	$\pm(0.03+40)$	8 mA
± 500 V	500 μ V	500 μ V	$\pm(0.03+100)$	$\pm(0.03+100)$	8 mA
± 1500 V	1.5 mV	1.5 mV	$\pm(0.03+300)$	$\pm(0.03+300)$	8 mA
± 3000 V	3 mV	3 mV	$\pm(0.03+600)$	$\pm(0.03+600)$	4 mA

a. \pm (% of reading value + fixed offset)

Table 4-15 HVSMU current range, resolution, and accuracy

Range	Force and measurement resolution	Force accuracy $\pm(\%+A+A)^a$	Measurement accuracy $\pm(\%+A+A)^a$	Maximum voltage	Minimum setting current ^b
± 1 nA	10 fA	$\pm(0.1+6E-13+V_o \times 1E-15)$	$\pm(0.1+6E-13+V_o \times 1E-15)$	3000 V	1 pA
± 10 nA	100 fA	$\pm(0.1+25E-13+V_o \times 1E-15)$	$\pm(0.1+25E-13+V_o \times 1E-15)$	3000 V	1 pA
± 100 nA	100 fA	$\pm(0.05+25E-12+V_o \times 1E-13)$	$\pm(0.05+25E-12+V_o \times 1E-13)$	3000 V	100 pA
± 1 μ A	1 pA	$\pm(0.05+1E-10+V_o \times 1E-13)$	$\pm(0.05+1E-10+V_o \times 1E-13)$	3000 V	100 pA
± 10 μ A	10 pA	$\pm(0.04+2E-9+V_o \times 1E-11)$	$\pm(0.04+2E-9+V_o \times 1E-11)$	3000 V	10 nA
± 100 μ A	100 pA	$\pm(0.03+3E-9+V_o \times 1E-11)$	$\pm(0.03+3E-9+V_o \times 1E-11)$	3000 V	10 nA
± 1 mA	1 nA	$\pm(0.03+6E-8+V_o \times 1E-10)$	$\pm(0.03+6E-8+V_o \times 1E-10)$	3000 V	100 nA
± 10 mA	10 nA	$\pm(0.03+2E-7+V_o \times 1E-9)$	$\pm(0.03+2E-7+V_o \times 1E-9)$	1500 V	1 μ A

a. \pm (% of reading value + fixed offset + proportional offset), V_o is the output voltage in V.

b. Output current needs to be set more than current shown in the table.

SMU Common Specifications

- SMU source measurement mode
 - For HPSMU: VFIM, IFVM
 - For HCSMU, HVSMU: VFIM, VFVM, IFVM, IFIM
- Output terminal/connection
 - For HPSMU: Dual triaxial connector, Kelvin (remote sensing)
 - For HCSMU: Triaxial connector (for Sense) and coaxial connector (for Force), Kelvin (remote sensing) by using 16493S-010 HCSMU Kelvin adapter or 16493S-020 Dual HCSMU Kelvin combination adapter.
 - For HVSMU: HV (high voltage) triaxial connector, non-Kelvin
- Voltage/current compliance (limiting)

The SMU can limit output voltage or current to prevent damaging the device under test.

 - Voltage compliance:
 - 0 V to ± 200 V (HPSMU)
 - 0 V to ± 40 V (HCSMU)
 - 0 V to ± 3000 V (HVSMU)
 - Current compliance:
 - ± 1 pA to ± 1 A (HPSMU)
 - ± 10 nA to ± 20 A (HCSMU)
 - ± 1 pA to ± 8 mA (HVSMU)
 - Compliance accuracy:
 - Same as the current or voltage setting accuracy.
- Power compliance
 - For HPSMU: 0.001 to 20 W, 0.001 W resolution
 - For HCSMU: 0.001 to 40 W (dc), 0.001 to 400 W (pulse), 0.001 W resolution
 - For HVSMU: No power compliance

Specifications and Options

Specifications

- SMU pulse measurement

For HPSMU:

- Pulse width: 500 μ s to 2 s, 2 μ s resolution
- Pulse period: 5 ms to 5 s, 100 μ s resolution
Period $\geq A + 2$ ms (when $A \leq 100$ ms), where $A = \text{delay} + \text{width}$
Period $\geq A + 10$ ms (when $A > 100$ ms), where $A = \text{delay} + \text{width}$
- Pulse delay: 0 s

For HCSMU:

- Pulse width: 50 μ s to 1 ms (20 A range), 50 μ s to 2 s (10 μ A to 1 A ranges), 2 μ s resolution
- Pulse period: 5 ms to 5 s, 100 μ s resolution
- Pulse duty:
For 20 A range: $\leq 1\%$
For 10 μ A to 1 A ranges:
Period $\geq A + 2$ ms (when $A \leq 100$ ms), where $A = \text{delay} + \text{width}$
Period $\geq A + 10$ ms (when $A > 100$ ms), where $A = \text{delay} + \text{width}$
- Pulse delay: 0 s to (period-width) s, 2 μ s resolution

For HVSMU:

- Pulse width: 500 μ s to 2 s, 2 μ s resolution
- Pulse period: 5 ms to 5 s, 100 μ s resolution
Period $\geq A + 2$ ms (when $A \leq 100$ ms), where $A = \text{delay} + \text{width}$
Period $\geq A + 10$ ms (when $A > 100$ ms), where $A = \text{delay} + \text{width}$
- Pulse delay: 0 s to (period-width) s, 2 μ s resolution
- Pulse output limitation:
When the pulse voltage is more than 1500 volts, the peak and base of pulse should be same polarities.
- Pulse measurement delay:
2 μ s to (period-pulse measurement time-0.002) s, 2 μ s resolution

- About measurement accuracy
 - RF electromagnetic field and SMU measurement accuracy
Voltage and current measurement accuracy may be affected by RF electromagnetic field of strength over 3 V/m at frequencies 80 MHz to 1 GHz and 1.4 GHz to 2.0 GHz, and 1 V/m at frequencies 2.0 GHz to 2.7 GHz. The extent of this effect depends upon how the instrument is positioned and shielded.
 - Induced RF field noise and SMU measurement accuracy
Voltage and current measurement accuracy can be affected by induced RF field noise strengths greater than 3V_{rms} in the frequency range of 150 kHz to 80 MHz. The extent of this effect depends upon how the instrument is positioned and shielded.

SMU Supplemental Characteristics

- Current compliance setting accuracy (for opposite polarity)
For HPSMU:
 - For 1 pA to 10 nA ranges: \pm (setting accuracy + 12 % of range)
 - For 100 nA to 1 A ranges: \pm (setting accuracy + 2.5 % of range)For HCSMU:
 - For 10 μ A to 1 A ranges: \pm (setting accuracy + 2.5 % of range)
 - For 20 A range: \pm (setting accuracy + 0.6 % of range)For HVSMU:
 - For 1 nA to 10 nA ranges: \pm (setting accuracy + 12 % of range)
 - For 100 nA to 10 mA ranges: \pm (setting accuracy + 2.5 % of range)
- SMU pulse setting accuracy (fixed measurement range)
For HPSMU:
 - Width: \pm (0.5 % + 50 μ s)
 - Period: \pm (0.5 % + 100 μ s)

Specifications and Options

Specifications

For HCSMU:

- Width: $\pm(0.1\% + 2\ \mu\text{s})$
- Period: $\pm(0.1\% + 100\ \mu\text{s})$

For HVSMU:

- Width: $\pm(0.1\% + 2\ \mu\text{s})$
- Period: $\pm(0.5\% + 100\ \mu\text{s})$
- Minimum pulse measurement time
16 μs (HPSMU), 2 μs (HCSMU), 6 μs (HVSMU)
- Voltage source output resistance (Force line, non-Kelvin connection)
0.2 Ω (HPSMU), 3 Ω (HVSMU, at 10 mA range)
- Voltage measurement input resistance
 $\geq 10^{13}\ \Omega$ (HPSMU)
 $\geq 10^9\ \Omega$ (HCSMU, $\leq 1\ \text{A}$), 80 k Ω (HCSMU, 20 A)
 $\geq 10^{12}\ \Omega$ (HVSMU)
- Current source output resistance
 $\geq 10^{13}\ \Omega$ (HPSMU)
 $\geq 10^9\ \Omega$ (HCSMU, $\leq 1\ \text{A}$), 80 k Ω (HCSMU, 20 A)
 $\geq 10^{12}\ \Omega$ (HVSMU, at 10 nA range)
- Maximum allowable cable resistance (Kelvin connection)

For HPSMU:

- Sense: 10 Ω
- Force: 10 Ω ($\leq 100\ \text{mA}$), 1.5 Ω ($> 100\ \text{mA}$)

For HCSMU:

- Sense: 10 Ω
- Force: 0.6 Ω (with Low Force (shield))
- Maximum allowable inductance

For HCSMU:

- Force: 3 μH (with Low Force (shield))

- Maximum load capacitance
For HPSMU:
 - For 1 pA to 10 nA ranges: 1000 pF
 - For 100 nA to 10 mA ranges: 10 nF
 - For 100 mA and 1 A ranges: 100 μ FFor HCSMU: 12 nF
For HVSMU:
 - For 1 nA to 1 μ A ranges: 1000 pF
 - For 10 μ A to 10 mA ranges: 10 nF
- Maximum guard capacitance
900 pF (HPSMU), 1500 pF (HVSMU)
- Maximum shield capacitance
5000 pF (HPSMU, HVSMU)
- Noise characteristics
For HPSMU, HVSMU:
 - Voltage source: 0.01 % of V range (rms.)
 - Current source: 0.1 % of I range (rms.)For HCSMU:
 - Voltage/current source: 100 mV (0 to peak) max
- Overshoot
For HPSMU:
 - Voltage source: 0.03 % of V range
 - Current source: 1 % of I rangeFor HCSMU (filter ON):
 - Voltage/current source: 10 % of rangeFor HVSMU:
 - Voltage source: 1 V (resistive load)
 - Current source: 1 % of I range

Specifications and Options

Specifications

- Range switching transient noise
For HPSMU (filter ON):
 - Voltage ranging: 250 mV
 - Current ranging: 70 mVFor HCSMU, 10 μ A to 1 A ranges:
 - Voltage ranging: 250 mV
 - Current ranging: 70 mVFor HCSMU, 20 A range:
 - Voltage ranging: 5 V maxFor HVSMU:
 - Voltage ranging: 300 mV
 - Current ranging: 300 mV
- Maximum guard offset voltage
 ± 1 mV (HPSMU), ± 5 mV (HVSMU)
- Maximum slew rate
0.2 V/ μ s (HPSMU), 1 V/ μ s (HCSMU), 0.4 V/ μ s (HVSMU)
- Output settling time
For HVSMU: 500 μ s to reach ± 0.01 % of setting value
Conditions: 100 V step, 8 mA compliance, 1000 pF load capacitance

MFCMU

Multi Frequency Capacitance Measurement Unit

- Measurement functions
 - Measurement parameters: Cp-G, Cp-D, Cp-Q, Cp-Rp, Cs-Rs, Cs-D, Cs-Q, Lp-G, Lp-D, Lp-Q, Lp-Rp, Ls-Rs, Ls-D, Ls-Q, R-X, G-B, Z- θ , Y- θ
 - Ranging: Auto or fixed
 - Measurement terminal: Four-terminal pair configuration, four BNC (female) connectors
 - Cable length: 1.5 m or 3 m, automatic identification of accessories
- Test signal
 - Frequency
Range: 1 kHz to 5 MHz
Resolution: 1 mHz (minimum)
Accuracy: $\pm 0.008\%$
 - Output signal level
Range: 10 mVrms to 250 mVrms
Resolution: 1 mVrms
Accuracy:
 $\pm (10.0\% + 1 \text{ mVrms})$ at the measurement port of the MFCMU
 $\pm (15.0\% + 1 \text{ mVrms})$ at the measurement port of the MFCMU cable (1.5 m or 3.0 m)
 - Output impedance: 50 Ω , typical
 - Signal level monitor
Range: 10 mVrms to 250 mVrms
Accuracy (open load):
 $\pm (10.0\% \text{ of reading} + 1 \text{ mVrms})$ at the measurement port of the MFCMU
 $\pm (15.0\% \text{ of reading} + 1 \text{ mVrms})$ at the measurement port of the MFCMU cable (1.5 m or 3.0 m)

Specifications and Options

Specifications

- DC bias function
 - DC bias

Range: 0 to ± 25 V

Resolution: 1 mV

Accuracy: $\pm (0.5 \% + 5.0 \text{ mV})$ at the measurement port of the MFCMU or the MFCMU cable (1.5 m or 3.0 m)
 - Maximum DC bias current, supplemental characteristics

Impedance range (Ω)	Maximum DC bias current (A)
50	10×10^{-3}
100	10×10^{-3}
300	10×10^{-3}
1×10^3	1×10^{-3}
3×10^3	1×10^{-3}
10×10^3	100×10^{-6}
30×10^3	100×10^{-6}
100×10^3	10×10^{-6}
300×10^3	10×10^{-6}

- Output impedance: 50 Ω , typical
- DC bias monitor

Range: 0 to ± 25 V

Accuracy (open load): $\pm (0.2 \% \text{ of reading} + 10 \text{ mV})$ at the measurement port of the MFCMU or the MFCMU cable (1.5 m or 3.0 m)
- Sweep characteristics
 - Available sweep parameters: DC bias voltage, oscillator level, frequency
 - Sweep type: linear, log
 - Sweep mode: single, double
 - Sweep direction: up, down
 - Number of measurement points: maximum 1001

- Measurement accuracy

Measurement accuracy at the measurement port of the MFCMU or the MFCMU cable (1.5 m or 3.0 m)

- $|Z|$ accuracy: $\pm E$ (%)
- θ accuracy: $\pm E/100$ (radian)
- C accuracy:
 $\pm E$ (%) at $Dx \leq 0.1$
 $\pm E \times (1 + Dx^2)^{1/2}$ (%) at $Dx > 0.1$
- D accuracy:
 $\pm E/100$ at $Dx \leq 0.1$
 $\pm E \times (1 + Dx)/100$ at $Dx > 0.1$
- G accuracy:
 $\pm E/Dx$ (%) at $Dx \leq 0.1$
 $\pm E \times (1 + Dx^2)^{1/2}/Dx$ (%) at $Dx > 0.1$

where,

Zx : Impedance measurement value (Ω)

Dx : Measurement value of D

$$E = E_P' + (Z_S' / |Zx| + Y_O' \times |Zx|) \times 100 \text{ (%)}$$

$$E_P' = E_{PL} + E_{POSC} + E_P \text{ (%)}$$

$$Y_O' = Y_{OL} + Y_{OSC} + Y_O \text{ (S)}$$

$$Z_S' = Z_{SL} + Z_{OSC} + Z_S \text{ (\Omega)}$$

For the parameter value, see Table 4-16 to Table 4-18. Calculation example of the measurement accuracy is also shown in Table 4-19.

Specification conditions:

- Temperature: $23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$
- Integration time: 1 PLC or 16 PLC

Specifications and Options
Specifications

Table 4-16 Parameters E_{POSC} , Z_{OSC}

Oscillator level V_{osc} mV	E_{POSC} %	Z_{OSC} m Ω
$125 < V_{osc} \leq 250$	$0.03 \times (250/V_{osc} - 1)$	$5 \times (250/V_{osc} - 1)$
$64 < V_{osc} \leq 125$	$0.03 \times (125/V_{osc} - 1)$	$5 \times (125/V_{osc} - 1)$
$32 < V_{osc} \leq 64$	$0.03 \times (64/V_{osc} - 1)$	$5 \times (64/V_{osc} - 1)$
$V_{osc} \leq 32$	$0.03 \times (32/V_{osc} - 1)$	$5 \times (64/V_{osc} - 1)$

V_{osc} is oscillator level in mV.

Table 4-17 Parameters E_{PL} , Y_{OL} , Z_{SL}

Cable length	E_{PL} %	Y_{OL} nS	Z_{SL} m Ω
1.5 m	$0.02 + 3 \times f / 100$	$750 \times f / 100$	5.0
3 m	$0.02 + 5 \times f / 100$	$1500 \times f / 100$	5.0

f is frequency in MHz. If measurement cable is extended, open compensation, short compensation, and load compensation must be performed.

Table 4-18 Parameters Y_{OSC} , Y_O , E_P , Z_S

Frequency f Hz	Y_{OSC} nS	Y_O nS	E_P %	Z_S m Ω
$1k \leq f \leq 200k$	$1 \times (125/V_{osc} - 0.5)$	1.5	0.095	5.0
$200k < f \leq 1M$	$2 \times (125/V_{osc} - 0.5)$	3.0	0.095	5.0
$1M < f \leq 2M$	$2 \times (125/V_{osc} - 0.5)$	3.0	0.28	5.0
$2M < f$	$20 \times (125/V_{osc} - 0.5)$	30.0	0.28	5.0

V_{osc} is oscillator level in mV.

Table 4-19 Example of calculated C/G measurement accuracy

Frequency	Measured Capacitance	C Accuracy ^a	Measured Conductance	G Accuracy ^a
5 MHz	1 pF	± 0.61 %	≤ 3 μS	± 192 nS
	10 pF	± 0.32 %	≤ 31 μS	± 990 nS
	100 pF	± 0.29 %	≤ 314 μS	± 9 μS
	1 nF	± 0.32 %	≤ 3 mS	± 99 μS
1 MHz	1 pF	± 0.26 %	≤ 628 nS	± 16 nS
	10 pF	± 0.11 %	≤ 6 μS	± 71 nS
	100 pF	± 0.10 %	≤ 63 μS	± 624 nS
	1 nF	± 0.10 %	≤ 628 μS	± 7 μS
100 kHz	10 pF	± 0.18 %	≤ 628 nS	± 11 nS
	100 pF	± 0.11 %	≤ 6 μS	± 66 nS
	1 nF	± 0.10 %	≤ 63 μS	± 619 nS
	10 nF	± 0.10 %	≤ 628 μS	± 7 μS
10 kHz	100 pF	± 0.18 %	≤ 628 nS	± 11 nS
	1 nF	± 0.11 %	≤ 6 μS	± 66 nS
	10 nF	± 0.10 %	≤ 63 μS	± 619 nS
	100 nF	± 0.10 %	≤ 628 μS	± 7 μS
1 kHz	100 pF	± 0.92 %	≤ 63 nS	± 6 nS
	1 nF	± 0.18 %	≤ 628 nS	± 11 nS
	10 nF	± 0.11 %	≤ 6 μS	± 66 nS
	100 nF	± 0.10 %	≤ 63 μS	± 619 nS

a. The calculation examples are specified under the conditions $D_x = 0.1$, 1 PLC integration time, 30 mVrms test signal level, and at four-terminal pair port of the MFCMU.

Accessories

N1258A module selector

- Input
 - HPSMU port 1 ea., Triaxial for Force and Sense
 - HCSMU port 1 ea., BNC for Force and Triaxial for Sense
 - HVSMU port 1 ea., HV triaxial
 - GNDU port 1 ea., Triaxial
 - Digital I/O port 1 ea., D-sub 25 pin
 - AC power line connector 1 ea.
- Output
 - High port 1 ea., HV triaxial for Force and Sense
 - Low port 1 ea., BNC for Force and Sense
 - External relay control output 1 ea., D-sub 25 pin
- Protection
 - HPSMU, GNDU, and HCSMU Low Force
- Power indicator
 - LED turns yellow when AC power is applied and turns green the module selector is ready to use.
- Status indicator
 - Green LED lights to indicate the present connection path of module selector; Open, HCSMU, HPSMU, or HVSMU.
- Maximum voltage/current
 - For HPSMU: ± 200 V/1 A
 - For HCSMU: ± 40 V/2 A, ± 20 V/30 A (Pulse width 1 ms, duty 1 %)
 - For HVSMU: ± 3000 V/4 mA, ± 1500 V/8 mA
- Leakage current, supplemental characteristics
 - For HPSMU: 10 pA at 200 V
 - For HCSMU: 100 pA at 10 V (High Force to Low Force, High Sense to Low Sense)

For HVSMU: 10 pA at 1500 V (humidity range: 20 % to 70 % RH),
20 pA at 3000 V (humidity range: 20 % to 50 % RH)

N1259A test fixture

- Input

HPSMU port 2 ea., Triaxial for Force and Sense

HCSMU port 2 ea., BNC for Force and Triaxial for Sense

HVSMU port 1 ea., HV triaxial

GNDU port 1 ea., Triaxial

AUX port 2 ea., BNC

Interlock port 1 ea.

- Protection

HPSMU, GNDU, and HCSMU Low Force

- High voltage indicator

LED turns red when a SMU output voltage is ≥ 42 V.

- Maximum voltage/current

For HPSMU: Force: ± 200 V/1 A, Sense: ± 200 V

For HCSMU:

High Force: ± 40 V/2 A, ± 20 V/40 A (Pulse width 1 ms, duty 1 %)

Low Force: ± 40 V/2 A, ± 20 V/40 A (Pulse width 1 ms, duty 1 %)

High Sense: ± 40 V

Low Sense: ± 40 V

For HVSMU: Force: ± 3000 V/4 mA, ± 1500 V/8 mA

Note: The total power consumption of all modules cannot exceed 50 W when using the N1259A under the condition that operating temperature is > 35 °C.

- Leakage current, supplemental characteristics

For HPSMU (Force, Sense): 10 pA at 200 V

For HCSMU (High Force, High Sense): 100 pA at 10 V

For HVSMU (Force): 10 pA at 1500 V (humidity range: 20 % to 70 % RH),
20 pA at 3000 V (humidity range: 20 % to 50 % RH)

N1259A-010 inline package socket module (3 pin)

- Number of terminals: 6 ea., Ø4 mm jack (banana)
- DUT interface: Inline package socket (3-pin)
- Maximum voltage for terminals: 3000 Vdc

N1259A-011 universal socket module

- Number of terminals: 8 ea., Ø4 mm jack (banana)
- Maximum voltage for terminals: 3000 Vdc

N1259A-013 curve tracer test adapter socket module

- Number of terminals: 6 ea., Ø4 mm jack (banana)
- Test adapter interface¹: 6 ea., Ø4 mm jack (banana)
- Maximum voltage for terminals: 3000 Vdc

N1259A-020 high voltage bias-tee

- Input
 - DC Bias Input port 1 ea., Ø4 mm jack (banana) for Force and Guard
 - MFCMU Input port 1 ea., BNC for Hcur, Hpot, Lcur, and Lpot on the rear panel
- Output
 - MFCMU port 1 ea., SHV for High and Low
- External DC bias voltage: ± 3000 V
- Frequency: 10 kHz to 1 MHz (150 Ω at 10 kHz)
- Series capacitance: 110 nF ± 5 %
- Input resistance: 100 k Ω ± 1 %

1. Tektronix 370B/371B test adapter port. One test adapter can be connected to this interface.

N1259A-021 1 M Ω R-box

- Input/output: 1 ea., \varnothing 4 mm jack (banana)
- Resistance: 1 M Ω \pm 5 %
- Maximum voltage: \pm 3000 V
- Power rating: 9 W
- Leakage current, supplemental characteristics: 10 pA at 100 V

N1259A-022 100 k Ω R-box

- Input/output: 1 ea., \varnothing 4 mm jack (banana)
- Resistance: 100 k Ω \pm 5 %
- Maximum voltage: \pm 3000 V
- Power rating: 6.4 W
- Leakage current, supplemental characteristics: 10 pA at 100 V

N1259A-030 1 k Ω R-box for gate

- Input/output: 1 ea., \varnothing 4 mm jack (banana)
- Resistance: 1 k Ω \pm 10 %
- Maximum voltage: \pm 200 V
- Power rating: 1 W
- Leakage current, supplemental characteristics: 10 pA at 100 V

N1259A-300 module selector for test fixture

- Input
 - HPSMU port 1 ea., Triaxial for Force and Sense
 - HCSMU port 1 ea., BNC for Force and Triaxial for Sense
 - HVSMU port 1 ea., HV triaxial
 - GNDU port 1 ea., Triaxial
 - Digital I/O port 1 ea., D-sub 25 pin
 - AC power line connector 1 ea.

Specifications and Options

Specifications

- Output
High port 1 ea., \varnothing 4 mm jack (banana) for Guard, Force, Sense, and Guard
Low port 1 ea., \varnothing 4 mm jack (banana) for Force and Sense
- Protection
HPSMU, GNDU, and HCSMU Low Force
- Power indicator
LED turns yellow when AC power is applied and turns green the module selector is ready to use.
- Status indicator
Green LED lights to indicate the present connection path of module selector; Open, HCSMU, HPSMU, or HVSMU.
- Maximum voltage/current
For HPSMU: ± 200 V/1 A
For HCSMU: ± 40 V/2 A, ± 20 V/30 A (Pulse width 1 ms, duty 1 %)
For HVSMU: ± 3000 V/4 mA, ± 1500 V/8 mA
- Leakage current, supplemental characteristics
For HPSMU: 10 pA at 200 V
For HCSMU: 100 pA at 10 V (High Force to Low Force, High Sense to Low Sense)
For HVSMU: 10 pA at 1500 V (humidity range: 20 % to 70 % RH),
30 pA at 3000 V (humidity range: 20 % to 50 % RH)

N1260A high voltage bias-tee

- Input
HVSMU port 1 ea., HV triaxial
MFCMU port 1 ea., BNC for Hcur, Hpot, Lcur, and Lpot
- Output
Output port: 1 ea., SHV for High, Low, and AC Guard
- External DC bias voltage: ± 3000 V
- Frequency: 10 kHz to 1 MHz (150 Ω at 10 kHz)

- Series capacitance: 110 nF \pm 5 %
- Input resistance: 100 k Ω \pm 1 %

N1261A-001 protection adapter for HPSMU (triaxial output)

- Input: Triaxial for Force and Sense
- Output: Triaxial for Force and Sense
- Leakage current, supplemental characteristics: 10 pA at 200 V

N1261A-002 protection adapter for GNDU (BNC output)

- Input: Triaxial for GNDU
- Output: BNC for Force and Sense

N1261A-003 protection adapter for HPSMU (HV triaxial output)

- Input: Triaxial for Force and Sense
- Output: HV triaxial for Force and Sense
- Leakage current, supplemental characteristics: 10 pA at 200 V

N1261A-004 protection adapter for GNDU (SHV output)

- Input: Triaxial for GNDU
- Output: SHV for Force and Sense

N1262A-001 1 M Ω R-box

- Input: HV triaxial for HVSMU
- Output: SHV
- Resistance: 1 M Ω \pm 5 %
- Maximum voltage: \pm 3000 V
- Power rating: 9 W
- Leakage current, supplemental characteristics: 10 pA at 100 V

Specifications and Options

Specifications

N1262A-002 100 k Ω R-box

- Input: HV triaxial for HVSMU
- Output: SHV
- Resistance: 100 k Ω \pm 5 %
- Maximum voltage: \pm 3000 V
- Power rating: 6.4 W
- Leakage current, supplemental characteristics: 10 pA at 100 V

N1262A-010 1 k Ω R-box for gate (triaxial output)

- Input: Triaxial for SMU Force
- Output: Triaxial
- Resistance: 1 k Ω \pm 10 %
- Maximum voltage: \pm 200 V
- Power rating: 1 W
- Leakage current, supplemental characteristics: 10 pA at 100 V

N1262A-011 1 k Ω R-box for gate (SHV output)

- Input: HV triaxial for SMU Force
- Output: SHV
- Resistance: 1 k Ω \pm 10 %
- Maximum voltage: \pm 3000 V
- Power rating: 1 W
- Leakage current, supplemental characteristics: 10 pA at 100 V

Agilent EasyEXPERT Software

Operation mode

- Application test mode
- Classic test mode
- Tracer test mode (curve tracer mode)
- Quick test mode

Key features

- Categorized and predefined application test library
- GUI-based application test editor
- Save/recall My Favorite setups
- Define/customize application library
- Measurement control (Single, Repeat, Append, Stop)
- Quick test execution
- Direct control by using FLEX commands
- Save/recall measurement data and settings
- Test result data management
- Import/export device definition, measurement settings, my favorite setup, measurement data, and application library
- Graph plot display/analysis/printing
- Workspace management
- Self-test, self-calibration, diagnostics

Application library

Sample test definitions for the following categories. They are subject to change without notice.

High power device, Utility

SMU source output functions

Each SMU supports the following source output functions.

- VAR1
Primary sweep controls the staircase (dc or pulsed) voltage or current sweep.
Maximum number of steps: $N_1 = 1001$
- VAR2
Subordinate linear staircase or linear pulsed sweep. After primary sweep is completed, the VAR2 unit output is changed.
Maximum number of steps: $N_2 = 1001$ (condition: $1 \leq N_1 \times N_2 \leq 128128$)
- VAR1'
Staircase or pulse sweep synchronized with the VAR1 sweep. Sweep is made with a user specified ratio and offset value.
$$\text{VAR1}' = a \times \text{VAR1} + b$$
where “a” is the user specified ratio and “b” is the user specified offset value.
- CONST
A source unit can be set as a constant voltage or current source depending on the unit.
- Standby mode
SMUs in “Standby” remain the specified source output condition even as other units are reset for the next measurement.
- SMU setting capabilities
Limited auto ranging, voltage/current compliance, power compliance, automatic sweep abort functions

Measurement functions

Agilent B1505A supports the following measurement functions.

- Measurement mode
 - IV spot
 - IV staircase sweep
 - IV pulsed spot

- IV pulsed sweep
- IV staircase sweep with pulsed bias
- IV sampling
- IV high speed sampling
- Multi channel sweep (VAR1' is not supported)
- Multi channel pulsed spot
- Multi channel pulsed sweep
- CV (DC bias) sweep
- CV (AC signal level) sweep
- C-t sampling
- C-f sweep
- List sweep
- Linear search (supported by FLEX command)
- Binary search (supported by FLEX command)
- Sweep measurement time settings
 - Hold time: 0 to 655.35 s, 10 ms resolution
 - Delay time
 - 0 to 65.5350 s, 100 μ s resolution (Staircase sweep, multi channel sweep)
 - 0 to 655.350 s, 100 μ s resolution (CV (DC bias) staircase sweep, AC level sweep, frequency sweep)
 - Step delay time: 0 to 1 s, 100 μ s resolution
 - Step output trigger delay time: 0 to delay time s, 100 μ s resolution
 - Step measurement trigger delay time: 0 to 65.535 s, 100 μ s resolution
- Staircase sweep measurement mode

Forces swept voltage or current, and measures DC voltage or current. One channel can sweep current or voltage while up to 5 channels can measure current or voltage. A second channel can be synchronized with the primary sweep channel as an additional voltage or current sweep source.

Number of steps: 1 to 1001

Sweep type: linear or logarithmic

Specifications and Options

Specifications

Sweep direction: single or double sweep

- Pulsed sweep measurement mode

Forces pulsed swept voltage or current, and measures DC voltage or current. A second channel can be programmed to output a staircase sweep voltage or current synchronized with the pulsed sweep output.

- Staircase sweep with pulsed bias measurement mode

Forces swept voltage or current, and measures DC voltage or current. A second channel can be programmed to output a pulsed bias voltage or current. A third channel can be synchronized with the primary sweep channel as an additional voltage or current sweep source.

- Sampling (time domain) measurement mode

Displays the time sampled voltage/current data (by SMU) versus time.

Sampling channels: up to 5

Sampling type: linear or logarithmic

Sampling points: 1 to 100,001/(number of channels) for linear sampling, or 1 to 1 + (number of data for 11 decades) for log sampling

Sampling interval range: 2 ms to 65.535 s in 1 ms resolution, or $100\ \mu\text{s} + 20\ \mu\text{s} \times (\text{number of channels} - 1)$ to 2 ms in 10 μs resolution

Hold time, initial wait time: -90 ms to -100 μs in 100 μs resolution, or 0 to 655.35 s in 10 ms resolution

Measurement time resolution: 100 μs

- Current offset cancel

This function subtracts the offset current from the current measurement raw data, and returns the result as the measurement data. This function is used to compensate the error factor (offset current) caused by the measurement path such as the measurement cables, manipulators, or probe card.

- Timestamp

The B1505A supports a time stamp function utilizing an internal quartz clock.

Resolution: 100 μs

Arithmetic and analysis functions

- User functions

Up to 20 user-defined functions can be defined using arithmetic expressions.

Measured data and pre-defined variables can be used in the computation. The results can be displayed on the LCD.

- Arithmetic operators

+, -, *, /, ^, abs (absolute value), at (arc tangent), avg (averaging), cond (conditional evaluation), delta, diff (differential), exp (exponent), integ (integration), lgt (logarithm, base 10), log (logarithm, base e), mavg (moving average), max, min, sqrt, trigonometric function, inverse trigonometric function, and so on

- Physical constants

Keyboard constants are stored in memory as follows:

- q: Electron charge, 1.602177E-19 C
- k: Boltzman's constant, 1.380658E-23 J/K
- ε (e): Dielectric constant of vacuum, 8.854188E-12 F/m

- Engineering units

The following unit symbols are also available on the keyboard.

a (10^{-18}), f (10^{-15}), p (10^{-12}), n (10^{-9}), u or μ (10^{-6}), m (10^{-3}), k (10^3), M (10^6), G (10^9), T (10^{12}), P (10^{15})

Analysis capabilities

- Overlay graph comparison

Graphical plots can be stored and overlaid.

- Scale

Auto scale and zoom

- Marker

Marker to min/max, interpolation, direct marker, and marker skip

- Cursor

Direct cursor

- Line

Specifications and Options

Specifications

Two lines, normal mode, grad mode, tangent mode, and regression mode

- Automatic analysis function

On a graphics plot, the markers and lines can be automatically located using the auto analysis setup. Parameters can be automatically determined using automatic analysis, user function, and read out functions.

- Data variable display

Up to 20 user-defined parameters can be displayed on the graphics screen.

- Analysis functions

Up to 20 user-defined analysis functions can be defined using arithmetic expressions.

Measured data, pre-defined variables, and read out functions can be used in the computation. The results can be displayed on the LCD.

- Read out functions

The read out functions are built-in functions for reading various values related to the marker, cursor, or line.

- Graph plot

- Display mode

Data display window can be printed. Only X-Y graph can be printed.

- Graph plot file

Graph plot can be stored as image data to clip board or mass storage device.

File type: bmp, gif, png, emf

- Output

- Display mode

X-Y graph, list, and parameter

- X-Y graph display

X-axis and up to eight Y-axis. Linear and log scale. Real time graph plotting.

- List display

Measurement data and calculated user function data are listed in conjunction with VAR1 step number or time domain sampling step number. Up to 20 data sets can be displayed.

Other functions

- File export/import
File type: Agilent EasyEXPERT format, XML-SS format, CSV format
- Data storage
Hard disk drive, DVD-ROM/CD-R/CD-RW drive
- Interfaces
GPIB, interlock, USB (USB 2.0, 2 ea. on front, 2 ea. on rear),
LAN (100BASE-TX/10BASE-T), trigger in/out, digital I/O
- Trigger I/O
Only available in the GPIB remote mode.
Trigger in/out synchronization pulses before and after setting and measuring DC voltage and current. Arbitrary trigger events can be masked or activated independently.

Supported external instruments

Agilent 4284A, E4980A, 81110A, 3458A

The supported external instruments can be controlled by using application tests.

Furnished Software

- Prober control execution files
- Desktop EasyEXPERT software with license-to-use for Standard edition
- 4155/56 setup file converter tool

NOTE

For the latest system requirements, go to www.agilent.com and type in B1505A in the Search field at the top of the page.

General Specifications

- Temperature range
Operating: +5 °C to +40 °C, Storage: -20 °C to +60 °C
- Humidity
Operating: 20 % to 70 % RH, Storage: 10 % to 90 % RH. Non-condensing
- Altitude
Operating: 0 to 2,000 m (6,561 ft.), Storage: 0 to 4,600 m (15,092 ft.)
- Power requirement
90 to 264 V, 47 to 63 Hz
- Maximum volt-amps (VA)
B1505A: 900 VA, N1258A: 65 VA, N1259A-300: 35 VA
- Regulatory compliance

EMC	IEC61326-1 / EN61326-1 AS/NZS CISPR 11
Safety	CSA C22.2 No.1010.1-1992 IEC61010-1 / EN61010-1 UL Std No. 61010B-1
- Certification
CE, CSA(c/us), C-Tick
- Dimensions

B1505A:	420 mm (W) × 330 mm (H) × 575 mm (D)
N1258A:	330 mm (W) × 120 mm (H) × 410 mm (D)
N1259A:	420 mm (W) × 272 mm (H) × 410 mm (D)
N1260A:	164 mm (W) × 53 mm (H) × 125 mm (D)
N1261A-001:	80 mm (W) × 40 mm (H) × 110 mm (D)
N1261A-002:	80 mm (W) × 40 mm (H) × 110 mm (D)
N1261A-003:	90 mm (W) × 40 mm (H) × 140 mm (D)
N1261A-004:	80 mm (W) × 40 mm (H) × 125 mm (D)
N1262A:	50 mm (W) × 40 mm (H) × 125 mm (D)
- Weight
B1505A (empty): 20 kg, B1510A: 2.0 kg, B1512A: 2.1 kg, B1513A: 2.0 kg,
B1520A: 1.5 kg, N1258A: 5.0 kg, N1259A: 12.0 kg, N1260A: 0.6 kg,
N1261A: 0.3 kg, N1262A: 0.3 kg

Accessories and Options

Furnished accessories and the available options and accessories for Agilent B1505A are listed in Table 4-20 and Table 4-21.

Table 4-20 **Furnished Accessories**

Description	Quantity
Power cable	1
Desktop EasyEXPERT CD	1
License-to-use for Desktop EasyEXPERT Standard edition	1
Disk set for Agilent 4155B/4155C/4156B/4156C firmware update	1
SMU number label, for the B1505A installed with SMU	1
16444A-001 USB keyboard	1
16444A-002 USB mouse	1
16444A-003 Stylus pen	1
16493J Interlock cable	1
16493L GNDU cable	1
16494A Triaxial cable, for the B1505A installed with HPSMU	2/module
16493S HCSMU cable, for the B1505A installed with HCSMU	1/module
16493S-010 HCSMU Kelvin adapter, for the B1505A installed with HCSMU	1/module
16493T HVSMU cable, for the B1505A installed with HVSMU	1
N1300A CMU cable, for the B1505A installed with MFCMU	1

Specifications and Options
Accessories and Options

Table 4-21 Options and Accessories

Model Number	Option Item	Description
B1505A		Power Device Analyzer/Curve Tracer
	B1505A-015	1.5 m cable length
	B1505A-030	3 m cable length
	B1505A-050	50 Hz power line frequency
	B1505A-060	60 Hz power line frequency
	B1505A-A6J	ANSI Z540 compliant calibration
	B1505A-UK6	Commercial calibration certificate with test data
	B1505A-ABA	Paper manual set, English
	B1505A-ABJ	Paper manual set, Japanese
	B1505A-ICM	Rack mount kit
B1510A		High Power Source/Monitor Unit module (HPSMU)
B1512A		High Current Source/Monitor Unit module (HCSMU)
B1513A		High Voltage Source/Monitor Unit module (HVSMU)
B1520A		Multi Frequency Capacitance Measurement Unit module (MFCMU)
B1540A		EasyEXPERT software
	B1540A-001	Standard edition
	B1540A-002	Plus edition (supports E5250A+E5252A by switching matrix GUI)
B1541A		Desktop EasyEXPERT software
	B1541A-001	Standard edition
	B1541A-002	Plus edition (supports E5250A+E5252A by switching matrix GUI and expands 4155/4156 support functions)
N1253A		Accessories for Digital I/O
	N1253A-100	Digital I/O T-cable
	N1253A-200	Digital I/O BNC box

Model Number	Option Item	Description
N1254A		Accessories
	N1254A-100	GNDU Kelvin adapter, 1 ea.
	N1254A-500	HV(jack) connector, panel mount, for soldering, 1 ea.
	N1254A-501	HV(jack)-HV(jack) adapter, panel mount, 1 ea.
	N1254A-502	HV(plug) connector, panel mount, for soldering, 1 ea.
	N1254A-503	BNC(m) to no connector coaxial cable, 1.5 m, 1 ea.
	N1254A-505	HV(plug) to no connector triaxial cable, 1.5 m, 1 ea.
	N1254A-506	HV(plug) to no connector coaxial cable, 1.5 m, 1 ea.
	N1254A-507	HV(plug)-HV(plug) coaxial cable, 1.5 m, 1 ea.
	N1254A-508	Connection wire, red 1 ea.
	N1254A-509	Connection wire, black 1 ea
	N1254A-510	Dolphin clip adapter, black 1 ea. and red 1ea.
	N1254A-511	Cable lag adapter, black 1 ea. and red 1ea.
	N1254A-512	SHV(plug)-SHV(plug) test lead, 1 ea.
	N1254A-513	SHV(jack)-banana adapter, 1 ea.
	N1254A-514	BNC(m)-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.	
N1258A		Module Selector

Specifications and Options
Accessories and Options

Model Number	Option Item	Description
N1259A		Test Fixture (furnished with the built-in HPSMU protection adapter, the built-in GNDU protection adapter, a Kelvin socket module for inline package device, four black connection wire, and six red connection wire)
	N1259A-001	Test Fixture
	N1259A-010	Kelvin socket module for inline package device
	N1259A-011	Universal socket module for power device
	N1259A-012	Blank teflon board
	N1259A-013	Curve tracer test adapter socket module
	N1259A-020	High voltage bias-T (furnished with two SHV-SHV test leads and two SHV-banana adapters)
	N1259A-021	1 M Ω R-box
	N1259A-022	100 k Ω R-box
	N1259A-030	1 k Ω R-box
	N1259A-300	Module selector
N1260A		High voltage bias-T
N1261A		Protection Adapter
	N1261A-001	HPSMU protection adapter, Triax(f)
	N1261A-002	GNDU protection adapter, BNC(f)
	N1261A-003	HPSMU protection adapter, HV(jack)
	N1261A-004	GNDU protection adapter, SHV(jack)
N1262A		High Voltage R-box
	N1262A-001	1 M Ω R-box, SHV(jack)
	N1262A-002	100 k Ω R-box, SHV(jack)
	N1262A-010	1 k Ω R-box, Triax(f)
	N1262A-011	1 k Ω R-box, SHV(jack)

Model Number	Option Item	Description
N1300A		CMU cable
	N1300A-001	1.5 m length
	N1300A-002	3 m length
16444A		Accessories for B1500 series
	16444A-001	USB keyboard
	16444A-002	USB mouse
	16444A-003	Stylus pen
16493G		Digital I/O connection cable
	16493G-001	1.5 m length
	16493G-002	3 m length
16493J		Interlock cable
	16493J-001	1.5 m length
	16493J-002	3 m length
	16493J-003	5 m length
16493K		HPSMU Kelvin triaxial cable
	16493K-001	1.5 m length
	16493K-002	3 m length
16493L		GNDU cable
	16493L-001	1.5 m length
	16493L-002	3 m length
	16493L-003	5 m length

Specifications and Options
Accessories and Options

Model Number	Option Item	Description
16493S		HCSMU cable
	16493S-001	1.5 m length
	16493S-002	3 m length
	16493S-010	HCSMU Kelvin adapter
	16493S-011	HCSMU non-Kelvin adapter
	16493S-020	Dual HCSMU Kelvin combination adapter (Adapter, 40 A, when connecting to wafer prober directly without N1258A selector)
	16493S-021	Dual HCSMU combination adapter (Adapter, 40 A, when not connecting to wafer prober directly)
16493T		HVSMU cable, HV(plug)-HV(plug) triaxial cable
	16493T-001	1.5 m length
	16493T-002	3 m length
16493U		High current coaxial cable, BNC(m)-BNC(m)
	16493U-001	1.5 m length
	16493U-002	3 m length
16494A		Triaxial cable
	16494A-001	1.5 m length
	16494A-002	3 m length
	16494A-003	80 cm length
	16494A-004	40 cm length
	16494A-005	4 m length