

# Keysight Technologies B1507A Power Device Capacitance Analyzer

# Notices

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## Manual Part Number

B1507-90000

## Edition

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To get the latest version of the declaration of conformity, go to <http://www.keysight.com/go/conformity> and type in the product number in the Search field.

## Latest Information

To get the latest firmware/software/electronic manuals/specifications/support information, go to [www.keysight.com](http://www.keysight.com) and type in the product number in the Search field at the top of the page.

## **COMPLIANCE WITH GERMAN NOISE REQUIREMENTS**

This is to declare that this product is in conformance with the German Regulation on Noise Declaration for Machines (Lärmangabe nach der Maschinenlärminformation-Verordnung -3.GSGV Deutschland).

- **Herstellerbescheinigung**

GERÄUSCHEMISSION

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

### **South Korean Class A EMC declaration**

This equipment is Class A suitable for professional use and is for use in electromagnetic environments outside of the home.

A급 기기

(업무용 방송통신기자재)

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

## WARNING



### High Voltage

is used in the operation of this equipment.

### LETHAL VOLTAGE on CONTACT

may be present at measurement terminals,  
if you fail to take in all safety precautions!

- When the RED indicator lights, lethal voltage ( $\pm 3000$  V dc/pulse) may appear at measurement terminals.
- **Usually use the interlock function.**
- Do not operate the instrument unless another person is around the work space who is familiar with instrument operation and hazards or administering first aid.
- Potentials less than  $\pm 500$  V may cause death under certain conditions. Therefore, adequate preventive measures must be taken at all times!

### FIRST AID FOR ELECTRIC SHOCK

#### *SPECIAL ATTENTION TO RESCUE IN SAFETY*

- Never rush into an accidental situation.
- Take special attention to the following notices to prevent second accident.
  - Do NOT touch the CASUALTY or conductive surface with your hands unprotected.
  - Shut off high voltage at once.
  - Disconnect AC mains.
- If it is unsure to make safe, the following procedure will help to protect your lives during the CASUALTY is rescued.
  - Stand on a dry insulating material; use a dry wooden or plastic implement to free the CASUALTY from contact with hazardous electrical source.
  - Ground the circuit to de-energize.

- Free the CASUALTY from the LIVE conductor

### CALL EMERGENCY

- Call your local Emergency number immediately, if any of signs or symptoms shown in the following table will be found.

[http://en.wikipedia.org/wiki/Emergency\\_telephone\\_number#Emergency\\_numbers](http://en.wikipedia.org/wiki/Emergency_telephone_number#Emergency_numbers)


### DELAYED SYMPTOMS

- In some cases, electric shock can cause injuries that are not evident and symptoms may be delayed.
- Burns to the CASUALTY may be greater than they appear on the surface.
- For these reasons, all electric shock CASUALTY should be taken to hospital for advanced observation.

<i>English</i>	<i>Deutsch</i>	<i>French</i>	<i>Japanese</i>	<i>Korean</i>	<i>Simplified Chinese</i>	<i>Traditional Chinese</i>
<b>Symptoms</b>	<b>Symptome</b>	<b>Symptômes</b>	<b>兆候</b>	<b>징후</b>	<b>征候</b>	<b>徵候</b>
Cardiac arrest	Herz-Kreislauf-Stillstand	Arestation cardiopulmonaire	心肺停止	심폐 정지	心肺停止	心肺停止
Abnormal cardiac rhythm	Arrhythmia	Arythmie	不整脈	부정맥	脉律不齐	脈律不齊
Respiratory failure (difficult or absent breathing)	Respiratorischer Mißerfolg	Échec respiratoire	呼吸不全	호흡 부전	呼吸不全	呼吸不全
Muscle pain and contractions	Muskelschmerz und Zusammenziehungen	Douleur du muscle et contractions	筋肉痛 / 痙攣	근육통 / 수축	肌肉痛 / 痙攣	肌肉痛 / 痙攣
Seizures (heart beat stopped)	Herzlähmung	Paralysie cardiaque	心臟麻痺	심장 마비	心脏麻痹	心臟麻痺
Numbness and tingling	Eine Taubheit / Stachel	Un engourdissement / Une épine	痺れ / 刺痛	저리다 / 가시痛	发麻 / 刺痛	發麻 / 刺痛
Unconsciousness	Bewusstlosigkeit	Évanouissement	意識不明	의식 불명	意识不明	意識不明
Entrance and exit wound burns	Eine elektrische Schockspur	Une trace du choc électrique	感電跡	감전 자국	触电痕迹	觸電痕跡

## First Aid for Electric Shock Procedure

Do not give compression-only CPR to infants and children — all infants and children who have a sudden cardiac arrest need conventional CPR. Also should not be used for adults whose cardiac arrest is from respiratory causes, or for an unwitnessed cardiac arrest.

D	Danger	Check for DANGER, make SAFE first to YOU, Others, and the CASUALTY.	
R	Response	Check for a RESPONSE.	
		Leave on back. If not conscious, <ol style="list-style-type: none"> <li>1. Ask others to emergency CALL for an ambulance immediately.</li> <li>2. HELP to bring AED, ASAP.</li> <li>3. Start CPR by YOU.</li> </ol>	
C	CPR for ADULT only	Start the center of chest compressions (>100 compressions per minute) without stopping until emergency medical services arrive.	
		One of the most famous chest compression-only CPR is AHA Hands-Only CPR which is without mouth-to-mouth rescue breaths. <a href="http://handsonlycpr.org/">http://handsonlycpr.org/</a> <a href="http://www.youtube.com/watch?v=zuJkRpJ7Fyg">http://www.youtube.com/watch?v=zuJkRpJ7Fyg</a>	
		Rhythm of chest compression: <a href="http://www.heart.org/HEARTORG/CPRAndECC/CommunityTraining/CommunityPrograms/CPR-Week_UCM_427219_SubHomePage.jsp">http://www.heart.org/HEARTORG/CPRAndECC/CommunityTraining/CommunityPrograms/CPR-Week_UCM_427219_SubHomePage.jsp</a> <a href="http://www.youtube.com/watch?v=n5hP4DIBCEE&amp;feature=player_detailpage">http://www.youtube.com/watch?v=n5hP4DIBCEE&amp;feature=player_detailpage</a>	
		Continue CPR until <ul style="list-style-type: none"> <li>● Signs of life return.</li> <li>● AED is ready to use.</li> <li>● Medical services arrive and take over.</li> </ul>	
If YOU have a trained rescue skill, should apply the following step. If not, only keep chest compression until others help.			
A	Airway	<b>No foreign material</b> Leave on back, open airway.	<b>Foreign material</b> Place in the recovery position, clear of objects.
B	Breathing	30 compress & 2 breaths	
D	Defibrillator 	Apply AED with following voice prompts. If no AED available, continue CPR until qualified personnel arrives.	

- ※AED: Automated External Defibrillator
- ※CPR: Cardio Pulmonary Resuscitation
- ※AHA: American Heart Association, Inc.

## Reference

- AHA CPR & Emergency Cardiovascular Care (ECC)  
([http://www.heart.org/HEARTORG/CPRAndECC/CPR\\_UCM\\_001118\\_SubHomePage.jsp](http://www.heart.org/HEARTORG/CPRAndECC/CPR_UCM_001118_SubHomePage.jsp))
- AHA Hands-only CPR (<http://handsonlycpr.org/>)
- Save a Life  
([http://www.heart.org/HEARTORG/CPRAndECC/CommunityTraining/CommunityPrograms/CPR-Week\\_UCM\\_427219\\_SubHomePage.jsp](http://www.heart.org/HEARTORG/CPRAndECC/CommunityTraining/CommunityPrograms/CPR-Week_UCM_427219_SubHomePage.jsp))
- AHA CPR Translated Website  
([http://www.heart.org/HEARTORG/CPRAndECC/International/TranslatedWebsites/Translated-Websites\\_UCM\\_303149\\_SubHomePage.jsp](http://www.heart.org/HEARTORG/CPRAndECC/International/TranslatedWebsites/Translated-Websites_UCM_303149_SubHomePage.jsp))  
Deutsch (<http://www.american-heart.de/startseite>)  
Japanese (<http://eccjapan.heart.org/>) available as of March, 2012))
- Chain of Survival  
([http://www.heart.org/HEARTORG/CPRAndECC/WhatisCPR/ECCIntro/Chain-of-Survival\\_UCM\\_307516\\_Article.jsp](http://www.heart.org/HEARTORG/CPRAndECC/WhatisCPR/ECCIntro/Chain-of-Survival_UCM_307516_Article.jsp))
- ECC Guidelines Highlights 2010  
English ([http://eccjapanheart.org/pdf/ECC\\_Guidelines\\_Highlights\\_2010.pdf](http://eccjapanheart.org/pdf/ECC_Guidelines_Highlights_2010.pdf))  
Japanese ([http://eccjapanheart.org/pdf/ECC\\_Guidelines\\_Highlights\\_2010JP.pdf](http://eccjapanheart.org/pdf/ECC_Guidelines_Highlights_2010JP.pdf))  
Deutsch ([http://www.american-heart.at/fileadmin/downloads/Guidelines2010-Highlights\\_D/Guidelines2010-Highlights\\_D.pdf](http://www.american-heart.at/fileadmin/downloads/Guidelines2010-Highlights_D/Guidelines2010-Highlights_D.pdf))

## International

- ILCOR (<http://www.ilcor.org/home/>)
- ILCOR CoSTR 2010 Consensus  
(<http://www.ilcor.org/consensus-2010/costr-2010-documents/>)

## Europe

- ERC (<https://www.erc.edu/>)
- ERC Guidelines 2010 (<http://www.cprguidelines.eu/2010/>)  
Local language translation (<https://www.erc.edu/index.php/doclibrary/en/185/1/>)

## America

- AHA (<http://www.americanheart.org/>)
- AHA Guidelines 2010 (<http://guidelines.ecc.org/2010-guidelines-for-cpr.html>)

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## 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. Keysight Technologies 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.keysight.com](http://www.keysight.com) and type the product model number in the Search field at the top of the page.

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### 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 measurement terminals must not be connected to line-voltage mains.

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- *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.

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### WARNING

**Hazardous voltage, instrument maximum output voltage may appear at the measurement terminals (Force, Guard, and Sense) if Interlock terminal is closed. Open the Interlock terminal when the measurement terminals are accessible. Voltage applied to the terminals will be limited up to  $\pm 42$  V.**

**Do not work the interlock function intentionally in order to bring the output voltage to the safe level. While the high voltage indicator is lit, the dangerous voltage by the output voltage or the residual charge appears on the measurement terminal.**

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- *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.

- *DO NOT REMOVE COVERS*

No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock do not remove covers.

- *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. Return the instrument to a Keysight Technologies sales or service office for services and repair to ensure that safety features are maintained.















- *USE ONLY THE SPECIFIC ACCESSORIES*

Specific accessories satisfy the requirements for specific characteristics for using the instrument. Use the specific accessories, cables, adapters, and so on for safety reasons.

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## Safety Symbols

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

-  Direct current.
-  Alternating current.
-  Earth (ground) terminal.
-  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.
-  Caution, refer to accompanying documentation. The equipment will be marked with this symbol when it is necessary for the user to refer to the instruction manual.

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### 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.

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### 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.

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CAT I IEC Measurement Category I



The CE mark shows that the product complies with all applicable European Directives.



The CSA mark is a registered trademark of the Canadian Standards Association.



The RCM mark is a registered trademark of the Australian Communications Authority. This signifies compliance with the Australian EMC Framework Regulations under the terms of the Radio communications Act.

**ICES/NMB-001**

This ISM device complies with Canadian ICES-001.

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

**ISM GROUP 1 CLASS A**

This is the symbol for an Industrial, Scientific and Medical, Group 1 Class A product. (CISPR 11)



Korea's safety and EMC mark



China RoHS - Environmentally Green Product Label



China RoHS - Product with Toxic Substance 40 yr EPUP



The Chinese mark for paper-based packaging materials; Paperboard and Corrugated Fiberboard

CFB



Plastic Material Coding Identification

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## 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. There is the danger of electric shock by touching the floated measurement terminals. Keep in mind it to protect yourself. And it is a reason of using the recommended accessories.

- 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

Keysight 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

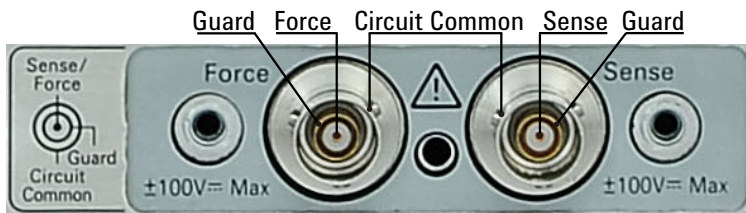
Source/monitor unit, SMU, can simultaneously perform DC voltage or current output and measurement. Typical SMU has the Force, Guard, Sense, and Circuit Common terminals as shown below. Normally the Force, Guard, and Sense terminals are the same potential. Voltage marked around the terminals indicates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

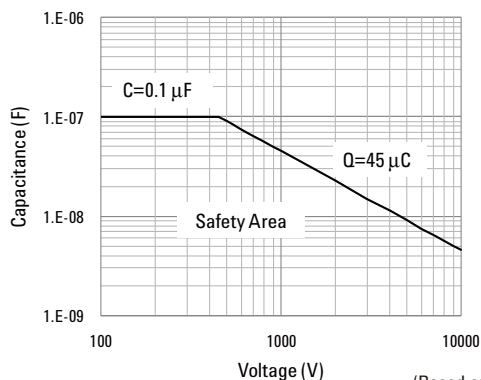
Guard should be extended to around the device terminal for reducing leakage current caused by a coaxial cable used. Guard must be never connected to anything at the device side.

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

The following image is the Kelvin triaxial connector of Medium Power SMU.



- To Avoid Risk of Residual Charge



(Based on standards IEC60950-1 and IEC61010-1.)

This graph shows the load capacitance vs voltage characteristics generally considered as safety. Use the instrument within the safety area up to 0.1  $\mu\text{F}$  or 45  $\mu\text{C}$  according to the voltage. Also do not connect the capacitive load over the maximum load capacitance specified for the instrument, for example 10 nF for HVSMU.

Before touching the measurement terminal, confirm that it has been discharged enough. For that, ground and discharge the terminals over 10 seconds after stopping the high voltage output, and confirm that they have been safety voltage by using another volt meter.

If abnormal end of measurement, breaking of cable, or device damage occurs, do not touch the terminals until they are discharged enough.

Also if a series resistor is connected, do not touch the terminal until it is discharged enough.



### **High Voltage Shock Hazard**

Keysight B1507A can force dangerous voltages ( $\pm 3000$  Vdc for HVSMU and  $\pm 100$  Vdc for MPSMU) at the Force, Guard, and Sense terminals. To prevent electric shock hazard, the following safety precautions must be observed during the use of Keysight B1507A.

- Connect the instrument to an electrical ground (safety ground) by using three-conductor AC power cable.
- 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 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 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 Keysight B1507A können Spannungen an den Anschlüssen "Force", "Guard" und "Sense" von bis zu 3000 V ausgehen. Um elektrischem Schlag vorzubeugen, ist bei der Benützung der Geräte Keysight B1507A folgendes zu beachten.

- Verwenden Sie ein dreiphasiges AC-Stromkabel für die Gerätsteckvorrichtung (Eingang) und schließen Sie das Instrument an eine Erdung an (Sicherheitserdung).
- 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 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 MPSMU; 100 Vdc) émanant du dispositif Keysight B1507A peut être sortie aux bornes Force, Guard et Sense. 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).
- 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 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

Keysight B1507A の Force、Guard、Sense 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  $\pm 3000$  Vdc、MPSMU の場合は最大  $\pm 100$  Vdc)。感電事故防止のため、Keysight B1507A 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。
- 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を確認してください。
- Force、Guard、Sense 端子に繋がる接続部に触れる前には、本器の電源をオフしてください。また、測定系のキャパシタを放電してください。電源をオフしない場合は、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。
  - 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。
- 周囲のほかの作業者に対しても、高電圧危険に対する注意を徹底してください。

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## 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 Keysight office or visit the following website for more information.

<http://about.keysight.com/en/companyinfo/environment/>

- LCD Fluorescent Lamp

Certain products sold by Keysight 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://about.keysight.com/en/quality/env\\_compliance.shtml](http://about.keysight.com/en/quality/env_compliance.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.keysight.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

Keysight B1507A Power Device Capacitance Analyzer operates in the Microsoft Windows environment. Keysight B1507A requires Keysight Easy Test Navigator software, a specially-designed Windows application program.

- About guarantee and support for Keysight B1507A

Keysight Technologies guarantees and supports the performance of Keysight B1507A for the same condition as the preload condition when shipped from the factory.

- About updating Keysight Easy Test Navigator and the Windows Update

Keysight Technologies confirms the operation of Easy Test Navigator patch programs and important Windows security patches, and provides recommended update information. Visit Keysight B1507A support site, download the patches, and perform the software update.

- About Windows application programs and peripherals (including driver)

Using commercial products on Keysight B1507A is your responsibility. Keysight Technologies cannot provide compatibility information for commercial products. If problems arise, perform Keysight B1507A system recovery.

- About servicing

Bench repair service is available at your nearest Keysight Technologies service center. Be aware that the B1507A 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 Keysight B1507A 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 Keysight B1507A from computer viruses.
- If you connect Keysight B1507A 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, installation information, measurement operation, and software reference information of Keysight Technologies B1507A.








This manual consists of the following chapters:

- Chapter 1, “Introduction”  
This chapter describes basic features of Keysight B1507A.
- Chapter 2, “Installation”  
This chapter describes installation and maintenance.
- Chapter 3, “How To Perform Measurement”  
This chapter explains how to perform measurement by using Keysight B1507A.
- Chapter 4, “GUI Reference”  
This chapter provides the reference information of Keysight Easy Test Navigator software.

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



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# 1 Introduction

## Introduction

This chapter describes the basic functions and features of Keysight B1507A Power Device Capacitance Analyzer, and consists of the following sections.

- “Overview”
- “Mainframe Front View”
- “Mainframe Rear View”
- “Test Fixture Front View”
- “Test Fixture Rear View”
- “Software”
- “Accessories”
- “Options”
- “Measurement Resources”

---

## Overview

Keysight B1507A Power Device Capacitance Analyzer provides a complete solution for the evaluation of power device capacitance (such as input, output, and reverse transfer capacitances). Intuitive GUI allows you to automatically measure all capacitances under a wide range of operating voltages. In addition, it makes it easy to switch back and forth between leakage tests (to verify the device is not damaged) and capacitance measurements without having to do any recabbling.

The B1507A can help identify substandard devices under actual circuit operating voltage biases (up to 3 kV). This is an ideal complement to conventional IV test equipment (such as curve tracers) that do not have either capacitance or leakage testing capabilities.

The furnished software presents the user with an intuitive user interface that makes it easy to characterize devices without going through any formal training. Integrated switching circuitry within the test fixture supports fully-automated testing, with the ability to automatically make the correct connections for all types of capacitance measurements. This includes the insertion of DC blocking capacitors and AC blocking resistors as well as making the connections necessary for correct gate and drain/collector leakage measurements.

Unique plug-in style device test fixture socket adapter helps to eliminate cable connection and other human-related errors.

The B1507A contains the mainframe, the test fixture, the connection cables, and the control software. For the furnished accessories, see Table 1-1.



## Mainframe

Mainframe is equipped with the measurement resources listed below, the 15-inch touch screen LCD panel, hard disk drive, DVD drive, USB, LAN, GPIB, GPIO interfaces, and so on. For more information on the measurement resources, see “Measurement Resources” on page 1-23.

- HVSMU, high voltage source/monitor unit, 1 ea.
- MFCMU, multi frequency capacitance measurement unit, 1 ea.
- MPSMU, medium power source/monitor unit, 1 ea.
- GNDU, ground unit, 1 ea.

The B1507A provides an intuitive graphical user interface, touch screen LCD, stylus pen, USB keyboard, and USB mouse for easy and effective measurement and analysis on the Windows environment, and supports the following B1507A control software. For more information, see “Software” on page 1-17.

- Easy Test Navigator software
- EasyEXPERT software

## Test Fixture and Selector

The test fixture is required to connect your device under test (DUT). The following furnished accessories are available.

- Socket module for connecting a 3-pin inline package device
- Accessories for connecting other type of device
  - Connection wire
  - Clip
  - Banana pin adapter

The selector is connected between the mainframe and the test fixture. And it is used for switching the IV measurement and the CV measurement.

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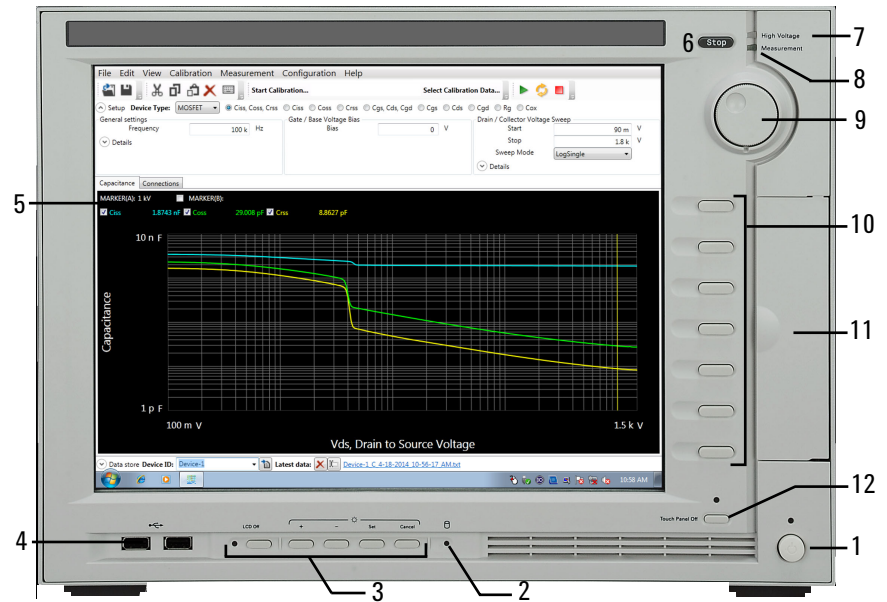
**NOTE**

---

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

## Mainframe Front View

This section describes the front view of the mainframe.



### 1. Standby switch

Turns on/off the mainframe. Pressing the button in the ON state makes it in the standby state. The green LED lights when it is in the ON state.

## NOTE

### Opening measurement terminals

Open the measurement terminals at the device side when turning the B1507A 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 drive. Do not turn the instrument off during this LED lights.

## Introduction

### Mainframe Front View

#### 3. LCD adjustment keys

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

Four keys are available for adjusting brightness. Use + and - to adjust it and then press *Set* to fix it. Pressing *Cancel* instead of *Set* cancels the adjustment.

#### 4. USB interfaces

USB, 2 ports. For keyboard, mouse, and so on.

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

#### 5. LCD panel

15 inch TFT XGA display, 1024 × 768 resolution. Displays the Windows screen, the B1507A control software window, and so on. Touch screen operation is available when the Touch Panel Off indicator does not light.

To adjust the touch panel, use Microchip TSHARC Control Panel which is opened by selecting *Microchip TSHARC Control Panel* from the Start menu.

#### 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 dangerous voltage.

#### 8. Measurement status indicator

This green LED lights when a measurement channel performs measurement.

#### 9. Rotary knob

Works on the execution environment of the B1507A control software. Rotating the knob moves the marker on the graph, 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 the B1507A control software. Used to select an alternative for the entry field specified or the dialog box.



11. DVD-R drive

For data backup, software update, and so on. With the option DR1, the drive is changed to the DVD-ROM drive.

12. Touch Panel Off key

Works on the execution environment of the B1507A control software. Enables or disables the touch screen operation. The green LED lights when the touch screen is disabled.

## Mainframe Rear View

This section describes the rear view of the mainframe.

---

**WARNING**

To avoid electrical shock and instrument damage, turn the all instruments off before connecting or disconnecting measurement cable.

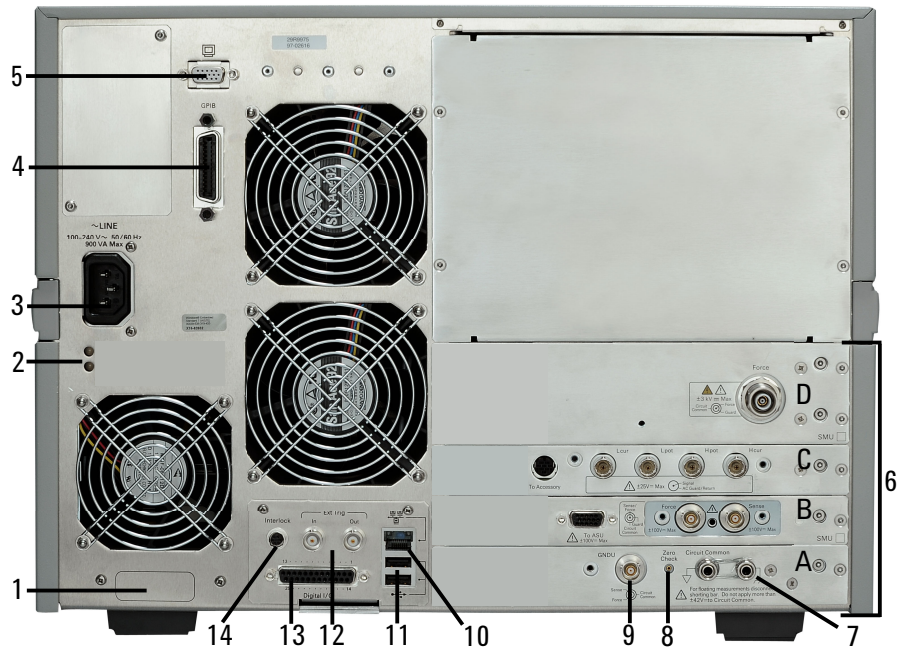
Mettez la machine hors tension pour fixer le connecteur ou pour retirer le connecteur de l'unité centrale.

---

**WARNING**

There are potentially hazardous voltages ( $\pm 3000$  Vdc for HVSMU and  $\pm 100$  Vdc for MPSMU) present at the Force, Sense, and Guard terminals of the instruments. To prevent electrical shock, the following safety precautions must be observed during the use of instruments.

- Connect the instrument to an electrical ground (safety ground) by using three-conductor AC power cable.
- Connect the mainframe Interlock terminal to the selector Interlock terminal by using an interlock cable. Also connect the selector Interlock terminal to the test fixture Interlock terminal by using an interlock cable.
- Confirm periodically that the interlock function works normally.
- Before touching the connections on the Force, Sense, and Guard terminals in the test fixture, turn the instruments off and discharge any capacitors. If you do *not* turn the instruments off, complete *all* of the following items, regardless of the instrument settings.
  - Press the front panel Stop key to set the source output off.
  - Confirm that the front panel High Voltage indicator is not lit.
  - Open the Interlock terminal (open the fixture cover).
  - Discharge any capacitors connected to a measurement resource.
- Warn persons working around the instrument about dangerous conditions.



1. Serial number

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

2. LED status indicator

For troubleshooting. Followings are some examples.

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

3. LINE input receptacle

AC power cable is connected to this receptacle.

## Introduction

### Mainframe Rear View

#### 4. GPIB interface

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

#### 5. Video output terminal

VGA connector. For an external display. Signal to the built-in LCD is also applied to this terminal.

#### 6. Measurement Resources

See A to D described later.

#### 7. 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 dangerous voltage to the Circuit Common terminal. Failure to heed this caution may result in damage to the instrument.

#### 8. Zero Check terminal

Ground reference point of the instrument.

---

### CAUTION

---

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

#### 9. GNDU terminal

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

#### 10. LAN interface

RJ45 connector.

#### 11. USB interfaces

USB, 2 ports. For keyboard, mouse, or peripherals.

To remove USB devices from the instrument, use “Safely Remove Hardware” on Windows taskbar. If it is not used, the instrument may cause the internal USB communication error.


If the error occurs, turn the instrument off and disconnect the power cable from it. Leave it about 30 seconds before rebooting it, and connect the power cable again, and then turn the instrument on.

12. Ext Trig terminals

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

13. Digital I/O terminal

Used to connect the test fixture.

 14. Interlock terminal

Used to connect the test fixture. If the fixture cover is open, maximum output is limited to  $\pm 42$  V.

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

 A. GNDU/ADC

Ground unit (GNDU) and A/D converter.

 B. MPSMU

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

 C. MFCMU


Multi frequency capacitance measurement unit (MFCMU) has four coaxial connectors, Lcur, Lpot, Hpot, and Hcur, for the four-terminal pair connection.

---

**CAUTION**

---

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

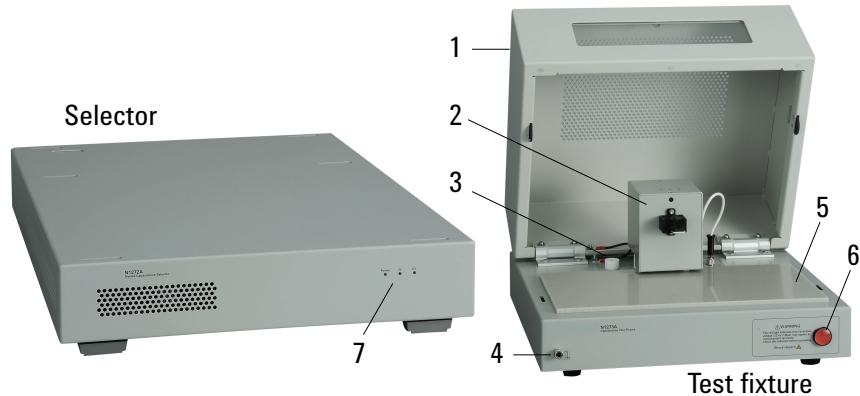
 D. HVSMU

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

---

## Test Fixture Front View

This section describes the front view of the test fixture and selector.



1. 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 output voltage is limited to  $\pm 42$  V.

---

### WARNING

**Hazardous voltage, instrument maximum output voltage may appear at the Force, Sense, and Guard 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.**

**Assurez-vous que le couvercle est fermé correctement avant de commencer la mesure. Ne pas effectuer la mesure lorsqu'un câble dépasse du couvercle de l'appareil.**

2. 3-pin inline package socket module

Attach the module to the measurement terminals if your device under test (DUT) is a 3-pin inline packaged device.



3. Measurement terminals

Connects the connection wire or attaches the socket module for connecting your DUT. For more information, see “Measurement Terminals” on page 1-13.

4. Terminal for connecting wrist strap
5. DUT stage (silicon plate)



6. Hazardous voltage status indicator

This red LED lights when a measurement resource applies dangerous voltage. This indicator is connected to the mainframe via the Interlock terminal and works with the High Voltage indicator on the mainframe 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  $\pm 3000$  Vdc) may appear at measurement terminals. Check this indicator before accessing.**

**Le témoin rouge indique qu'une tension dangereuse ( $\pm 3000$  V Max) risque d'apparaître au niveau des bornes de mesure. Vérifiez cet indicateur avant d'accéder.**

7. Status indicator

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

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

IV LED lights when the B1507A is in the IV measurement condition.

CV LED lights when the B1507A is in the capacitance measurement condition.



## Measurement Terminals

---

**WARNING**

**Set the instrument output off before connecting or disconnecting connection wire.**

**Press the mainframe front panel Stop key to set the source output off. And confirm that the mainframe front panel High Voltage indicator is not lit.**

---

**WARNING**

**Do not connect or disconnect your device under test (DUT) while Keysight B1507A is applying voltage or current. Otherwise, the DUT may be damaged.**

**When you touch the DUT after measurement, devise a countermeasure of residual charge and heat to prevent electrical shock and burn. Use glove and any tool. Also have enough time for discharge and radiation.**

**Pour éviter toute électrocution et tout risque d'endommagement de l'appareil, ne retirez pas les câbles pendant le fonctionnement.**

## Introduction

### Test Fixture Front View

**Lorsque vous touchez le MST après la mesure, élaborer une contre-mesure de la charge résiduelle et du chauffage afin d'éviter tout choc électrique et toute brûlure. Utilisez des gants et des outils. Prévoyez également du temps pour la décharge et la radiation.**

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#### CAUTION

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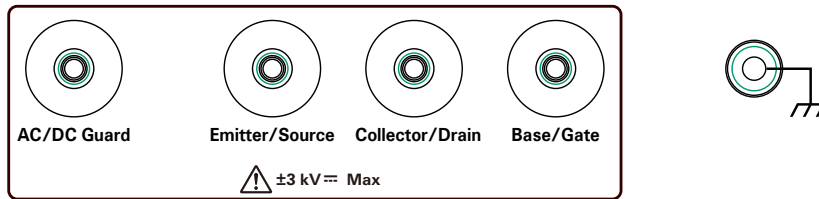
Never connect the terminals to any output, including circuit common and chassis ground. Connecting other output may damage the connected one.

---

#### NOTE

---

To use the 3-pin inline package socket module, attach it to the Base/Gate, Collector/Drain, and Emitter/Source terminals. Then do not use the AC/DC Guard terminal.



If you do not use the 3-pin inline package socket module, connect your device under test (DUT) to the terminals by using connection wire, clip, adapter, and so on.

1. Base/Gate terminal

Connect the terminal to the gate or base terminal of DUT.

2. Collector/Drain terminal

Connect the terminal to the drain or collector terminal of DUT.

3. Emitter/Source terminal

Connect Force and Sense to the source or emitter terminal of DUT.

4. AC/DC Guard terminal

When the CV LED lights, this terminal works as the AC guard.

When the IV LED lights, this terminal works as the DC guard.

In the most cases, never connect anything to this terminal for safety and to prevent instrument damage.

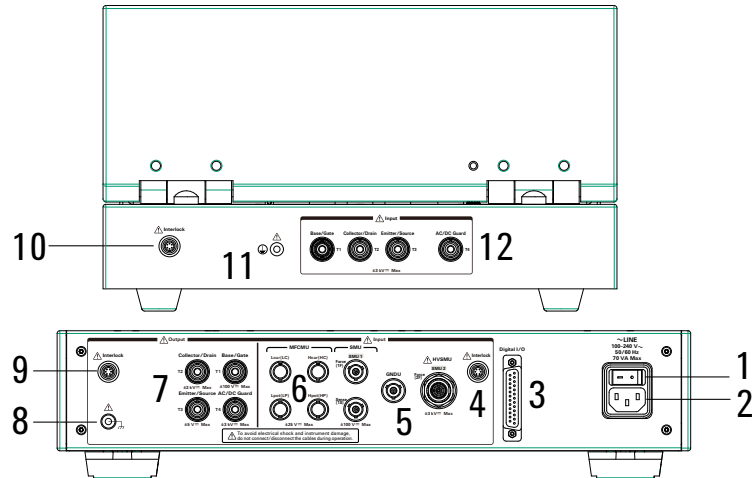
5. Chassis common terminal

Use for grounding or shielding.



## Test Fixture Rear View

This section describes the rear view of the test fixture and selector. For connecting the cables, see “To Connect Selector and Test Fixture” on page 2-11.



1. Power switch

Turns on/off the test fixture.

2. LINE input receptacle


AC power cable is connected to this receptacle.

3. Digital I/O terminal

This terminal is used to connect the Digital I/O cable from the mainframe Digital I/O terminal.

 4. Interlock terminal

This terminal is used to connect the interlock cable from the mainframe Interlock terminal. The interlock cable is included in the system cable.

 5. Connectors for connecting the system cable from the mainframe






The following measurement resources in the mainframe are connected by using the system cable.

- HVSMU

## Introduction

### Test Fixture Rear View

- MPSMU
- GNDU



-  6. Connectors for connecting the CMU cable  
The connectors are used to connect the CMU cable from the MFCMU in the mainframe.
-  7. Connectors for connecting the system cable from the test fixture  
The connectors are used to connect the system cable for connecting the test fixture.
-  8. Earth terminal  
Screw terminal for earthing. This terminal is used to connect the earthing wire for connecting the test fixture. The wire is included in the system cable.
-  9. Interlock terminal  
This terminal is used to connect the interlock cable for connecting the test fixture. The interlock cable is included in the system cable.
-  10. Interlock terminal  
This terminal is used to connect the interlock cable from the selector.

---

### **WARNING**

---

**Potentially hazardous voltage may be present at the test fixture measurement terminals when the Interlock terminals are shorted on the test fixture.**

-  11. Earth terminal  
Screw terminal for earthing. This terminal is used to connect the earthing wire from the selector.
-  12. Connectors for connecting the system cable from the selector  
The connectors are used to connect the system cable from the selector.

## Software

Keysight B1507A realizes easy and effective measurement and analysis on the Windows environment using an intuitive graphical user interface, touch screen LCD, stylus pen, keyboard, and mouse. The following software is previously installed or stored in the mainframe.

- “Easy Test Navigator Software”
- “EasyEXPERT Software”
- “Utility Software”

## Easy Test Navigator Software

The Easy Test Navigator software provides measurement control programs for power device characterization. It supports various types of measurement task with ease-of-use and simple operation. Some of the functions are listed below. For more information on the Easy Test Navigator software, see Chapters 3 and 4.

- Programs included:
  - Three-terminal device capacitance measurement program
  - I/V characteristics measurement program
  - Device power loss calculation program
- Ready-to-use measurement templates for typical power device characteristics measurements
- Ability to automatically accumulate measurement data on the HDD in exportable formats

## EasyEXPERT Software

The EasyEXPERT software is an application program for controlling Keysight B1500 series. Some of the functions are listed below. For more information, see Keysight EasyEXPERT *User's Guide*.

- 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
- Remote control function from an external computer

The EasyEXPERT has the following measurement execution environments.

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

---

### NOTE

#### Application Library

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, Keysight Technologies is NOT LIABLE for the damage.

---

## Utility Software

Followings are the utility software available for the B1507A. For more information on the utility software, see Keysight EasyEXPERT *User's Guide Vol. 2*.

- Desktop EasyEXPERT software  
EasyEXPERT software runs on an external Windows PC. Not installed.
- 4155/4156 setup file converter

Program for converting the 4155/4156 measurement setup files (file extension MES or DAT) into EasyEXPERT classic test setup files. This program is stored in the following folder.

<program folder>\Agilent\B1500\EasyEXPERT\415xC\Conversion\

- MDM file converter

Program for converting EasyEXPERT data files (file extension XTR or ZTR) into Keysight IC-CAP MDM files. This program is stored in the following folder.

<program folder>\Agilent\B1500\EasyEXPERT\IC-CAP Support\MDM\

- Prober control programs

Execution files for controlling the probers listed below. The files are stored in the following folder.

<program folder>\Agilent\B1500\EasyEXPERT\Utilities\

Probers supported:

- Cascade Microtech Summit 12K or S300
- SUSS MicroTec PA200 or PA300
- Vector Semiconductor VX-2000 or VX-3000
- sleep.exe program

Execution file for inserting a wait time in the test execution flow of an EasyEXPERT application test. This file is stored in the following folder.

<program folder>\Agilent\B1500\EasyEXPERT\Utilities\

---

**NOTE****Notations**

<program folder> is as follows. Then, <system drive> is the drive the B1507A control software has been installed.

For Windows 7 64 bit version, <system drive>:\Program Files (x86)

For Windows 7 32 bit version, Vista, or XP, <system drive>:\Program Files

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## Accessories

Furnished accessories and the available accessories for Keysight B1507A are listed in Tables 1-1 and 1-2.

**Table 1-1**

**Furnished Accessories**

Description	Quantity
System cable between mainframe and selector	1
System cable between selector and fixture	1
CMU cable	1
Digital I/O cable	1
3-pin inline package socket module	1
Connection wire, 200 mm	4
Banana pin adapter for connection wire	4
Mini alligator clip	4
USB keyboard	1
USB mouse	1
Stylus pen	1
Power cable	2
Product Reference CD-ROM	1

**Table 1-2 Available Accessories**

<b>Model Number</b>	<b>Option Item</b>	<b>Description</b>
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
N1300A		CMU connection cable
	N1300A-001	1.5 m length
	N1300A-002	3 m length

## Options

Options available for Keysight B1507A are listed in Table 1-3.

**Table 1-3**

### Options

<b>Option Item</b>	<b>Description</b>
Calibration	
B1507A-A6J	ANSI Z540-1-1994 Calibration
B1507A-UK6	Commercial calibration certificate with test data
Documentation	
B1507A-ABA	User's Guide, English
B1507A-ABJ	User's Guide, Japanese
Drive option	
B1507A-DR1	Replace a built-in DVD-R drive with a read-only DVD drive



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## Measurement Resources

Keysight B1507A is equipped with the following measurement resources.

- “GNDU - Ground Unit”
- “MPSMU - Medium Power SMU”
- “HVSMU - High Voltage SMU”
- “MFCMU - Multi Frequency CMU”

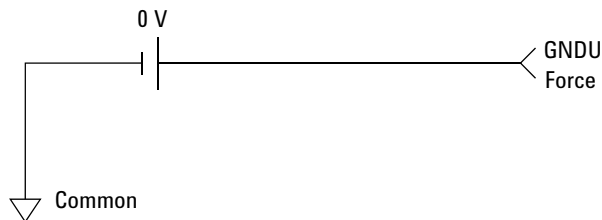
See Keysight EasyEXPERT *User’s Guide Vol. 1* for the functions available for Keysight EasyEXPERT software. See *Programming Guide* for the functions available for the GPIB remote mode.

### GNDU - Ground Unit

The ground unit (GNDU) is a 0 V constant voltage source, and used for the reference of measurement ground. Also the GNDU can sink up to  $\pm 4.2$  A, so it is effective for using MPSMU or HVSMU. Figure 1-1 is a simplified circuit diagram of GNDU.

Figure 1-1

Simplified GNDU Circuit Diagram



## About SMU

Source/monitor unit (SMU) can apply DC voltage or current, and can measure DC current or voltage. Figure 1-2 is a simplified SMU circuit diagram.

The MPSMU can perform the following operations:

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

The HCSMU, MCSMU, and HVSMU can perform the following operations:

- Apply voltage and measures current and/or voltage
- Apply current and measures current and/or voltage

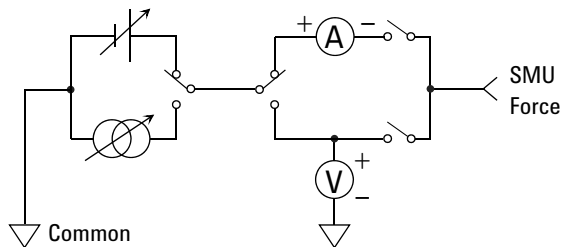
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**NOTE**

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

**Figure 1-2** 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 on the compliance, see *Keysight EasyEXPERT User's Guide Vol. 1*.

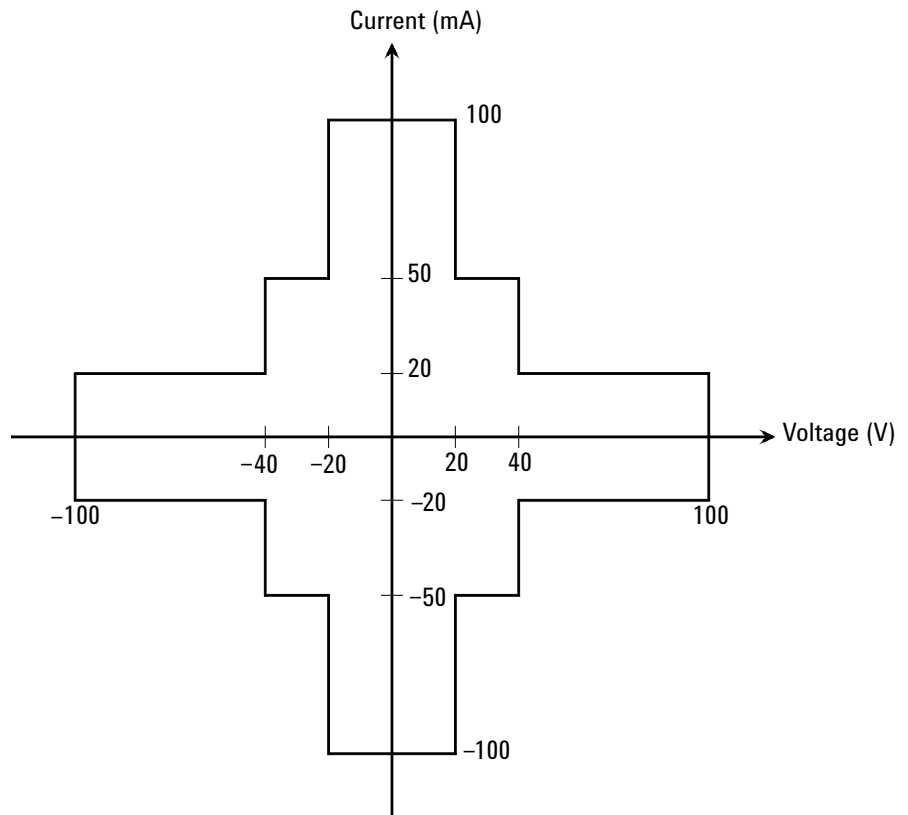
## MPSMU - Medium Power SMU

This section describes typical specification of the medium power source/monitor unit (MPSMU).

- Maximum voltage, current, output power:  $\pm 100$  V,  $\pm 100$  mA, 2 W
- Minimum range: 0.5 V, 1 nA
- Output/measurement value and resolution: see Table 1-4 to Table 1-7.

Figure 1-3

MPSMU Output and Measurement Ranges



**Table 1-4**      **MPSMU Output Voltage Ranges and Resolutions**

Range	Output Value	Setting Resolution	Maximum Current
0.5 V	$0 \leq  V  \leq 0.5 \text{ V}$	25 $\mu\text{V}$	$\pm 100 \text{ mA}$
2 V	$0 \leq  V  \leq 2 \text{ V}$	100 $\mu\text{V}$	$\pm 100 \text{ mA}$
5 V	$0 \leq  V  \leq 5 \text{ V}$	250 $\mu\text{V}$	$\pm 100 \text{ mA}$
20 V	$0 \leq  V  \leq 20 \text{ V}$	1 mV	$\pm 100 \text{ mA}$
40 V	$0 \leq  V  \leq 20 \text{ V}$	2 mV	$\pm 100 \text{ mA}$
	$20 \text{ V} <  V  \leq 40 \text{ V}$	2 mV	$\pm 50 \text{ mA}$
100 V	$0 \leq  V  \leq 20 \text{ V}$	5 mV	$\pm 100 \text{ mA}$
	$20 \text{ V} <  V  \leq 40 \text{ V}$	5 mV	$\pm 50 \text{ mA}$
	$40 \text{ V} <  V  \leq 100 \text{ V}$	5 mV	$\pm 20 \text{ mA}$

**Table 1-5**      **MPSMU Output Current Ranges and Resolutions**

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

**Table 1-6 MPSMU Measurement Voltage Values and Resolutions**

Range	Measurement Value <sup>a</sup>	Measurement Resolutions	
		High Speed ADC	High Resolution ADC
0.5 V	$0 \leq  V  \leq 0.55 \text{ V}$	25 $\mu\text{V}$	0.5 $\mu\text{V}$
2 V	$0 \leq  V  \leq 2.2 \text{ V}$	100 $\mu\text{V}$	2 $\mu\text{V}$
5 V	$0 \leq  V  \leq 5.5 \text{ V}$	250 $\mu\text{V}$	5 $\mu\text{V}$
20 V	$0 \leq  V  \leq 22 \text{ V}$	1 mV	20 $\mu\text{V}$
40 V	$0 \leq  V  \leq 44 \text{ V}$	2 mV	40 $\mu\text{V}$
100 V	$0 \leq  V  \leq 100 \text{ V}$	5 mV	100 $\mu\text{V}$

**Table 1-7 MPSMU Measurement Current Values and Resolutions**

Range	Measurement Value <sup>a</sup>	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 $\mu\text{A}$	$0 \leq  I  \leq 1.15 \text{ } \mu\text{A}$	50 pA	1 pA
10 $\mu\text{A}$	$0 \leq  I  \leq 11.5 \text{ } \mu\text{A}$	500 pA	10 pA
100 $\mu\text{A}$	$0 \leq  I  \leq 115 \text{ } \mu\text{A}$	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	$0 \leq  I  \leq 100 \text{ mA}$	5 $\mu\text{A}$	100 nA

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

## HVSMU - High Voltage SMU

This section describes typical specification of the high voltage source/monitor unit (HVSMU).

- 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 1-8 and Table 1-9.

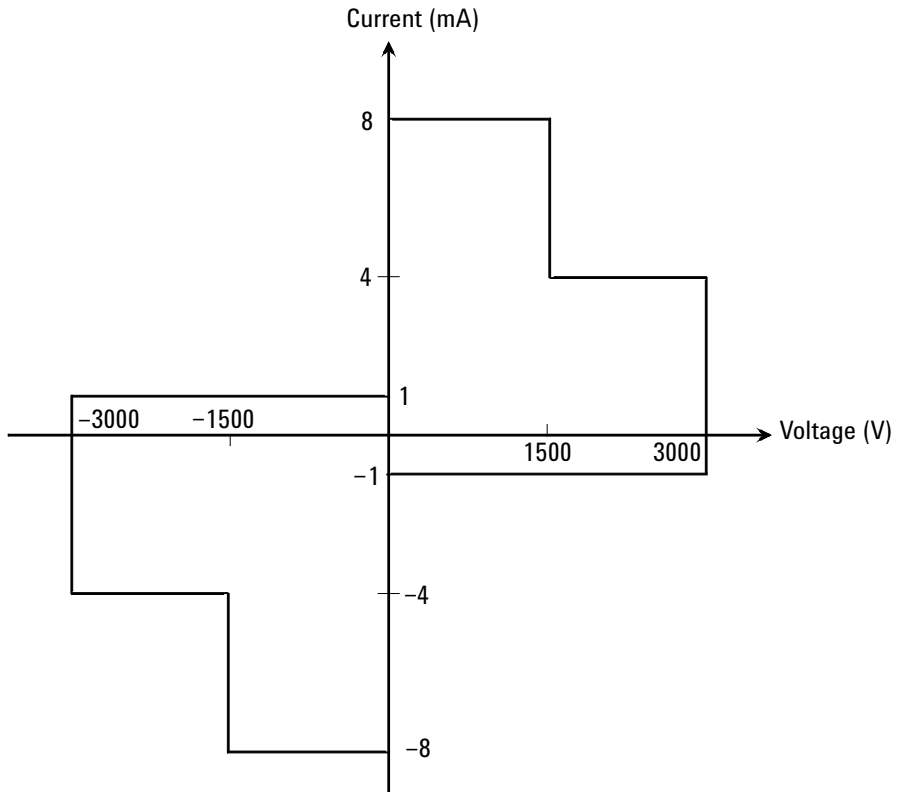
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**CAUTION**

---

Never connect the HVSMU Force and Guard terminals to any output, including circuit common, chassis ground, or any other measurement resource such as SMU. Connecting other measurement resource may damage the connected one.

Figure 1-4 HVSMU Output and Measurement Ranges



**Table 1-8 HVSMU Voltage Ranges and Resolutions**

<b>Range</b>	<b>Output Value and Measurement Value</b>	<b>Setting/ Measurement Resolution</b>	<b>Maximum Current  Imax </b>
200 V	$0 \leq  V  \leq 200 \text{ V}$	200 $\mu\text{V}$	8 mA
500 V	$0 \leq  V  \leq 500 \text{ V}$	500 $\mu\text{V}$	8 mA
1500 V	$0 \leq  V  \leq 1500 \text{ V}$	1.5 mV	8 mA
3000 V	$0 \leq  V  \leq 3000 \text{ V}$	3 mV	4 mA

**Table 1-9 HVSMU Current Ranges and Resolutions**

<b>Range</b>	<b>Output Value and Measurement Value</b>	<b>Setting/ Measurement Resolution</b>	<b>Maximum Voltage  Vmax </b>
1 nA <sup>a</sup>	$0 \leq  I  \leq 1.15 \text{ nA}$	10 fA	3000 V
10 nA	$0 \leq  I  \leq 11.5 \text{ nA}$	100 fA	3000 V
100 nA	$0 \leq  I  \leq 115 \text{ nA}$	100 fA	3000 V
1 $\mu\text{A}$	$0 \leq  I  \leq 1.15 \mu\text{A}$	1 pA	3000 V
10 $\mu\text{A}$	$0 \leq  I  \leq 11.5 \mu\text{A}$	10 pA	3000 V
100 $\mu\text{A}$	$0 \leq  I  \leq 115 \mu\text{A}$	100 pA	3000 V
1 mA	$0 \leq  I  \leq 1.15 \text{ mA}$	1 nA	3000 V
10 mA	$0 \leq  I  \leq 8 \text{ mA}$	10 nA	1500 V
	$0 \leq  I  \leq 4 \text{ mA}$		3000 V

a. DC only

## MFCMU - Multi Frequency CMU

This section describes typical specification of the multi frequency capacitance measurement unit (CMU). The CMU performs the impedance measurement and returns the specified measurement data such as Cp-G.

- Measurement parameters: See Table 1-10.
- 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  $\pm 25$  V, using MFCMU internal DC bias  
0 to  $\pm 3000$  V, using HVSMU and high voltage bias-tee
- Measurement range:  
For the fixed ranging mode, measurement range (impedance range) must be specified to perform measurement. Table 1-11 shows the available measurement ranges and the corresponding impedance value. And Figure 1-5 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).



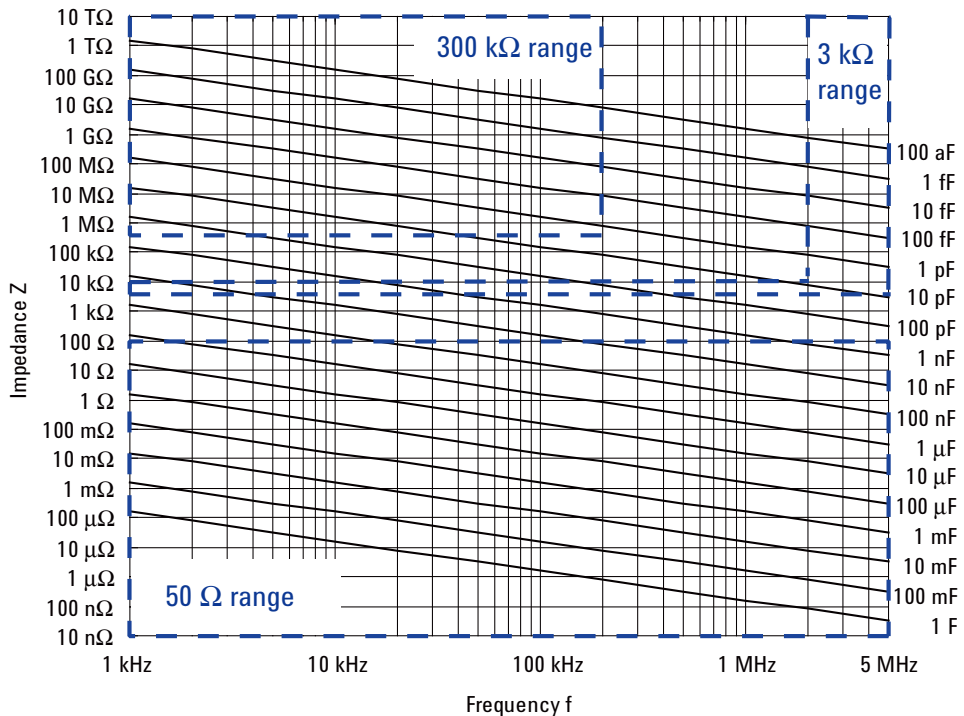
**Table 1-10 Measurement Parameters**

<b>Primary Parameter</b>	<b>Secondary Parameter</b>
R (resistance, $\Omega$ )	X (reactance, $\Omega$ )
G (conductance, S)	B (susceptance, S)
Z (impedance, $\Omega$ )	$\theta$ (phase, radian)
Z (impedance, $\Omega$ )	$\theta$ (phase, degree)
Y (admittance, S)	$\theta$ (phase, radian)
Y (admittance, S)	$\theta$ (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, $\Omega$ )
Cs (series capacitance, F)	Rs (series resistance, $\Omega$ )
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, $\Omega$ )
Ls (series inductance, H)	Rs (series resistance, $\Omega$ )
Ls (series inductance, H)	D (dissipation factor)
Ls (series inductance, H)	Q (quality factor)

**Table 1-11 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 $\Omega$	50 $\Omega$	50 $\Omega$
$100 \Omega \leq Z < 300 \Omega$	100 $\Omega$	100 $\Omega$	100 $\Omega$
$300 \Omega \leq Z < 1 \text{ k}\Omega$	300 $\Omega$	300 $\Omega$	300 $\Omega$
$1 \text{ k}\Omega \leq Z < 3 \text{ k}\Omega$	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 1-5 Impedance vs Frequency Characteristics of Capacitive Load, Calculation Example**



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**2**

## **Installation**

## Installation

This chapter describes how to install Keysight B1507A.

- “Requirements”
- “Inspection and Installation”
- “Connecting Accessories”
- “Maintenance”
- “Before Shipping to Service Center”

---

**WARNING**

**To avoid electrical shock and instrument damage, turn the all instruments off before connecting or disconnecting measurement cable.**

**Mettez la machine hors tension pour fixer le connecteur ou pour retirer le connecteur de l'unité centrale.**

---

**WARNING**

**The mainframe and the test fixture are heavy and require a two person lift.**

**Le châssis principale et l'équipement de test sont lourds et nécessitent un levage par deux personnes.**

---

**CAUTION**

Do not grab the fixture cover when lifting the test fixture.

---

**WARNING**

There are potentially hazardous voltages ( $\pm 3000$  Vdc for HVSMU and  $\pm 100$  Vdc for MPSMU) present at the Force, Guard, and Sense terminals of the instruments. To prevent electrical shock, the following safety precautions must be observed during the use of instruments.

- Connect the instrument to an electrical ground (safety ground) by using three-conductor AC power cable.
  - Connect the mainframe Interlock terminal to the selector Interlock terminal by using an interlock cable. Also connect the selector Interlock terminal to the test fixture Interlock terminal by using an interlock cable.
  - Confirm periodically that the interlock function works normally.
  - Before touching the connections on the Force, Guard, and Sense terminals in the test fixture or the shielding box, turn the instruments off and discharge any capacitors. If you do *not* turn the instruments off, complete *all* of the following items, regardless of the instrument settings.
    - Press the front panel Stop key to set the source output off.
    - Confirm that the front panel High Voltage indicator is not lit.
    - Open the Interlock terminal (open the fixture cover or the shielding box access door).
    - Discharge any capacitors connected to a measurement resource.
  - Warn persons working around the instruments about dangerous conditions.
-

## Requirements

This section describes the requirements for the environment this instrument is used.

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

## Power Requirements

This instrument can operate from any single-phase AC power source supplying 100/240 V ( $\pm 10\%$ ) at 50/60 Hz. The maximum power consumption is shown below.

- Mainframe: 900 VA
- Selector: 70 VA

## Operating Environment

This instrument must be operated within the following environmental conditions:

<b>Temperature:</b>	+5 °C to +40 °C
<b>Humidity:</b>	20 % to 70 % RH, no condensation
<b>Altitude:</b>	0 to 2,000 m (6,561 ft.)

## Storaging/Shipping Environment

This instrument must be stored/shipped within the following environmental conditions:

<b>Temperature:</b>	-20 °C to +60 °C
<b>Humidity:</b>	10 % to 90 % RH, no condensation
<b>Altitude:</b>	0 to 4,600 m (15,092 ft.)

## Installation Requirements

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**WARNING**

**Do not operate the instrument in dusty environment, or in the presence of flammable gasses, corrosive gasses, or fumes.**

**Ne pas utiliser l'appareil dans un endroit poussiéreux, ou en présence de gaz inflammables, corrosifs ou de fumée.**

---

- Environmental conditions for this instrument are documented in the previous page. In principle, this instrument should only be operated indoors in a controlled environment.
- Install the instrument horizontal place then face the roof up.
- The dimensions of this instrument are shown below. Fan cools the instrument by drawing air through the sides and exhausting it out the back. The instrument must be installed in a location that allows sufficient space at the sides and back of the instrument for adequate air circulation.
  - Mainframe: 420 mm (W) × 575 mm (D) × 330 mm (H)
  - Selector: 420 mm (W) × 575 mm (D) × 75 mm (H)
  - Test fixture: 340 mm (W) × 345 mm (D) × 200 mm (H)

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.

- Make sure that there is enough space for connecting/disconnecting the power cable easily.

## Power Cable

---

**WARNING**

**FIRE HAZARD:** Use only the power cable supplied with your instrument. Using other types of power cable may cause overheating of the power cable, resulting in fire.

**SHOCK HAZARD:** The power cable provides the chassis ground through a third conductor. Be sure to connect to a three-conductor type power outlet with the correct pin grounded.

**RISQUE D'INCENDIE :** utilisez uniquement le câble d'alimentation fourni avec votre appareil. L'utilisation d'autres types de câble d'alimentation peut provoquer une surchauffe du câble d'alimentation et provoquer un incendie.

**RISQUE DE CHOC ÉLECTRIQUE:** le câble d'alimentation fournit la masse du châssis par le biais d'un troisième conducteur. Assurez-vous de connecter la prise d'alimentation de type trois conducteurs avec la broche correcte mise à la terre.

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**NOTE**




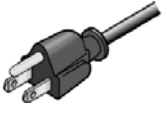

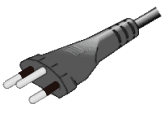


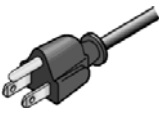





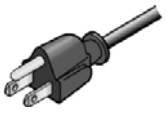

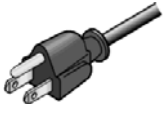

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The detachable power cable may be used as an emergency disconnecting device. Removing the power cable will disconnect AC input power to the instrument.

Connect the power cable to the IEC 320 connector on the rear of the instrument. If the wrong power cable was shipped with your instrument, contact your nearest Keysight Sales and Support Office.

The AC input on the back of your instrument is a universal AC input. It accepts nominal line voltages in the range of 100 to 240 VAC.



<p>Option 900</p>  <ul style="list-style-type: none"> <li>• Plug: BS 1363/A, 250 V, 10 A</li> <li>• PN: 8120-4420</li> </ul>	<p>Option 901</p>  <ul style="list-style-type: none"> <li>• Plug: AS/NZS 3112, 250 V, 10 A</li> <li>• PN: 8120-4419</li> </ul>	<p>Option 902</p>  <ul style="list-style-type: none"> <li>• Plug: IEC 60277-1, 250 V, 10 A</li> <li>• PN: 8121-1226</li> </ul>	<p>Option 903</p>  <ul style="list-style-type: none"> <li>• Plug: NEMA 5-15P, 125 V, 10 A</li> <li>• PN: 8120-6825</li> </ul>
<p>Option 904</p>  <ul style="list-style-type: none"> <li>• Plug: NEMA 6-15P, 250 V, 10 A</li> <li>• PN: 8120-3996</li> </ul>	<p>Option 906</p>  <ul style="list-style-type: none"> <li>• Plug: SEV 1011, 250 V, 10 A</li> <li>• PN: 8120-4416</li> </ul>	<p>Option 912</p>  <ul style="list-style-type: none"> <li>• Plug: SB 107-2-D1, 250 V, 10 A</li> <li>• PN: 8121-1655</li> </ul>	<p>Option 917</p>  <ul style="list-style-type: none"> <li>• Plug: IS 1293 and IS 6538, 250 V, 10 A</li> <li>• PN: 8121-1690</li> </ul>
<p>Option 918</p>  <ul style="list-style-type: none"> <li>• Plug: JIS C 8303, 125 V, 12 A</li> <li>• PN: 8121-0743</li> </ul>	<p>Option 919</p>  <ul style="list-style-type: none"> <li>• Plug: Israel SI 32, 250 V, 10 A</li> <li>• PN: 8121-0724</li> </ul>	<p>Option 920</p>  <ul style="list-style-type: none"> <li>• Plug: IRAM 2073, 250 V, 10 A</li> <li>• PN: 8121-0725</li> </ul>	<p>Option 921</p>  <ul style="list-style-type: none"> <li>• Plug: CEI 23-16, 250 V, 10 A</li> <li>• PN: 8121-0722</li> </ul>
<p>Option 922</p>  <ul style="list-style-type: none"> <li>• Plug: GB 1002 figure 3, 250 V, 10 A</li> <li>• PN: 8120-8376</li> </ul>	<p>Option 923</p>  <ul style="list-style-type: none"> <li>• Plug: SANS 164-1, 250 V, 10 A</li> <li>• PN: 8121-0564</li> </ul>	<p>Option 927</p>  <ul style="list-style-type: none"> <li>• Plug: NEMA WD-6, 250 V, 10 A</li> <li>• PN: 8120-0674</li> </ul>	<p>Option 930</p>  <ul style="list-style-type: none"> <li>• Plug: NBR 14136, 250 V, 10 A</li> <li>• PN: 8121-1809</li> </ul>
<p>Option 931</p>  <ul style="list-style-type: none"> <li>• Plug: CNS 10917-2, 125 V, 10 A</li> <li>• PN: 8121-1635</li> </ul>	<p>Option 932</p>  <ul style="list-style-type: none"> <li>• Plug: CS 0017, 250 V, 10 A</li> <li>• PN: 8121-1638</li> </ul>		

## Inspection and Installation

Do the following when this instrument arrived.

- “To Inspect Shipment”
- “To Perform Initial Setup”
- “To Connect Selector and Test Fixture”
- “To Check Operation of Selector”

Do the following setup if you need.

- “To Change Windows Logon Setting”
- “To Change GPIB Address”
- “To Enable System Controller”

### To Inspect Shipment

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, contact Keysight Technologies.

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

If anything is missing, contact Keysight Technologies.

After the inspection, move the instrument and accessories to the installation site. For the requirements for the installation site, see “Requirements” on page 2-4.

## To Perform Initial Setup

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

If the mainframe is operating correctly, the power-on self-test is automatically performed. If problems arise, contact Keysight Technologies.

7. 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 B1507A. See *Keysight EasyEXPERT User's Guide Vol. 2* for the system recovery.
  - b. Set Country or region, Time and currency, and Keyboard layout.  
If you use the furnished USB keyboard, the Keyboard layout must be US.
  - c. Accept the End User License Agreement.
  - d. Set Time zone, date and time.

If the mainframe has been already connected to your site LAN, you can proceed the network connection setup. If you connect the mainframe to the network, take care to protect it from computer virus.

---

**NOTE**

### Other Windows setup

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

---

**NOTE**

Keysight Technologies cannot guarantee the performance and provide compatibility information for all B1507As under several conditions. If problems arise, perform Keysight B1507A system recovery.

To perform recovery, see *Keysight EasyEXPERT User's Guide Vol. 2*.

Installation  
Inspection and Installation

Users listed in Table 2-1 are available just after the initial setup.

**Table 2-1**

**Users Available Just After the Initial Setup**

<b>User Account</b>	<b>Description</b>
Keysight B1500 User	Account for automatic logon. Password is not set to this account.
keysightOnly	Account for Keysight 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.

## To Connect Selector and Test Fixture

**WARNING**

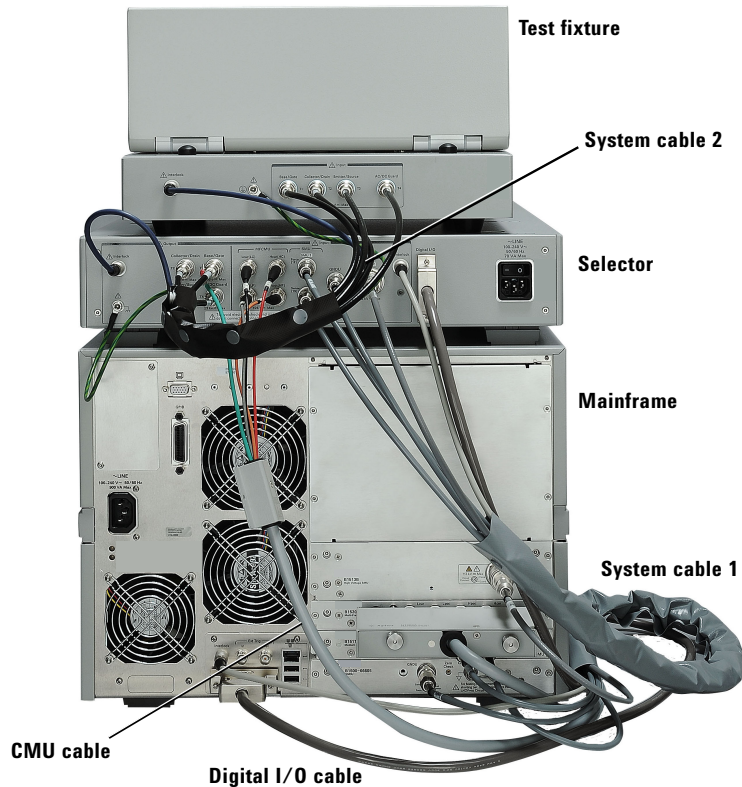


To avoid electrical shock and instrument damage, turn the all instruments off before connecting or disconnecting measurement cable.

Mettez la machine hors tension pour fixer le connecteur ou pour retirer le connecteur de l'unité centrale.

Figure 2-1

B1507A Rear View



Connect the system cables between the mainframe, selector, and test fixture as shown in Figure 2-1. Also see Tables 2-2 and 2-3.

1. Connect the System cable between the mainframe and the selector.
2. Connect the CMU cable.
3. Connect the Digital I/O cable.

Installation  
 Inspection and Installation

4. Connect the System cable between the selector and the test fixture.

**Table 2-2**

**System Cable Connections between Mainframe and Selector**

Mainframe		Label of Cable		Selector	
<b>System Cable 1</b>					
Interlock		none	none	Interlock	
GNDU		GNDU	GNDU	GNDU	
SMU1	Sense	1S	1S	Sense (1S)	SMU SMU1
	Force	1F	1F	Force (1F)	
SMU2	Force	2	2	Force (2F)	HVSMU SMU2
<b>CMU Cable</b>					
MFCMU		Hpot	HP	Hpot (HP)	MFCMU
		Lpot	LP	Lpot (LP)	
		Hcur	HC	Hcur (HC)	
		Lcur	LC	Lcur (LC)	
<b>Digital I/O Cable</b>					
Digital I/O		none	none	Digital I/O	

**Table 2-3**

**System Cable Connections between Selector and Test Fixture**

Selector	Label of Cable		Test Fixture
<b>System Cable 2</b>			
AC/DC Guard	T4	T4	AC/DC Guard
Emitter/Source	T3	T3	Emitter/Source
Base/Gate	T1	T1	Base/Gate
Collector/Drain	T2	T2	Collector/Drain
Earth terminal	none	none	Earth terminal
Interlock	none	none	Interlock

## To Check Operation of Selector

1. Complete the cable connections described in “To Connect Selector and Test Fixture” on page 2-11.
2. Connect the power cable from the selector to an AC power outlet.
3. Connect the power cable from the mainframe to an AC power outlet.
4. Open the measurement terminals of the test fixture and close the fixture cover.
5. Set the selector power switch to the ON position to turn on the selector.
6. Press the mainframe Standby switch to turn on the mainframe.
7. After boot up, launch the Capacitance Measurement software.
8. Click the Configuration > Module menu to display the Module Configuration dialog box.
9. Perform diagnosis of the selector by using the Module Configuration dialog box. If problems arise, contact Keysight Technologies.

## To Change Windows Logon Setting

Windows automatic logon has been enabled initially. 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 *Keysight B1500 User*, disable the automatic logon.

## To Change GPIB Address

When this instrument 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 > Keysight IO Libraries Suite > Keysight Connection Expert* from the Start menu. Keysight Connection Expert window appears.
3. At the *Instrument I/O on this PC* area, select GPIB0, and click the Change Properties... button. Keysight 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 Keysight 82350 PCI GPIB Interface - GPIB0 window.
7. On the Reboot Required dialog box, click the Reboot Now button, and reboot the mainframe.



## To Enable System Controller

To allow this instrument to control external GPIB devices, perform the following procedure. After the procedure, you cannot control the instrument from an external computer.

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 > Keysight IO Libraries Suite > Keysight Connection Expert* from the Start menu. Keysight Connection Expert window appears.
3. At the *Instrument I/O on this PC* area, select GPIB0, and click the Change Properties... button. Keysight 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 Keysight 82350 PCI GPIB Interface - GPIB0 window.
8. On the Reboot Required dialog box, click the Reboot Now button, and reboot the mainframe.

---

### NOTE

#### To Disable System Controller

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.

---

## Connecting Accessories

The test fixture is used to connect your device under test (DUT). The B1507A is furnished with the following accessories.

- “3-pin Inline Package Socket Module”
- “Accessories for Connecting a DUT”

---

**WARNING**

**Set the instrument output off before connecting or disconnecting connection wire.**

**Press the mainframe front panel Stop key to set the source output off. And confirm that the mainframe front panel High Voltage indicator is not lit.**

---

**WARNING**

**To prevent electrical shock and DUT damage, do not connect or disconnect the DUT while the instrument is applying voltage or current.**

**When you touch the DUT after measurement, devise a countermeasure of residual charge and heat to prevent electrical shock and burn. Use glove and any tool. Also have enough time for discharge and radiation.**

**Pour éviter toute électrocution et tout risque d'endommagement de l'appareil, ne retirez pas les câbles pendant le fonctionnement.**

**Lorsque vous touchez le MST après la mesure, élaborer une contre-mesure de la charge résiduelle et du chauffage afin d'éviter tout choc électrique et toute brûlure. Utilisez des gants et des outils. Prévoyez également du temps pour la décharge et la radiation.**

---

## 3-pin Inline Package Socket Module

Use the socket module to connect a three-terminal inline packaged device. See the following simple instruction.

### Requirements

- 3-pin inline package socket module
- DUT

### Procedure

1. If the earthing wire is not connected to the socket module, connect it.
2. Attach the socket module directly to the Base/Gate, Collector/Drain, and Emitter/Source terminals of the test fixture.
3. Connect the earthing wire of the socket module to the chassis common terminal.
4. Set your DUT on the socket.
5. Close the fixture cover and perform measurement.



---

### WARNING



**Hazardous voltage, instrument maximum output voltage may appear at the measurement terminals if the fixture cover is closed.**

---

### WARNING

**Open the Guard terminal of the test fixture. Do not connect anything to it.**

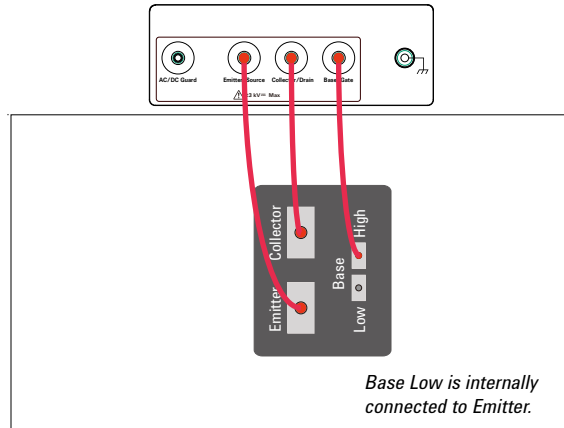
---

### NOTE

Short plate is furnished with the socket module. It is used for performing the short correction before the capacitance measurement. Set it on the socket before the short correction and remove it after the correction.

## Accessories for Connecting a DUT

Use the connection wire, clip, adapter, and so on to connect a device other than 3-pin inline package.



### Requirements

- Connection wire, clip, adapter, and so on. Use the furnished accessories.
- DUT (other than 3-pin inline package device)

### Procedure

1. Put your DUT on the DUT stage (silicon plate). The device size should be smaller than approximately 280 mm (W) × 140 mm (D) × 100 mm (H).
2. Connect your DUT to the measurement terminals of the test fixture by using connection wire, clip, adapter, and so on.
3. Close the fixture cover and perform measurement.

---

#### WARNING



**Hazardous voltage, instrument maximum output voltage may appear at the measurement terminals if the fixture cover is closed.**

---

#### WARNING

**Open the AC/DC Guard terminal to avoid electrical shock, instrument damage, or DUT damage. Do not connect anything to this terminal which may have the same potential as the Collector/Drain terminal.**

---

#### 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.**

**Assurez-vous que le couvercle est fermé correctement avant de commencer la mesure. Ne pas effectuer la mesure lorsqu'un câble dépasse du couvercle de l'appareil.**

---

## Maintenance

Maintenance should be performed periodically to keep the instrument 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 Diagnosis

This instrument 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 diagnosis.

- Self-test
- Self-calibration
- Diagnosis

If problems arise, contact Keysight Technologies.

---

#### NOTE



#### Interlock Open/Close test and High Voltage LED test

Interlock function limits the maximum output voltage to  $\pm 42$  V when the measurement terminal is touchable. For safety, this function must be checked before using the instrument after power on at least once a day by performing the diagnosis.

---

### 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 Keysight Technologies. Trained service personnel will perform the calibration and adjustments.

## Before Shipping to Service Center

Before shipping this instrument to service center, you have to do following:

- “To Make Backup”
- “To Check Module Slots”
- “To Collect Equipment and Accessories”

### To Make Backup

If the internal hard disk drive (HDD) is failed, you will lose all data stored in the HDD. So it is important to make backup constantly.

Before shipping the instrument to the service center, make backup of data in the HDD. And keep the backup media in trust. You may need to perform data recovery of the instrument returned from the service center.

If the HDD is replaced, the instrument will be returned with the latest revision of the software.

### To Check Module Slots

Do not remove the plug-in module from the mainframe. The instrument must be shipped with all modules. The module cannot be repaired or calibrated without the mainframe.

If a module is removed and installed, the specifications are not guaranteed. The specifications are guaranteed after the calibration is performed at Keysight Technologies service center.

### To Collect Equipment and Accessories

The mainframe, test fixture, and all connection cables are required for servicing and must be shipped to the service center. For details, contact the service center.

---

**WARNING**

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

**Mettez la machine hors tension pour fixer le connecteur ou pour retirer le connecteur de l'unité centrale.**

---

**3**

## **How To Perform Measurement**

## How To Perform Measurement

This chapter describes how to measure the power devices by using Keysight B1507A and Keysight Easy Test Navigator Software, and consists of the following sections:

- **How To Perform Capacitance Measurement**

This section describes how to perform the measurement using the capacitance measurement software.

- **How To Perform I/V Measurement**

This section describes how to perform the measurement using the I/V measurement software.

- **How To Calculate Power Loss**

This section describes how to calculate the power loss using the power loss calculation software.

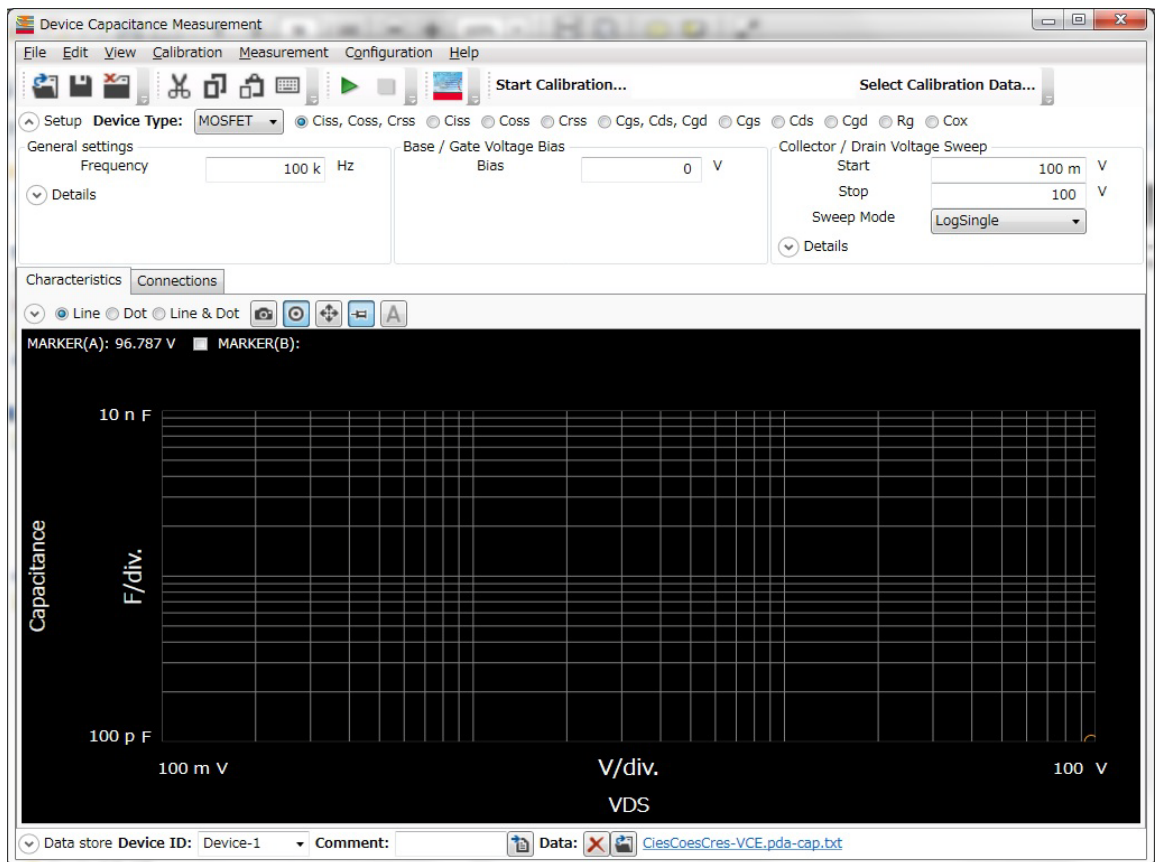


## How To Perform Capacitance Measurement

This section describes how to perform a measurement using the capacitance measurement software and consists of the following sub-sections:

- Preparing Measurement
- Executing Measurement
- Setting Parameter

Figure 3-1 Capacitance Measurement Software



## Preparing Measurement

---

**WARNING**

Set the instrument output off before connecting or disconnecting connection wire.

Press the mainframe front panel Stop key to set the source output off. And confirm that the mainframe front panel High Voltage indicator is not lit.

---

**WARNING**

To prevent electrical shock and DUT damage, do not connect or disconnect the DUT while the instrument is applying voltage or current.

When you touch the DUT after measurement, devise a countermeasure of residual charge and heat to prevent electrical shock and burn. Use glove and any tool. Also have enough time for discharge and radiation.

---

**Step 1.** Prepare the test fixture and other accessories to connect your device under test (DUT).

For more information on the test fixture and its accessories, see the following sections:

- “To Connect Selector and Test Fixture” on page 2-11
- “3-pin Inline Package Socket Module” on page 2-17
- “Accessories for Connecting a DUT” on page 2-18

**Step 2.** Connect the test fixture and, 3-pin inline package socket module or other accessories that is adequate for your DUT.

For more information, see the following sections:

- “To Connect Selector and Test Fixture” on page 2-11
- “3-pin Inline Package Socket Module” on page 2-17
- “Accessories for Connecting a DUT” on page 2-18

**Step 3.** Turn the instrument on.  
Don't connect your DUT to the test fixture at this time.

## Executing Measurement


---

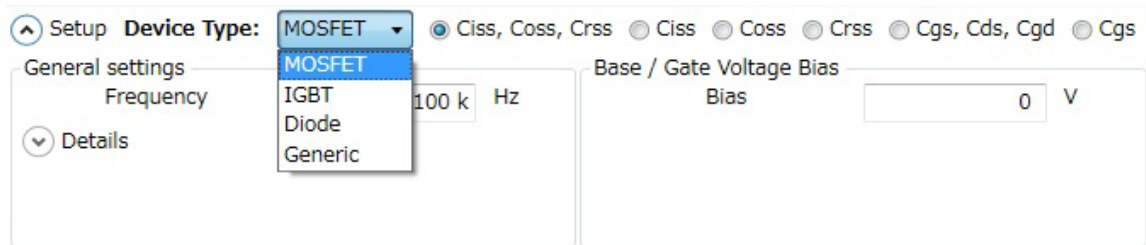
**NOTE**

---

This section explains the procedure using an example that selects MOSFET as a device type of DUT and Ciss, Coss, Crss as a measurement item.

Execute a measurement as follows:

- Step 1.** On the software palette, click the Capacitance Measurement icon . The Capacitance Measurement software (Figure 3-1) opens.
- Step 2.** At the Setup area in work area, select a device type of your DUT and a measurement item to be measured.



- Device Type

Select a device type from the Device Type drop-down list.

---

**NOTE**

---

This example selects MOSFET.

- Measurement Item

From the radio buttons located on the right of a Device Type selection, which is MOSFET in this example, select a measurement item to be measured.

---

**NOTE**

---

This example selects Ciss, Coss, Crss.

---

**NOTE**

---

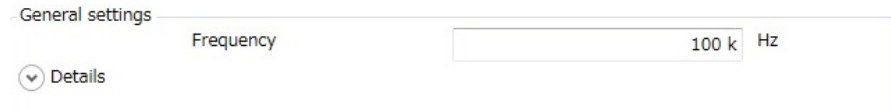
For information on the available device types and measurement items, see Table 3-1 on page 3-8

By selecting a device type and measurement item, the setup items displayed in the Setup area are automatically switched.

## How To Perform Measurement

### How To Perform Capacitance Measurement

**Step 3.** Enter the measurement frequency in the Frequency of General settings located at the left part of Setup area.



The screenshot shows a software interface for "General settings". There is a "Frequency" field with a text input box containing "100 k" and a unit selector set to "Hz". Below the field is a "Details" chevron icon.

By clicking the **Details** chevron, the area expands to set more detail conditions.

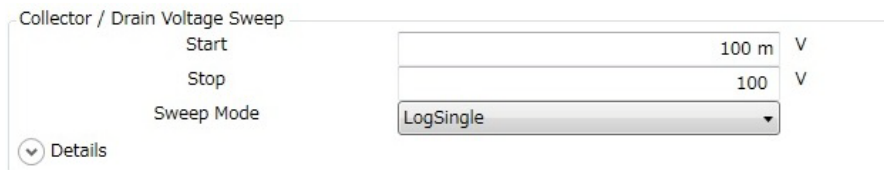
For more information on setting items, see “Setup” on page 4-11.

**Step 4.** Enter the bias voltage value in the Bias of Base/Gate Voltage Bias at the center of Setup area.



The screenshot shows a software interface for "Base / Gate Voltage Bias". There is a "Bias" field with a text input box containing "0" and a unit selector set to "V".

**Step 5.** Enter or select the voltage sweep conditions in the Collector/Drain Voltage Sweep at the right of Setup area.



The screenshot shows a software interface for "Collector / Drain Voltage Sweep". It has three fields: "Start" with a value of "100 m" and unit "V", "Stop" with a value of "100" and unit "V", and "Sweep Mode" with a dropdown menu set to "LogSingle". There is also a "Details" chevron icon.

**Start** Enter a start voltage value of sweep.

**Stop** Enter a stop voltage value of sweep.

**Sweep Mode** Select a sweep mode.

**LinearSingle** One-way linear sweep from the Start to the Stop.

**LogSingle** One-way logarithmic sweep from the Start to the Stop.

**LinearDouble** Linear-sweep from the Start to the Stop and then return linear-sweep from the Stop to the Start.

**LogDouble** Logarithmic-sweep from the Start to the Stop and then return logarithmic-sweep from the Stop to the Start.


By clicking the **Details** chevron, the area expands to set more detail conditions.


For more information on setting items, see “Setup” on page 4-11.

**Step 6.** Click the Start Calibration... button in the toolbar to measure the calibration data of measurement path.

Follow the instruction displayed on the dialog to measure the open and short calibration data.

If you have measured and saved the calibration data of measurement path, click the Select Calibration Data... button in the toolbar to select and load the stored calibration data.

**Step 7.** Set your DUT on the test fixture and click the Start Measurement button  to start a measurement.

You can stop the measurement by clicking the Stop Measurement button  during a measurement execution.

---

**NOTE**

If your DUT is diode, connect the cathode of your DUT to the Collector/Drain terminal of the test fixture and the anode of your DUT to the Emitter/Source terminal of the test fixture.

---

**Step 8.** Click the Characteristics tab to display the Characteristics area.

After a measurement is finished, a measured capacitance characteristics curve is displayed on the Characteristics area. This example shows the Ciss, Coss, and Crss, characteristics curves.



How To Perform Measurement  
 How To Perform Capacitance Measurement

For the operation on the graph display, see “Displaying and Operating Graph” on page 3-26.

## Setting Parameters

**Table 3-1 Available Device Types and Measurement Items**

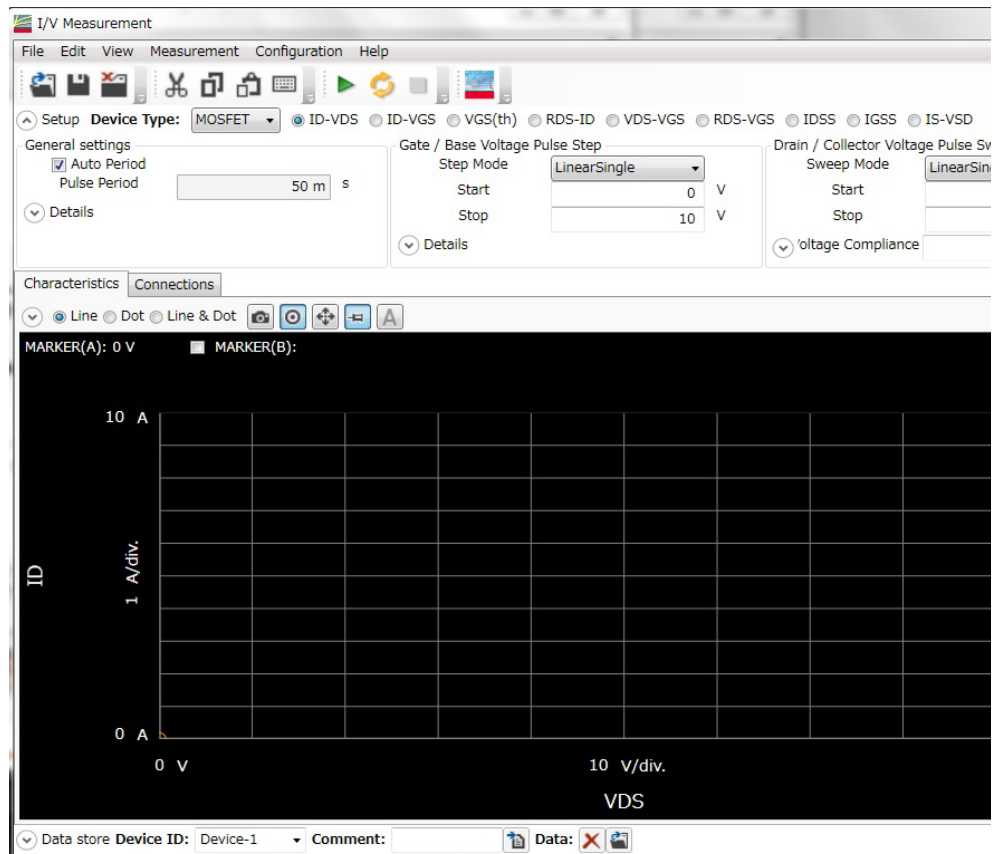
Device Type	Measurement Item	Description
MOSFET	Ciss	Ciss (Input capacitance) - Vds characteristics
	Coss	Coss (Output capacitance) - Vds characteristics
	Crss	Crss (Feedback capacitance) - Vds characteristics
	Ciss, Coss, Crss	Ciss, Coss, and Crss characteristics
	Cgs	Cgs (Gate to Source capacitance) - Vds characteristics
	Cds	Cds (Drain to Source capacitance) - Vds characteristics
	Cgd	Cgd (Gate to Drain capacitance) - Vds characteristics
	Cgs, Cds, Cgd	Cgs, Cds, and Cgd characteristics
	Rg	Rg (Gate resistance) - Vgs characteristics
	Cox	Cox (Gate oxide film capacitance) - Vgs characteristics
IGBT	Cies	Cies (Input capacitance) - Vce characteristics
	Coes	Coes (Output capacitance) - Vce characteristics
	Cres	Cres (Feedback capacitance) - Vce characteristics
	Cies, Coes, Cres	Cies, Coes, and Cres characteristics
	Cge	Cge (Gate to Emitter capacitance) - Vce characteristics
	Cce	Cce (Collector to Emitter capacitance) - Vce characteristics
	Cgc	Cgc (Gate to Collector capacitance) - Vce characteristics
	Cge, Cce, Cgc	Cge, Cce, and Cgc characteristics
Rg	Rg (Gate resistance) - Vge characteristics	
Diode	CT	Total capacitance at reverse bias to bias voltage characteristics
Generic	Collector/Drain Voltage Sweep	Cp-G model capacitance between Collector/Drain terminal and Emitter/Source terminal to Vce/Vds characteristics
	Base/Gate Voltage Sweep	Cs-Rs model capacitance between Base/Gate terminal and Emitter/Source terminal to Vbe/Vgs characteristics

## How To Perform I/V Measurement

This section describes how to perform a measurement using the I/V measurement software and consists of the following sub-sections:

- Preparing Measurement
- Executing Measurement
- Setting Parameter

Figure 3-2 I/V Measurement Software



## Preparing Measurement

---

**WARNING**

Set the instrument output off before connecting or disconnecting connection wire.

Press the mainframe front panel Stop key to set the source output off. And confirm that the mainframe front panel High Voltage indicator is not lit.

---

**WARNING**

To prevent electrical shock and DUT damage, do not connect or disconnect the DUT while the instrument is applying voltage or current.

When you touch the DUT after measurement, devise a countermeasure of residual charge and heat to prevent electrical shock and burn. Use glove and any tool. Also have enough time for discharge and radiation.

---

**Step 1.** Prepare the test fixture and other accessories to connect your device under test (DUT).

For more information on the test fixture and its accessories, see the following sections:

- “To Connect Selector and Test Fixture” on page 2-11
- “3-pin Inline Package Socket Module” on page 2-17
- “Accessories for Connecting a DUT” on page 2-18

**Step 2.** Connect the test fixture and, 3-pin inline package socket module or other accessories that is adequate for your DUT.

For more information, see the following sections:

- “To Connect Selector and Test Fixture” on page 2-11
- “3-pin Inline Package Socket Module” on page 2-17
- “Accessories for Connecting a DUT” on page 2-18

**Step 3.** Turn the instrument on and then connect your DUT to the test fixture.

If your DUT is diode, connect a cathode terminal of your DUT to the Collector/Drain terminal of test fixture and a anode terminal of your DUT to the Emitter/Source terminal of test fixture.



## Executing Measurement


---

**NOTE**

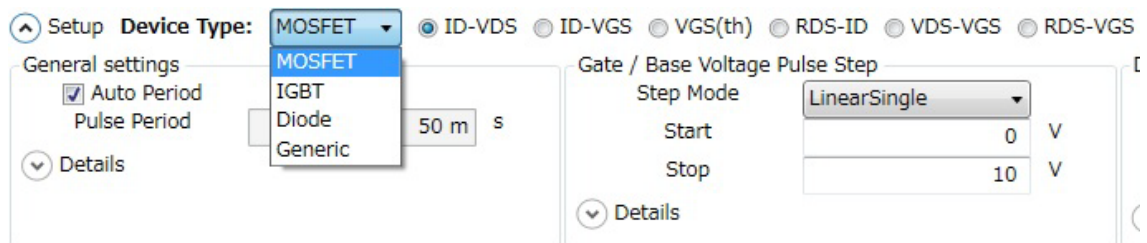
---

This section explains the procedure using an example that selects MOSFET as a device type of DUT and ID-VDS as a measurement item.

Execute a measurement as follows:

**Step 1.** On the software palette, click the I/V Measurement icon . The I/V Measurement software (Figure 3-2) opens.

**Step 2.** At the Setup area in work area, select a device type and measurement item to be measured.



- Device Type

From the Device Type drop-down list, select a device type.

---

**NOTE**

---

This example selects MOSFET.

- Measurement Item

From the radio buttons located on the right of a Device Type selection, which is MOSFET in this example, select a measurement item to be measured.

---

**NOTE**

---

This example selects ID-VDS.

---

**NOTE**

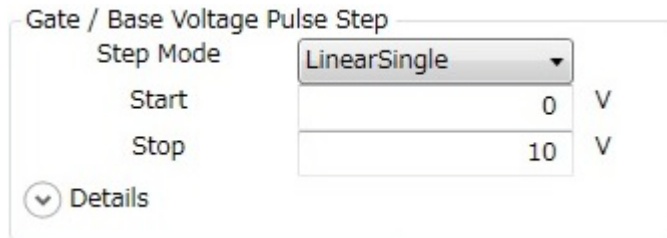
---

For information on the available device types and measurement items, see Table 3-2 on page 3-17

By selecting a device type and measurement item, the setup items displayed in the Setup area are automatically switched.

How To Perform Measurement  
How To Perform I/V Measurement

**Step 3.** Enter or select the setup conditions for the gate of MOSFET in Gate/Base Voltage Pulse Step at the center of Setup area.



- Selecting Step Mode

From the Step Mode drop-down list, select a step mode of pulse voltage output.

**LinearSingle** Outputs voltage level changes from the Start value to the Stop value at equal intervals.

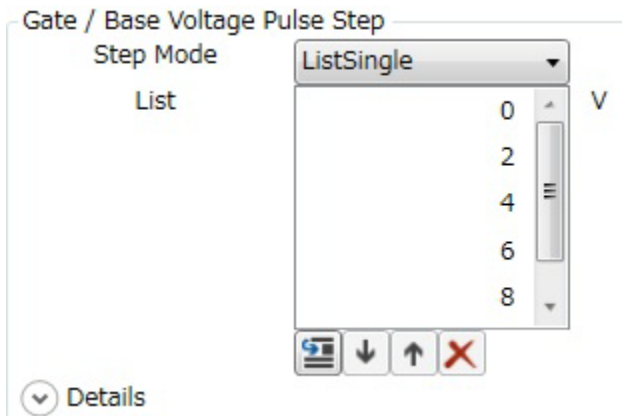
**ListSingle** Specify the output voltages of each step in the List. Each step voltage in the List will be output in order from top to bottom.

---

**NOTE**

---


This example selects the ListSingle.




- To change step values

Click the value in the List and you can change it to new value.


- To insert new step value

Select the step value immediately after where you want to insert new step value and click the Insert button .

- To change an output order of step values

Click the Move Down and the Move Up buttons  to move down or up an order of the selected step value.

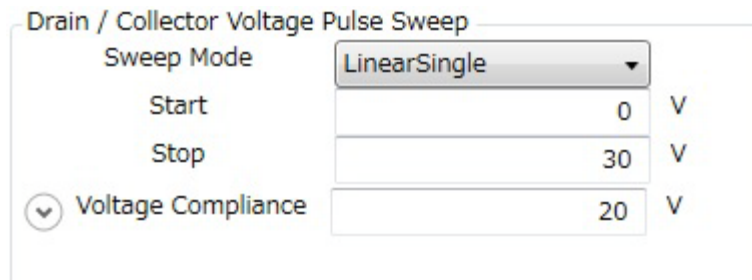
- To delete a step value


Click the Delete button  to delete the selected step value.

By clicking the **Details** chevron, the area expands to set more detail conditions.

For more information on setting items, see “Setup” on page 4-38.

- Step 4.** Enter or select the setup conditions for the drain of MOSFET in Drain/Collector Voltage Pulse Sweep at the right side of Setup area.



Drain / Collector Voltage Pulse Sweep		
Sweep Mode	LinearSingle	
Start	0	V
Stop	30	V
 Voltage Compliance	20	V

Select or specify a sweep mode, a sweep start value, a sweep stop value, and a voltage compliance.

- Sweep Mode

Select a sweep mode from the Sweep Mode drop-down list.

**LinearSingle** One-way linear sweep from the Start (sweep start value) to the Stop (sweep stop value).

**LogSingle** One-way logarithmic sweep from the Start (sweep start value) to the Stop (sweep stop value).

**LinearDouble** Linear-sweep from the Start (sweep start value) to the Stop (sweep stop value) and then return linear-sweep from the Stop to the Start.

## How To Perform Measurement

### How To Perform I/V Measurement

**LogDouble**      Logarithmic-sweep from the Start (sweep start value) to the Stop (sweep stop value) and then return logarithmic-sweep from the Stop to the Start.

- Start, Stop

Enter the sweep start value in the Start and the sweep stop value in the Stop.

- Voltage Compliance

Enter the voltage compliance value in the Voltage Compliance.

If the output voltage of measurement unit connected to a drain terminal is more than this value, a measurement unit stops the output.

By clicking the **Details** chevron, the area expands to set more detail conditions.

For more information on setting items, see “Setup” on page 4-38.

- Step 5.** Enter the setup conditions for the pulse output in General settings at the left side of Setup area.

General settings

Auto Period

Pulse Period      50 m s

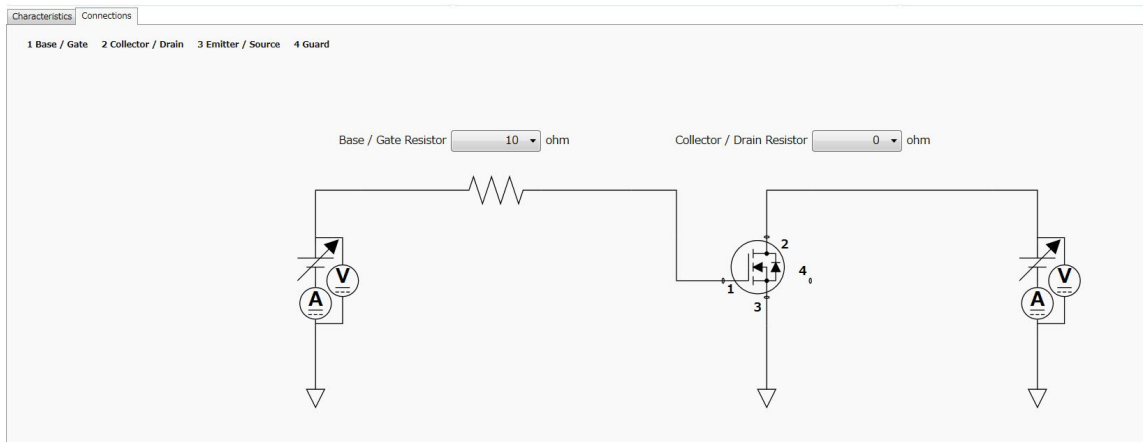
Details

**Auto Period**      Automatic adjustment for the pulse period.  
To enable this function, mark the check box.

**Pulse Period**      Pulse period.

However, if the Auto Period function is enabled, the pulse period is automatically adjusted to a minimum period corresponding to the pulse width.

**Step 6.** Click the Connections tab to display Connections area.



At Connections area, you can confirm a measurement circuit.

Also, you can select a gate resistor/drain resistor that may be effective to suppress a device oscillation during measurement.

- Base/Gate Resistor

You can select a gate resistor from this drop-down list.

A gate resistor may be effective to suppress a device oscillation during large current measurement.

---

**NOTE**

You can select a gate resistor only if a measurement resource is MCSCMU.

In this example, which selects MOSFET as a device type and ID-VDS as a measurement item, the default measurement resource is MCSCMU and you can select a gate resistor.

- Collector/Drain Resistor

You can select a drain resistor from this drop-down list.

A drain resistor may be effective to suppress a over current during a break-down measurement.

---


**NOTE**


You can select a drain resistor only if a measurement resource is HVSCMU.


## How To Perform Measurement

### How To Perform I/V Measurement

In this example, which selects MOSFET as a device type and ID-VDS as a measurement item, the default measurement resource is UHCU and a drain resistor is fixed to  $0\ \Omega$ .

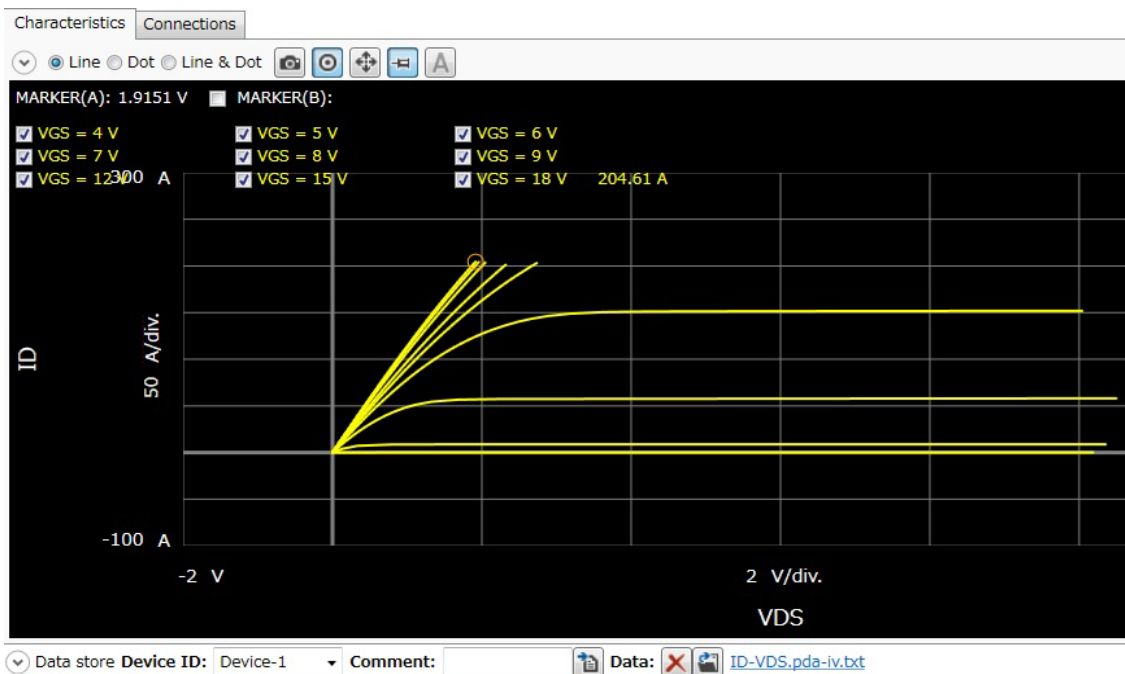
**Step 7.** Click the Start Measurement tool button  to start a measurement.

Or, click the Repeat Measurement tool button  to repeat a measurement.

After starting a measurement, you can stop a measurement by clicking the Stop Measurement tool button .

**Step 8.** Click the Characteristics tab to display the Characteristics area.

After a measurement is finished, a measured I/V characteristics curve is displayed on the Characteristics area. This example shows an ID-VDS characteristics curve.



For the operation on the graph display, see “Displaying and Operating Graph” on page 3-26.

## Setting Parameter

**Table 3-2 Available Device Types and Measurement Items**

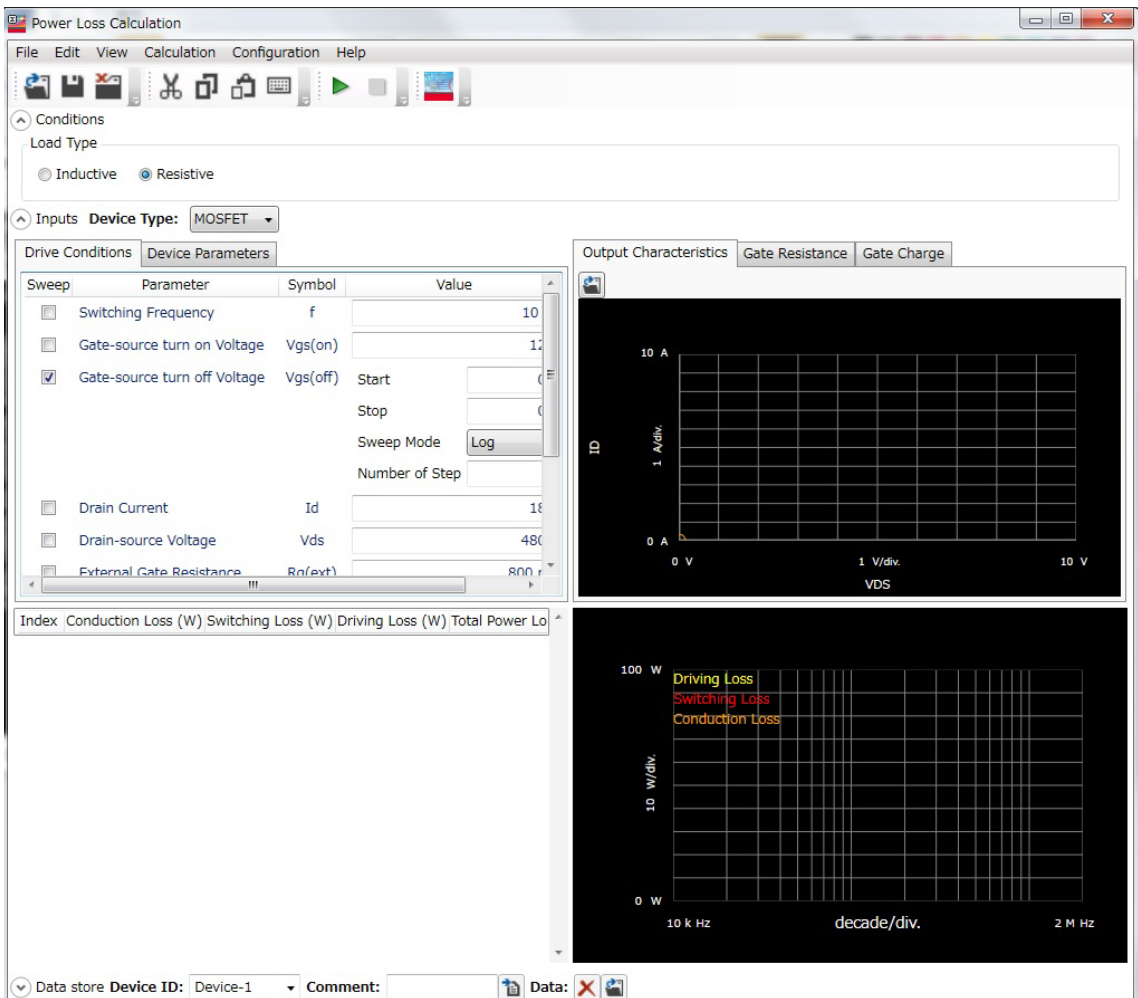
Device Type	Measurement Item	Description
MOSFET	ID-VDS	ID-VDS output characteristics
	ID-VGS	ID-VGS transmission characteristics
	RDS-ID	RDS (Drain to Source resistance) - ID characteristics
	VDS-VGS	VDS-VGS characteristics
	RDS-VGS	RDS (Drain to Source resistance) - VGS characteristics
	IDSS	Drain leak current - VDS characteristics
	IGSS	Gate leak current - VGS characteristics
	IS-VSD	Forward current of body diode - VSD characteristics
IGBT	IC-VCE	IC-VCE output characteristics
	IC-VGE	IC-VGE transmission characteristics
	VCE-VGE	VCE-VGE characteristics
	VCE(sat)	VCE(sat) (Collector to Emitter saturation voltage) - IC characteristics
	ICES	Collector leak current - VCE characteristics
	IGES	Gate leak current - VGE characteristics
Diode	IF-VF	Forward bias current - voltage characteristics
	IR-VR	Reverse bias current - voltage characteristics
Generic		Free setup on the measurement units connection and measurement conditions.

## How To Calculate Power Loss

This section describes how to calculate the power loss at a switching device using the power loss calculation software and consists of the following sub-sections:

- Calculating Power Loss
- Extracted Parameters By Power Loss Calculation

**Figure 3-3** Power Loss Calculation Software





The power loss calculation software calculates the power loss from the drive conditions and the device characteristics parameters of DUT.

There are the following two ways to specify the parameters for calculation:

- Specify the parameter values from the datasheet of DUT.  
If you want to calculate the power loss of DUT at the different drive conditions or there are the parameters that are not specified in the datasheet, you may specify the predicted values.
- Measure the switching device by the I/V measurement software, capacitance measurement software, and gate charge measurement software at your desired drive conditions and store the measurement data. Then, the power loss calculation software read the stored measurement data and extract the required drive conditions and characteristics parameters for power loss calculation.

This section explains the procedure that specify the measurement data file of DUT.

## Calculating Power Loss

### Step 1. Prepare the measurement data

The power loss calculation software uses the following measurement data files to calculate the power loss. So, measure the DUT at your desired drive conditions and save the measured data.

- Measurement data file of I/V measurement software

Prepare a measurement data file that measured either one of the following measurement item.

- ID-VDS
- RDS-ID
- VDS-VGS
- RDS-VGS

- Measurement data file of capacitance measurement software

Prepare the measurement data files that measured the following measurement items.


- Rg
- Crss

## How To Perform Measurement

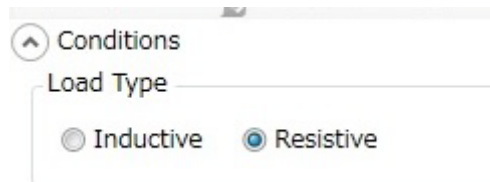
### How To Calculate Power Loss

- Measurement data file of gate charge measurement software

Prepare a measurement data file that measured any measurement item.

**Step 2.** On the software palette, click the Power Loss Calculation icon . The Power Loss Calculation software (Figure 3-3) opens.

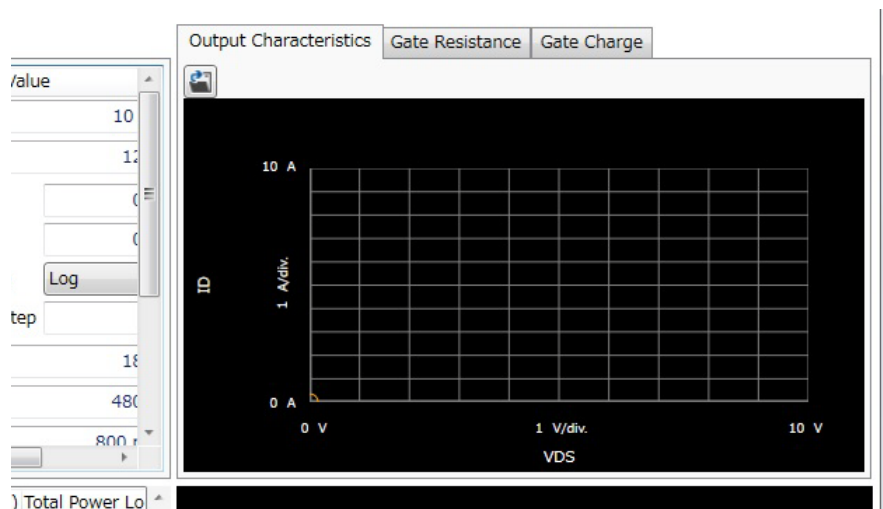
**Step 3.** Select the assumed load type to calculate the power loss in the Conditions area on the work area.




**Inductive**          Inductive load

**Resistive**          Resistive load

**Step 4.** Specify the measurement data files to be used for power loss calculation and load them.




1. Specify the measurement data file of the I/V measurement software to load.
  - a. Click the Output Characteristics tab at the right of work area to display the Output Characteristics area.

- b. Click the Load Measurement Data button  at the upper-left corner of the Output Characteristics area.


After the dialog box opens, specify the measurement data of I/V measurement software.

The characteristics graph of the loaded measurement item is displayed.

2. Specify the Rg measurement data file of the capacitance measurement software to load.
  - a. Click the Gate Resistance tab to display the Gate Resistance area.
  - b. Click the Load Measurement Data button  at the upper-left corner of the Gate Resistance area.


After the dialog box opens, specify the Rg measurement data of capacitance measurement software.

The loaded Rg characteristics graph is displayed.

3. Specify the Crss measurement data file of the capacitance measurement software to load.
  - a. Click the Reverse Transfer Capacitance tab to display the Revers Transfer Capacitance area.
  - b. Click the Load Measurement Data button  at the upper-left corner of the Reverse Transfer Capacitance area.

After the dialog box opens, specify the Crss measurement data of capacitance measurement software.

The loaded Crss characteristics graph is displayed.

4. Specify the measurement data file of the gate charge measurement software to load.
  - a. Click the Gate Charge tab to display the Gate Charge area.
  - b. Click the Load Measurement Data button  at the upper-left corner of the Gate Charge area.

After the dialog box opens, specify the measurement data of gate charge measurement software.

The gate charge characteristics graph of the loaded measurement item is displayed.

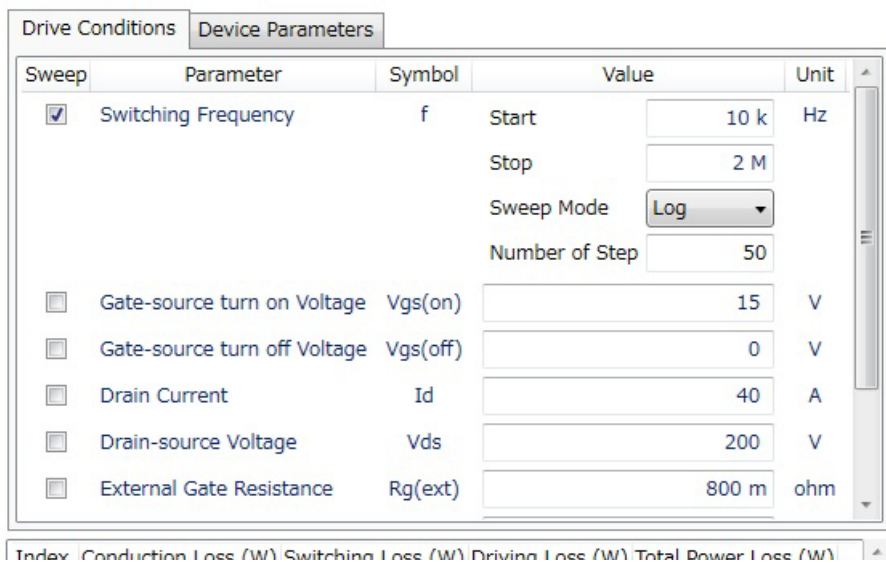
## How To Perform Measurement

### How To Calculate Power Loss

For the drive conditions and the device parameters for power loss calculation that extracted from the loaded measurement data, see “Measurement Data and Extracted Drive Conditions and Device Parameters for Power Loss Calculation” on page 25”.

You can confirm or change the drive conditions for power loss calculation by clicking the Drive Conditions tab at the left of work area.

Also, you can confirm or change the device parameters for power loss calculation by clicking the Device Parameters tab.



**Step 5.** Select a drive condition or device parameter to be swept and specify the sweep condition.

If you select a drive condition parameter to be swept, click the Drive Condition tab and mark the check box of the desired drive parameter.

If you select a device parameter to be swept, click the Device Parameters tab and mark the check box of the desired device parameter.

This example select a switching frequency to be swept.

1. Click the Drive Conditions tab and mark the check box of the Switching Frequency parameter to select.
2. Specify the sweep condition in the Value column.


**Start**                      Sweep start value

<b>Stop</b>	Sweep stop value
<b>Sweep Mode</b>	Sweep mode Log (logarithmic sweep) or Linear (linear sweep)
<b>Number of Step</b>	Number of sweep steps

**Step 6.** Specify the drive conditions that are not extracted from the loaded measurement data.

1. Click the Drive Conditions tab at the left of work area to display the Drive Conditions area.
2. Specify the following drive conditions that are not extracted from the measurement data.

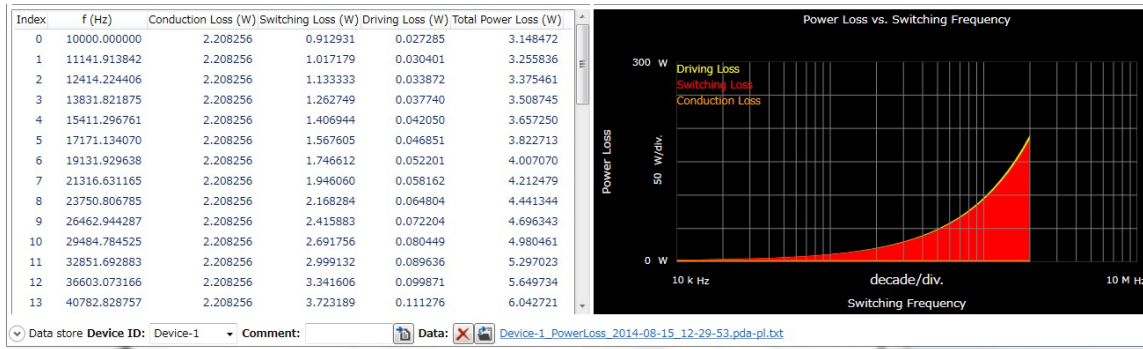
<b>Switching Frequency</b>	Switching frequency In this example, this parameter already specified by Step.4.
<b>Rg(ext)</b>	Gate input resistance in the external drive circuit
<b>Irms, D</b>	Irms: Effective drain current (the root mean square of the load current) D: Duty cycle.  Specify Irms or D. The relation between Irms and D is $I_{rms} = I_d \times D$ .

**Step 7.** Click the Start button  of toolbar to start the power loss calculation.

## How To Perform Measurement

### How To Calculate Power Loss

**Step 8.** After the calculation is completed, the list of calculated values are displayed at the left of the Results area and the trend chart of swept parameter and calculated values are displayed at the right of the Results area.



- List

The following calculated data are displayed in list format.

<b>Index</b>	Index number of sweep step.
<b>Sweep Parameter</b>	Sweep parameter and its step values.
<b>Conduction Loss</b>	Calculated conduction loss
<b>Switching Loss</b>	Calculated switching loss
<b>Driving Loss</b>	Calculated driving loss
<b>Total Power Loss</b>	Sum total of the conduction loss, switching loss, and driving loss.

For the calculation formula for each power loss, see “Results” on page 4-72.

- Trend Chart

The sweep parameter is assigned to X-axis, and the conduction loss, switching loss, and driving loss are assigned to Y-axis and accumulated in this order.

You can change the minimum and maximum values on the X and Y-axes by clicking the value.

## Extracted Parameters By Power Loss Calculation

Table 3-3

Measurement Data and Extracted Drive Conditions and Device Parameters for Power Loss Calculation

Measurement Data		Extracted Drive Conditions	Extracted Device Parameters
Measurement Software	Measurement Item		
I/V Measurement	ID-VDS, RDS-ID, RDS-VGS, or VDS-VGS		Rds(on) <sup>a</sup>
Capacitance Measurement	Rg		Rg <sup>b</sup>
	Crss		Qsw <sup>c</sup>
Gate Charge Measurement	Any measurement items	Vgs(on), Vgs(off), Id, Vds	Qg(on), Qg(off), Qsw, Vgs(pl)

- a. Extracted from Vgs(on)
- b. Extracted from Vgs(off)
- c. Extracted from Vgs(off) and Vds(off)

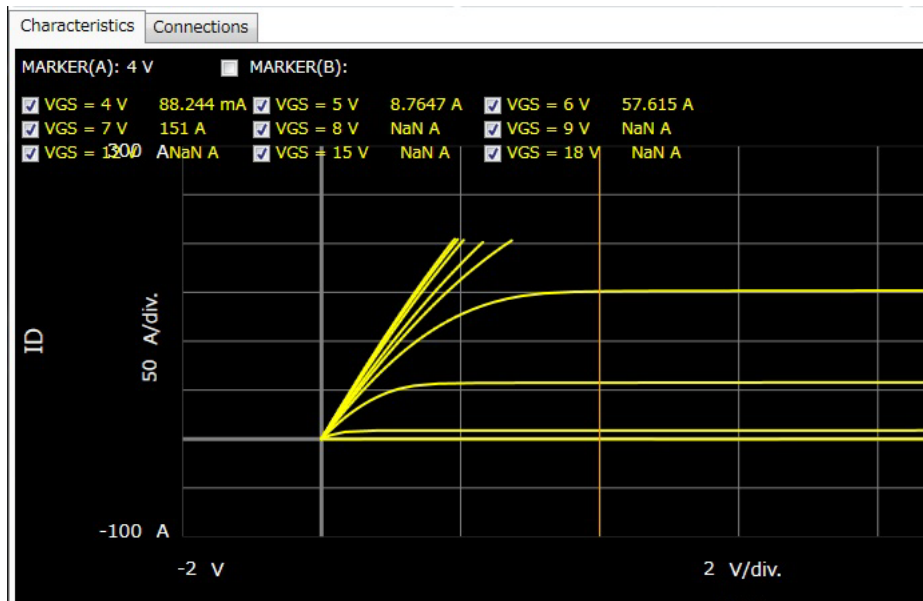
## Displaying and Operating Graph

This section describes the common graph operation within the measurement softwares and consists of the followings:

- How To Select and Display Characteristics Curve
- How To Use the Marker

### How To Select and Display Characteristics Curve

**Step 1.** Select the characteristics curves to display.

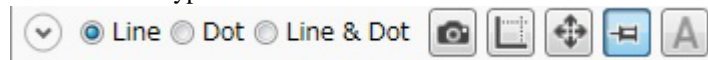


The check boxes for the available characteristics are displayed at the upper left on the graph area.

Mark the check boxes for the desired characteristics to display.

You can select the multiple characteristics to display.


**Step 2.** Select the line type of curve.







By the radio buttons at the top of graph area, you can select the line type of curve from the Line, Dot, or Line&Dot.

**Step 3.** Change the minimum and maximum values of X and Y-axes

If the auto scale mode button  is selected, the X and Y-axes of the graph are automatically changing to fit the measured data during measurement execution.

If the fixed scale mode button  is selected and the auto-scale button  is clicked, the X and Y-axes of the graph are changed to fit the measured data.

Or, you can change the minimum and maximum values of X and Y-axes by clicking the value.

## How To Use the Marker



You can use the domain marker and/or trace marker to read the value on the curve.

The following table shows the measurement softwares and their furnished marker function.

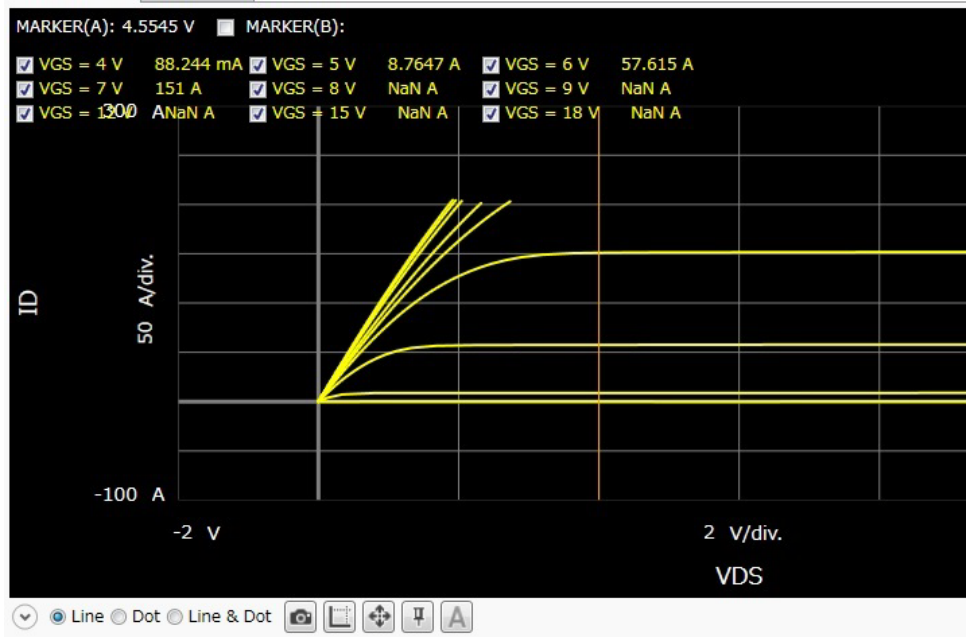
Marker	Description	Applied Software
Domain Marker	Vertical line marker. The marker moves in the direction of X and you can read the X-axis value of the marker and Y-axis values of the intersections of marker and characteristics curves.	I/V measurement, Capacitance measurement, Gate charge measurement
Trace Marker	Circle marker. The marker moves on a characteristics curve and you can read the X and Y-axis values of the marker.	I/V measurement, Capacitance measurement,

## How To Perform Measurement Displaying and Operating Graph

### Using the domain marker

**Step 1.** If the trace marker is displayed, click the trace marker mode button  to change to the domain marker mode .

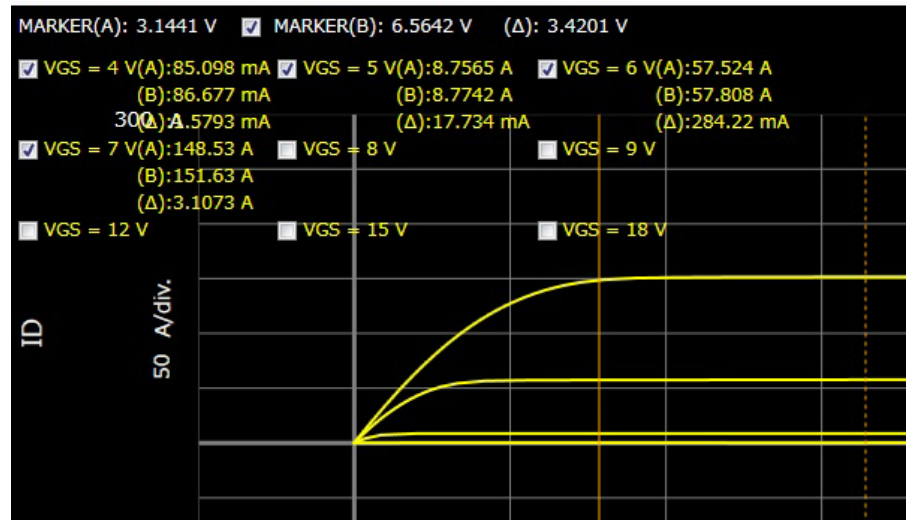
**Step 2.** Marker A (Vertical line) is displayed.



To move the marker, use the rotary knob or mouse.

The **MARKER(A)**: at the upper left of graph area shows the X-axis value of marker A and the Y-axis value of the intersection of the marker and each characteristics curve is displayed at the right of characteristics curve name.

**Step 3.** If the check box at the left of the **MARKER(B)**: is marked, the marker B (vertical dot line) is displayed.




The following information is displayed at the top of graph area:

**MARKER(B):** X-axis value of marker B

(Δ) X-axis value of marker B - X-axis value of marker A

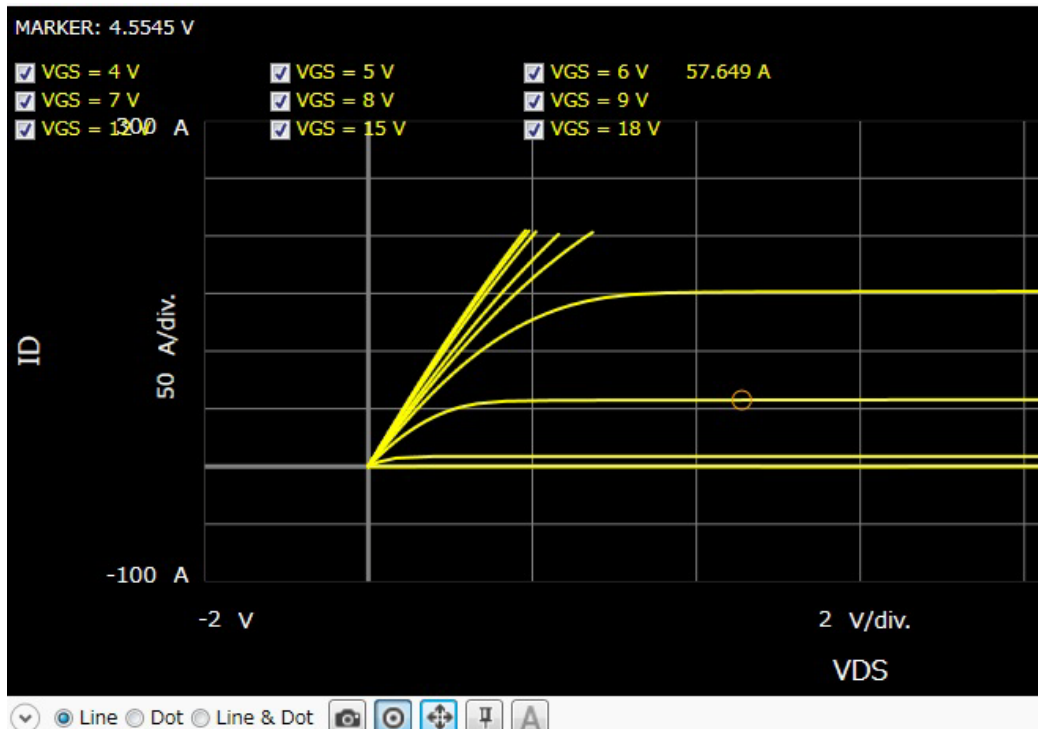
The Y-axis values of the intersection of the markers and each characteristics curve, and the differences of Y-axis values between the mark A interaction and the mark B interaction (B-A) are displayed at the right of characteristics curve name.

### Using the trace marker

**Step 1.** If the domain marker is displayed, click the domain marker mode button  to change to the trace marker mode .

## How To Perform Measurement Displaying and Operating Graph

**Step 2.** The trace marker (circle) is displayed.



You can move the trace marker on the characteristics curve using the rotary knob or mouse.

The **MARKER**: at the upper left of graph shows the X-axis value of the marker and the Y-axis value is displayed at the right of the characteristics curve name.

---

**4**

## **GUI Reference**

## GUI Reference

Keysight Easy Test Navigator software provides dedicated measurement software for power device characterization. It supports various types of measurement tasks with ease-of-use and simple operation.

This chapter describes reference information of the Keysight Easy Test Navigator software, and covers the following topics.

- “Software Palette”
- “Capacitance Measurement Software”
- “I/V Measurement Software”
- “Power Loss Calculation Software”

For how to perform the measurements, see Chapter 3.

For the EasyEXPERT software, see *EasyEXPERT User’s Guide*.

---

## Software Palette

The Software Palette provides a complete list of the B1507A's measurement software and also allows this software to be launched. The Software Palette lists icons with the measurement software names. You can start the measurement software by clicking the icons or software names. And, you can also start it by pressing the softkeys on the front panel, shown the correspondence by lines on the Software Palette.

The Software Palette is displayed in fullscreen mode after powering up the B1507A. The Software Palette can be minimized to access the Windows desktop.

The following shows the icons and texts displayed on the Software Palette, and actions by clicking them.



**Capacitance Measurement**

Starts the capacitance measurement software. See “Capacitance Measurement Software” on page 4-4.



**I/V Measurement**

Starts the I/V measurement software. See “I/V Measurement Software” on page 4-32.



**Power Loss Calculation**

Starts the power loss calculation software. See “Power Loss Calculation Software” on page 4-61.



**Minimize**

Minimizes the Software Palette. This is useful when you access the Windows desktop. When you click the icon on the taskbar, the Software Palette appears again.

## Capacitance Measurement Software

Capacitance measurement software provides:

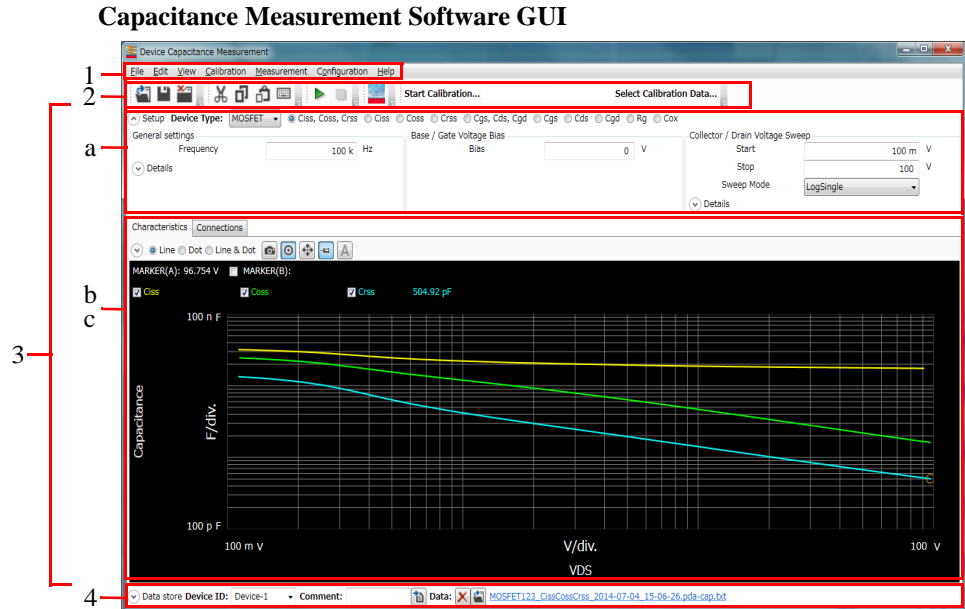
- Automated measurement circuit configuration for three-terminal device capacitance measurement (e.g. Ciss, Coss and Crss), with no need to manually modify any device connections
  - With DC bias (sweep) control up to 3 kV for Collector/Drain terminal
  - With DC bias (sweep) control up to 100 V for Base/Collector terminal
- Automated correction for every measurement path
- Stable measurements even if the low-side load capacitance changes due to a bias change (load adaptive gain-phase compensation)
- Predefined templates for typical capacitance measurements of both enhancement and depletion type MOSFETs, IGBTs and Diodes



## GUI Overview

The GUI (Graphical User Interface) of the capacitance measurement software is comprised of the following areas.

Figure 4-1



1. “Main Menu” on page 4-6  
This provides the functions needed for various operations in the menu format.
2. “Toolbar” on page 4-9  
This provides the functions that are very frequently used in the button format.
3. “Work Area” on page 4-11  
This area provides the functions to set the measurement conditions and observe the measurement results. This is separated to the following areas.
  - a. “Setup” on page 4-11
  - b. “Characteristics” on page 4-20
  - c. “Connections” on page 4-24
4. “Data List” on page 4-28

## GUI Reference

### Capacitance Measurement Software

This area provides the functions regarding the saving of the measurement data files.

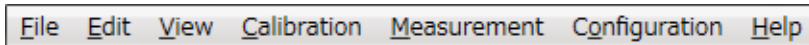
For the dialog boxes displayed during this software operation, see “Dialog Boxes” on page 4-30.

For the files handled by this software, see “Summary of Files” on page 4-31.

## Main Menu

**Figure 4-2**

### Main Menu



The following shows the structure of the main menu.

### File Menu

Displays the following menu items to operate the setup file and measurement data file. For the kinds of the files and file extensions, see “Summary of Files” on page 4-31.

<b>New</b>	Creates a new setup.  This destroys the setup that you are editing, and creates a new setup.
<b>Open...</b>	Opens an existing setup file or measurement data file.  This opens the file selection dialog box, destroys the setup that you are editing, and then opens the file selected in the dialog box.
<b>Save</b>	Saves the setup that you are editing to the original setup file.
<b>Save Setup As...</b>	Saves the setup that you are editing to the specified setup file.  This opens the file selection dialog box, and saves the present setup to the specified setup file.
<b>Save Data As...</b>	Saves the present setup data and measurement data to the specified measurement data file.  This opens the file selection dialog box, and saves the present setup data and measurement data to the specified measurement data file.
<b>Change Device ID...</b>	Changes the device ID recorded in the measurement data file.

This opens the Change Device ID dialog box, and changes the device ID recorded in the selected measurement data file(s). See “Change Device ID Dialog Box” on page 4-30.

**Recent Setup Files**

Lists a maximum of 10 names of the setup files that were recently edited, as menu items. You can easily open a setup file by using them.

**Exit**

Exits the capacitance measurement software. Unsaved data is destroyed.

**Edit Menu**

Displays the following menu items to edit the setup.

**Cut**

Moves the selected text to the clipboard.

**Copy**

Copies the selected text to the clipboard.

**Paste**

Pastes the text from the clipboard to the insertion point.

**On-screen  
keyboard...**

Displays the on-screen keyboard.

**View Menu**

Displays the following menu items for the display setting.

**Go to Palette**

Displays the Software Palette in fullscreen mode.

**Main Window**

Displays the following menu item.

**Fullscreen**

Changes the display style of the main window.

If this is marked, the main window does not have the titlebar and is displayed in fullscreen mode.

If this is unmarked, the main window has the titlebar and is displayed in the regular window style.

This is initially marked.

**Color Settings...**

Opens the Color Setting dialog box to set the color for parts in this software. See “Color Setting Dialog Box” on page 4-30.

**Calibration Menu**

Displays the following menu items for the calibration.

**Start**

Starts to get the calibration data.

GUI Reference  
Capacitance Measurement Software


Open or short the measurement circuit according to instructions of the wizard.

**Select Data** Opens the file selection dialog box, and then applies the selected calibration data file to the measurement.

**Measurement Menu**

Displays the following menu items for controlling the measurement.

**Start** Starts a measurement. During the measurement, the measurement status indicator on the front panel lights up.

To stop the measurement, select the Measurement > Stop menu, click the Stop Measurement button  on the toolbar, or press the Stop key on the front panel.

**Stop** Stops the measurement.

**Configuration Menu**

Displays the following menu item to administrate the configuration of the built-in modules in the mainframe and test fixture.

**Module...** Opens the Module Configuration dialog box. See “Module Configuration Dialog Box” on page 4-78.

**Help Menu**

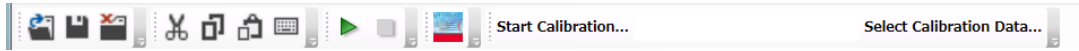
Displays the following menu item.

**About...** Opens the About Box dialog box. See “About Box Dialog Box” on page 4-30.

## Toolbar

Figure 4-3

Toolbar



The toolbar has five tool button groups. The following shows the tool buttons in the tool button groups.

### File tool button group



#### **Open**

Opens an existing setup file or measurement data file.

This opens the file selection dialog box, destroys the setup that you are editing, and then opens the file selected in the dialog box.



#### **Save**

Saves the setup that you are editing to the original setup file.



#### **Exit**

Exits the capacitance measurement software. Unsaved data is destroyed.

### Edit tool button group



#### **Cut**

Moves the selected text to the clipboard.



#### **Copy**

Copies the selected text to the clipboard.



#### **Paste**

Pastes the text from the clipboard to the insertion point.



#### **On-screen keyboard**

Displays the on-screen keyboard.

### Measurement tool button group


## GUI Reference

### Capacitance Measurement Software



#### **Start Measurement**

Starts a measurement. During the measurement, the measurement status indicator on the front panel lights up.

To stop the measurement, select the Measurement > Stop menu, click the Stop Measurement button  on the toolbar, or press the Stop key on the front panel.



#### **Stop Measurement**

Stops the measurement.

View tool button group



#### **Go to Palette**

Displays the Software Palette in fullscreen mode.

Calibration tool button group

#### **Start Calibration...**

Starts to get the calibration data.

Open or short the measurement circuit according to instructions of the wizard.

#### **Select Calibration Data...**

Opens the file selection dialog box, and then applies the selected calibration data file to the measurement.

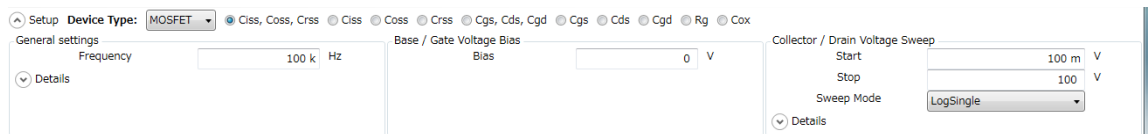
## Work Area

In this area, set the measurement conditions and observe the measurement results. This is separated to the following areas.

- “Setup” on page 4-11
- “Characteristics” on page 4-20
- “Connections” on page 4-24

## Setup

Figure 4-4



This is an area to select the device type and its measured parameters, and enter your measurement conditions.

### Device Type

Select the device type of your DUT from below.

- “MOSFET”
- “IGBT”
- “Diode”
- “Generic”

Select Generic to execute more general measurements for device other than above types.

### MOSFET

You can select one of the following capacitance and resistance parameter measurements for “MOSFET” device type.

- Ciss, Coss, Crss

Creates new settings to measure the characteristics of the input capacitance, output capacitance, and reverse transfer capacitance for the drain-source voltage in order.

- Ciss

Creates new settings to measure the characteristics of the input capacitance for the drain-source voltage.

## GUI Reference

### Capacitance Measurement Software

- **Coss**  
Creates new settings to measure the characteristics of the output capacitance for the drain-source voltage.
- **Crss**  
Creates new settings to measure the characteristics of the reverse transfer capacitance for the drain-source voltage.
- **Cgs, Cds, Cgd**  
Creates new settings to measure the characteristics of the gate-source capacitance, drain-source capacitance, and gate-drain capacitance for the drain-source voltage in order.
- **Cgs**  
Creates new settings to measure the characteristics of the gate-source capacitance for the drain-source voltage.
- **Cds**  
Creates new settings to measure the characteristics of the drain-source capacitance for the drain-source voltage.
- **Cgd**  
Creates new settings to measure the characteristics of the gate-drain capacitance for the drain-source voltage.
- **Rg**  
Creates new settings to measure the characteristics of the gate resistance for the gate-source voltage.
- **Cox**  
Creates new settings to measure the characteristics of the gate oxide capacitance for the gate-source voltage.

## IGBT

You can select one of the following capacitance and resistance parameter measurements for “IGBT” device type.

- **Cies, Coes, Cres**  
Creates new settings to measure the characteristics of the input capacitance, output capacitance, and reverse transfer capacitance for the collector-emitter voltage in order.
- **Cies**



Creates new settings to measure the characteristics of the input capacitance for the collector-emitter voltage.

- Coes

Creates new settings to measure the characteristics of the output capacitance for the collector-emitter voltage.

- Cres

Creates new settings to measure the characteristics of the reverse transfer capacitance for the collector-emitter voltage.

- Cge, Cce, Cgc

Creates new settings to measure the characteristics of the gate-emitter capacitance, collector-emitter capacitance, and gate-collector capacitance for the collector-emitter voltage in order.

- Cge

Creates new settings to measure the characteristics of the gate-emitter capacitance for the collector-emitter voltage.

- Cce

Creates new settings to measure the characteristics of the collector-emitter capacitance for the collector-emitter voltage.

- Cgc

Creates new settings to measure the characteristics of the gate-collector capacitance for the collector-emitter voltage.

- Rg

Creates new settings to measure the characteristics of the gate resistance for the gate-emitter voltage.

## **Diode**

You can select the following capacitance parameter measurements for “Diode” device type.

- CT

Creates new settings to measure the characteristics of the total anode-cathode capacitance for the reverse bias voltage.

## **Generic**

You can select one of the following measurements for “Generic” device type.

- Collector/Drain Voltage Sweep

## GUI Reference

### Capacitance Measurement Software

Creates new settings to measure the Cp-G model capacitance between the collector/drain and the emitter/source terminals for the swept collector-emitter or drain-source voltage.

- Base/Gate Voltage Sweep

Creates new settings to measure the Cs-Rs model capacitance between the base/gate and the emitter/source terminals for the swept base-emitter or gate-source voltage.

#### General settings

In this area, you can set the following measurement conditions.

- Frequency

Specify the output frequency of the AC signal from MFCMU.  
Setting range: 1 kHz to 1 MHz

- AC Level

Specify the output level of the AC signal from MFCMU.  
Setting range: 0 to 250 mV

- N PLC

Specify the measurement time (integral time) in the number of power line cycle.  
Setting range: 1 to 100

- Phase Compensation

Specify one from the following phase compensation modes.


- Auto

Uses the predefined phase compensation data.

- Adaptive

Compensates the phase at each measurement point before the measurement.

It is useful when you cannot measure in the Auto compensation mode by MFCMU oscillation.

The following parameter can be shown or hidden by clicking the chevron  of the Details.

- AC Level
- N PLC
- Phase Compensation

## Base/Gate drive settings

Specify the output settings for the base-collector or gate-source voltage. You can set them up depending on the types of the selected measurement: forcing the constant bias voltage or sweeping the bias voltage.

### Base/Gate Voltage Bias:

You can specify the following parameters to force the constant bias voltage.

- Bias  
Specify the bias voltage.  
Setting range: -100 V to +100 V

### Base/Gate Voltage Sweep:

You can specify the following parameters to sweep the bias voltage.

- Start  
Specify the sweep start value.  
Setting range: -100 V to +100 V
- Stop  
Specify the sweep stop value.  
Setting range: -100 V to +100 V
- Sweep Mode  
Select one from the following sweep modes.
  - LinearSingle (Sweep from start to stop in a linear incremental step)
  - LogSingle (Sweep from start to stop in a logarithmic incremental step)
  - LinearDouble (Sweep from start to stop to start in a linear incremental step)
  - LogDouble (Sweep from start to stop to start in a logarithmic incremental step)
- Number of Step  
Specify the number of sweep steps from start to stop.  
Setting range: 1 to 1001
- Hold Time  
Specify the hold time of the sweep start voltage. At the sweep start point, the start voltage is forced for more than the specified time.  
Setting range: 0 to 655.35 s
- Delay Time

## GUI Reference

### Capacitance Measurement Software

Specify the delay time of the measurement at each sweep step. The measurement is executed after waiting for more than the specified time at each sweep step.  
Setting range: 0 to 65.535 s


- Zero Bias Time

Keeps 0 V at every terminal for more than the specified time after one sweep measurement.

Setting range: 0 to 99.9 s

In the measurement of the same capacitance parameter as shown in the following table, the characteristics results by the single measurement and the continuous measurement may have the difference depending on the bias voltage condition between the measurements. This parameter is used to cancel the dependence on the bias voltage condition in the continuous measurement.

Device Type	Continuous Measurement	Single Measurement
MOSFET	<ul style="list-style-type: none"> <li>• Ciss, Coss, Crss</li> </ul>	<ul style="list-style-type: none"> <li>• Ciss</li> <li>• Coss</li> <li>• Crss</li> </ul>
	<ul style="list-style-type: none"> <li>• Cgs, Cds, Cgd</li> </ul>	<ul style="list-style-type: none"> <li>• Cgs</li> <li>• Cds</li> <li>• Cgd</li> </ul>
IGBT	<ul style="list-style-type: none"> <li>• Cies, Coes, Cres</li> </ul>	<ul style="list-style-type: none"> <li>• Cies</li> <li>• Coes</li> <li>• Cres</li> </ul>
	<ul style="list-style-type: none"> <li>• Cge, Cce, Cgc</li> </ul>	<ul style="list-style-type: none"> <li>• Cge</li> <li>• Cce</li> <li>• Cgc</li> </ul>

The following parameter can be shown or hidden by clicking the chevron  of the Details.

- Number of Step

- Hold Time
- Delay Time
- Zero Bias Time

### **Collector/Drain drive settings**

Specify the output settings for the collector-emitter or drain-source voltage. You can set them up depending on the types of the selected measurement: forcing the constant bias voltage or sweeping the bias voltage.

Collector/Drain Voltage Bias:

You can specify the following parameters to force the constant bias voltage.

- Bias

Specify the bias voltage.

Setting range: -3000 V to +3000 V

Collector/Drain Voltage Sweep:

You can specify the following parameters to sweep the bias voltage.

- Start

Specify the sweep start value.

Setting range: -3000 V to +3000 V

- Stop

Specify the sweep stop value.

Setting range: -3000 V to +3000 V

- Sweep Mode

Select one from the following sweep modes.

- LinearSingle (Sweep from start to stop in a linear incremental step)
- LogSingle (Sweep from start to stop in a logarithmic incremental step)
- LinearDouble (Sweep from start to stop to start in a linear incremental step)
- LogDouble (Sweep from start to stop to start in a logarithmic incremental step)

- Number of Step

Specify the number of sweep steps from start to stop.

Setting range: 1 to 1001

- Hold Time

GUI Reference  
 Capacitance Measurement Software

Specify the hold time of the sweep start voltage. At the sweep start point, the start voltage is forced for more than the specified time.

Setting range: 0 to 655.35 s

- Delay Time

Specify the delay time of the measurement at each sweep step. The measurement is executed after waiting for more than the specified time at each sweep step.

Setting range: 0 to 65.535 s


- Zero Bias Time

Keeps 0 V at every terminal for more than the specified time after one sweep measurement.

Setting range: 0 to 99.9 s

In the measurement of the same capacitance parameter as shown in the following table, the characteristics results by the single measurement and the continuous measurement may have the difference depending on the bias voltage condition between the measurements. This parameter is used to cancel the dependence on the bias voltage condition in the continuous measurement.

Device Type	Continuous Measurement	Single Measurement
MOSFET	<ul style="list-style-type: none"> <li>• Ciss, Coss, Crss</li> </ul>	<ul style="list-style-type: none"> <li>• Ciss</li> <li>• Coss</li> <li>• Crss</li> </ul>
	<ul style="list-style-type: none"> <li>• Cgs, Cds, Cgd</li> </ul>	<ul style="list-style-type: none"> <li>• Cgs</li> <li>• Cds</li> <li>• Cgd</li> </ul>
IGBT	<ul style="list-style-type: none"> <li>• Cies, Coes, Cres</li> </ul>	<ul style="list-style-type: none"> <li>• Cies</li> <li>• Coes</li> <li>• Cres</li> </ul>
	<ul style="list-style-type: none"> <li>• Cge, Cce, Cgc</li> </ul>	<ul style="list-style-type: none"> <li>• Cge</li> <li>• Cce</li> <li>• Cgc</li> </ul>

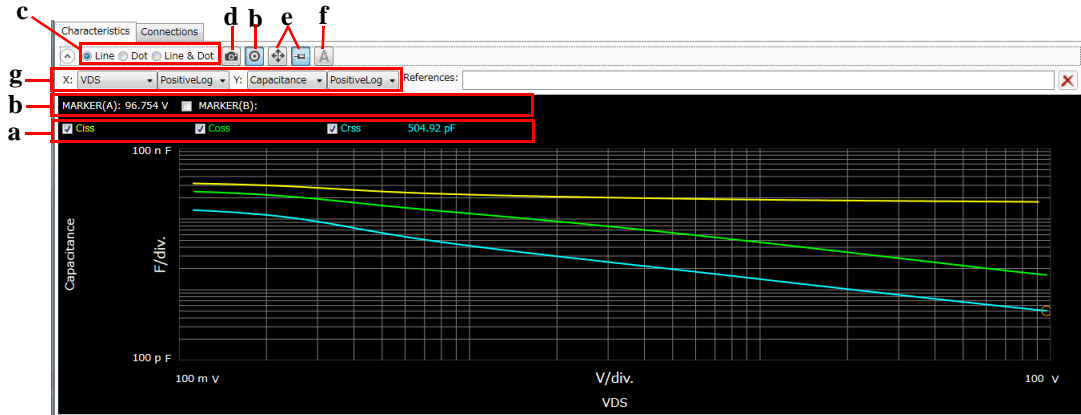
The following parameter can be shown or hidden by clicking the chevron  of the Details.

- Number of Step
- Hold Time
- Delay Time
- Zero Bias Time

## Characteristics

Figure 4-5

### Characteristics



This page shows the graph of the specified parameter characteristics as the measurement result. To display this page, click the Characteristics tab.

#### a. Displaying Characteristic Curves



The data for the X and Y-axes are assigned according to the parameter characteristics specified in the Setup.

If the graph has multiple characteristic curves for different measurement conditions, the measurement conditions are displayed on the graph with the check boxes. Marking the check box displays the characteristic curve for the measurement condition. You can mark multiple check boxes for the measurement conditions.

You can change the minimum and maximum values on the X and Y-axes by clicking the value.

#### b. Markers

This graph supports two kinds of markers: Domain marker and Trace marker. You can switch these markers by clicking the Marker button shown in the bottom part of the graph.

-  : Marker button when the Domain marker is used.
-  : Marker button when the Trace marker is used.

The Domain marker can read multiple characteristic values for the X-axis position.

The Domain marker supports two markers (A and B). Marker A is always available. To use the Marker B, mark the check box for the Marker B. The Marker B is a break line. To move the marker position, use the rotary knob or mouse.



The marker annotation on the graph has X-axis values for markers, and a difference value ( $\Delta$ ) between the Marker B and A (B–A). And, each curve annotation has Y-axis values and difference values ( $\Delta$ ) between the Marker B and A (B–A).


The Trace marker can read the characteristic value with tracing each characteristic curve. It is useful when you want to read the characteristic value on double sweep result.



The marker annotation on the graph has X-axis value for the marker. And, the traced curve annotation has Y-axis value.


### c. Curve Representation

The curves can be represented as Line, Dot, or combination (Line & Dot). Select any curve representation using the radio buttons shown in the bottom part of the graph.

### d. Reference Traces


You can register the presently-displayed curves as reference traces to compare with other measurement results on the graph. If you register them as reference traces, the reference traces are displayed as break lines on the graph when you open other measurement data files or execute the next measurement. To register as the reference traces, click the Capture button  shown in the bottom part of the graph.

You can register a maximum of 10 reference traces. The measurement data files registered as the reference traces are listed in the References field under the Capture button . You can show or hide the reference traces using the check boxes at the head of the measurement data file names. The References field can be shown or hidden by clicking the chevron  under the graph.

To remove unnecessary reference traces, select the measurement data file in the References field, and then click the Remove button .

The registration of the reference traces is cleared when you exit the capacitance measurement software.

### e. Auto Scale

Clicking the Auto Scale button  fits the measurement data at that time in the graph scale.

If the auto scale mode is selected by using the Scale mode button, the measurement data is automatically fit according to the progress of the measurement.

If the fixed scale mode is selected by using the Scale mode button, the scale is fixed until changing the scale manually or clicking the Auto Scale button.



: Scale mode button during selecting the auto scale mode.




: Scale mode button during selecting the fixed scale mode.

## GUI Reference

### Capacitance Measurement Software


#### f. Trace Labels

The step values for the characteristic curves can be shown or hidden by clicking the Trace Label button .

In the case that multiple curves (Ciss, Coss, and Crss of MOSFET, and so on) are displayed on the graph, the parameter name display is useful to identify which curve is for which parameter.

#### g. X/Y Data

You can select the data and scale for the X and Y-axes. As default, the data for the X and Y-axes are assigned according to the parameter characteristics specified in the Setup.

The X/Y data field can be shown or hidden by clicking the chevron  under the graph.

Select one from the following scales.

- Linear  
Linear scale
- PositiveLog  
Logarithm scale for positive data
- NegativeLog  
Logarithm scale for negative data

Select data for X and Y-axes. The data corresponding to the parameter specified in the Setup is represented as Capacitance, Conductance, or Resistance.

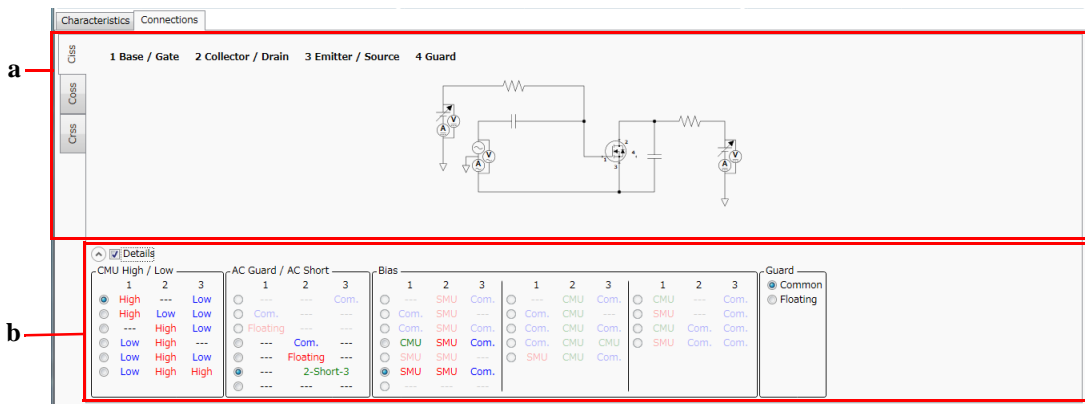
For example, in the case of the Ciss measurement, Cp is represented as Capacitance and G is represented as Conductance. In like manner, in the case of the Rs measurement, Rs is represented as Resistance and Cs is represented as Capacitance.

- Cp  
Parallel capacitance on the Cp-G model
- G  
Conductance on the Cp-G model
- Cs  
Serial capacitance on the Cs-Rs model
- Rs  
Serial resistance on the Cs-Rs model
- Ls

- Serial inductance on the Ls-Rs model
- Lp  
Parallel inductance on the Lp-G model
- R  
Resistance on the R-X (impedance) model
- X  
Reactance on the R-X (impedance) model
- G  
Conductance on the G-B (admittance) model
- B  
Susceptance on the G-B (admittance) model
- VGS (for MOSFET)/VGE (for IGBT)  
Gate-source voltage or base-emitter voltage
- IG  
Gate or base current
- VDS (for MOSFET)/VCE (for IGBT)  
Drain-source voltage or collect-emitter voltage
- ID (for MOSFET)/IC (for IGBT)  
Drain or collector current

## Connections

Figure 4-6 Connections



This page shows the measurement circuit that is automatically connected according to your specified measurement conditions. To display this page, click the Connections tab.

### a. Measurement Circuit

On the measurement circuit, the measurement terminals, the measurement resources, and the built-in capacitance and resistance are displayed. The following shows the relationship between the terminal numbers and the measurement terminals.

- 1: Base/Gate terminal
- 2: Collector/Drain terminal
- 3: Emitter/Source terminal
- 4: Guard terminal

### NOTE

If DUT is a diode, connect the cathode terminal to 2. Collector/Drain terminal, and the anode terminal to 3. Emitter/Source terminal.

In the case that the specified parameter characteristics has multiple measurements such as Ciss, Coss, and Crss measurements, the measurement circuits are respectively separated for the measurements by left-side tabs.

### b. Details

This area is hidden as default. You can show this area under the measurement circuit by clicking the chevron (⌵) of the Details.

This area shows the connection status for the terminals in the table format. To edit the settings, mark the check box in this area. You can set up the connections by the combination of the following items.

- CMU High/Low

Select a combination of connections between the DUT terminals (1 to 3) and the CMU terminals (High and Low).

<b>High</b>	Connects the DUT terminal to the High terminal of CMU.
<b>Low</b>	Connects the DUT terminal to the Low terminal of CMU.
<b>---</b>	No connection

- AC Guard/AC Short

Select a combination of connections between the DUT terminals (1 to 3) and AC Guard terminal, or AC short connection between the DUT terminals 2 and 3.

<b>Com.</b>	Connects the DUT terminal to the circuit common directly.
<b>Floating</b>	Connects the DUT terminal to the selected bias source or the circuit common via the built-in capacitor.
<b>2-Short-3</b>	Shorts between DUT terminals 2 and 3 via the built-in capacitor.
<b>---</b>	No connection

- Bias

Select a combination of connections between the DUT terminals (1 to 3) and the DC bias source (SMU, CMU, or Common).

<b>CMU</b>	Uses the bias source in the CMU that is connected.
<b>SMU</b>	Connects the DUT terminal to an SMU as the bias source.
<b>Com.</b>	Connects the DUT terminal to the circuit common.
<b>---</b>	No connection

- Guard

Select a connection between the DUT terminal 4 and AC Guard terminal.

<b>Com.</b>	Connects the DUT terminal 4 to circuit common directly.
<b>Floating</b>	Connects the DUT terminal 4 to the selected bias source or the circuit common via the built-in capacitor.

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The following table shows applicable connections between the DUT terminals and the measurement resources. The rightmost column shows the potential at the DUT terminal 4 when it is connected to the AC Guard terminal in the built-in capacitor (Floating connection). In the table, the blank cell means “same as above”.

**Table 4-1**                      **Applicable Connections**

CMU High/Low			AC Guard/AC Short			Bias			Guard
1	2	3	1	2	3	1	2	3	Floating
High	---	Low	---	Com.	---	CMU	Com.	Com.	AC Guard
						SMU	Com.	Com.	AC Guard
			---	Floating	---	CMU	SMU	Com.	Terminal 2
						SMU	SMU	Com.	Terminal 2
						CMU	---	Com.	AC Guard
						SMU	---	Com.	AC Guard
			---	2-Short-3		CMU	SMU	Com.	Terminal 2
						SMU	SMU	Com.	Terminal 2
High	Low	Low	---	---	---	CMU	Com.	Com.	AC Guard
						SMU	Com.	Com.	AC Guard
---	High	Low	Com.	---	---	Com.	SMU	Com.	AC Guard
			Floating	---	---	SMU	SMU	Com.	AC Guard
						---	CMU	Com.	AC Guard
						SMU	CMU	Com.	AC Guard
Low	High	---	---	---	Com.	Com.	SMU	Com.	AC Guard
						SMU	SMU	Com.	AC Guard
						Com.	CMU	Com.	AC Guard
						SMU	CMU	Com.	AC Guard
Low	High	Low	---	---	---	Com.	SMU	Com.	AC Guard

CMU High/Low			AC Guard/AC Short			Bias			Guard
1	2	3	1	2	3	1	2	3	Floating
						SMU	SMU	Com.	AC Guard
						Com.	CMU	Com.	AC Guard
						SMU	CMU	Com.	AC Guard
Low	High	High	---	---	---	Com.	CMU	CMU	AC Guard

## Data List

Figure 4-7

### Data List



The data list area provides the following functions regarding the saving of the measurement data files.


- Set the device ID to be recorded to the measurement data file  
See “Device ID” on page 4-28.
- Enter a comment to be recorded to the measurement data file  
See “Comment” on page 4-28.
- Operations for the latest measurement data file  
See “Data” on page 4-29.
- Access to the measurement data files that were automatically saved  
See “Data store” on page 4-29.

The setup data and measurement data are automatically saved to a new measurement data file at the end of the measurement. At this time, you can also record a device ID to identify your DUT and a comment. And, the destination folder of the measurement data file for auto-saving is predefined. You can set the device ID and comment, and change the destination folder using this area.

### Device ID

Enter device ID string to the Device ID field. The maximum 10 recently-entered device IDs can be kept as history, and you can also select one from the history list.

The entered device ID is automatically saved to the measurement data file at the end of the measurement.


You can also change the device ID in the latest measurement data file after the measurement here. To change it, change the device ID in the Device ID field, and then click the Apply button .

### Comment

Enter a comment string to the Comment field.



The entered comment is automatically saved to the measurement data file at the end of the measurement.



You can also change the comment in the latest measurement data file after the measurement here. To change it, change the comment in the Comment field, and then click the Apply button .


## Data

The Data field shows the latest auto-saved or last-opened measurement data file name. You can do the following operations.

- Open the measurement data file by clicking the Open button .
- Rename the measurement data file by clicking the measurement data file name.
- Delete the measurement data file by clicking the Delete button .

## Data store

Using the following fields, you can change the destination folder of the auto-saved measurement data file, and access the auto-saved measurement data files.

The following fields can be shown or hidden by clicking the chevron  next to “Data store”.

**Data folder** Shows the absolute path of the auto-saved measurement data file. To change this, click the Browse button to open the folder selection dialog box. Select your desired folder in the dialog box.

For the initial setting of the data folder, see “Summary of Files” on page 4-31.

**Recent data** Shows up to 10 auto-saved measurement data files that were automatically saved recently, in the hyper-link format. Clicking the hyper-link opens the selected measurement data file. This destroys the presently-editing data.

If the number of the auto-saved measurement data files is over ten, this field shows “more...”. Clicking this opens the file selection dialog box. Select a measurement data file to open.

## Dialog Boxes

### Change Device ID Dialog Box

The Change Device ID dialog box is used to change the device ID in all selected measurement data files at once.

- |                        |   |
|------------------------|---|
| <b>Device ID field</b> | Enter a new device ID. You can also select it from the history.   |
| <b>Add... button</b>   | Opens the file selection dialog box to select the measurement data file(s) that you want to change the device ID. The selected files are displayed into the list. |
| <b>Remove button</b>   | Excludes the selected measurement data file from the list.  |
| <b>Execute button</b>  | Changes the device ID.  |
| <b>Close button</b>    | Closes this dialog box.   |

This dialog box is opened by selecting the main menu File > Change Device ID....

### Color Setting Dialog Box

The Color Setting dialog box is used to set colors of parts in this software.

The graph elements supported by this dialog box are graph background, X and Y-axes, graph grid, graph text, marker, and three traces. Clicking the color pattern opens the dialog box for selecting a color.

The setting in the Color Setting dialog box is saved as a user setting.

- |                      |   |
|----------------------|---|
| <b>Apply button</b>  | Applies the present setting to the graph.                             |
| <b>Reset button</b>  | Resets to the default setting.  |
| <b>OK button</b>     | Applies the present setting to the graph, and closes this dialog box. |
| <b>Cancel button</b> | Closes this dialog box without applying the present setting.          |

This dialog box is opened by selecting the main menu View > Color Settings....

### About Box Dialog Box

The About Box dialog box displays the model number, the software revision number, download URL for software updating, and so on.

This dialog box is opened by selecting the main menu Help > About....

## Summary of Files

The following shows the summary of the files handled by the capacitance measurement software.

**Table 4-2 Summary of Files**

File Type	Description	Extension	Folder as Initial Setting
Setup File	Setup data You can save this if needed.	*.pda-cap	(You can specify the folder when saving the data)
Measurement Data File	Setup data and measurement data including the device ID and comment  This is automatically saved after the measurement. You can optionally save this.	*.pda-cap.txt	C:\Users\ <user name="">\Documents\Keysight\SeriesB150x\PowerDevice Analyzer\DeviceCapacitance\DataStore (You can change this)</user>
Calibration Data File	Calibration data  This is automatically saved after the calibration execution.	*.pda-cap.cal	C:\ProgramData\Keysight\SeriesB150x\PowerDevice Analyzer\DeviceCapacitance\UserCalibrationData
	Factory Default Calibration data  This is used when there is no user calibration data.		C:\ProgramData\Keysight\SeriesB150x\PowerDevice Analyzer\DeviceCapacitance\CalibrationData

### File name of Measurement Data File on Auto-saving

An auto-saved measurement data file is named as the following rule.

1. Concatenates the device ID, date and time on save by an underscore (\_).
2. Concatenates the file extension (.pda-cap.txt) to the end of the “step 1” string.
3. If the “step 2” file name duplicates the existing file name, concatenates the serial number from 2 enclosed by brackets and the file extension to the end of the “step 1” string.

## I/V Measurement Software

I/V Measurement Software provides:

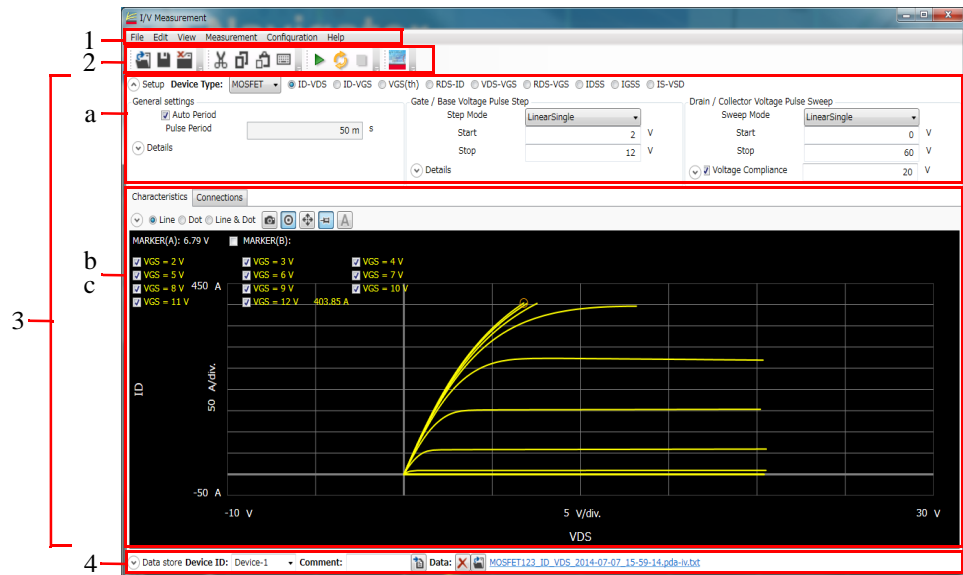
- Voltage/current sweep/spot measurements
- DC/pulse outputs
- Linear/log sweep with both single (one-way) and double (round-trip) capability for the primary sweep source (similar to the collector supply of a conventional curve tracer)
- Linear/list sweep capability for the secondary sweep source (corresponding to the step generator of a conventional curve tracer)
- The ability to assign the primary sweep source or the secondary sweep source to either the collector/drain terminal or to the base/gate terminal.
- Intuitive and interactive sweep/spot measurement operation using rotary knob.
- Predefined templates for typical MOSFET, IGBT and Diode I/V measurements.

## GUI Overview

The GUI (Graphical User Interface) of the I/V measurement software is comprised of the following areas.

Figure 4-8

### I/V Measurement Software GUI



1. “Main Menu” on page 4-34

This provides the functions needed for various operations in the menu format.

2. “Toolbar” on page 4-36

This provides the functions that are very frequently used in the button format.

3. “Work Area” on page 4-38

This area provides the functions to set the measurement conditions and observe the measurement results. This is separated to the following areas.

a. “Setup” on page 4-38

b. “Characteristics” on page 4-52

c. “Connections” on page 4-55

4. “Data List” on page 4-57

This area provides the functions regarding the saving of the measurement data files.

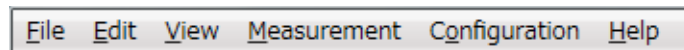
For the dialog boxes displayed during this software operation, see “Dialog Boxes” on page 4-59.

For the files handled by this software, see “Summary of Files” on page 4-60.

## Main Menu

Figure 4-9

### Main Menu



The following shows the structure of the main menu.

### File Menu

Displays the following menu items to operate the setup file and measurement data file. For the kinds of the files and file extensions, see “Summary of Files” on page 4-60.

<b>New</b>	Creates a new setup.  This destroys the setup that you are editing, and creates a new setup.
<b>Open...</b>	Opens an existing setup file or measurement data file.  This opens the file selection dialog box, destroys the setup that you are editing, and then opens the file selected in the dialog box.
<b>Save</b>	Saves the setup that you are editing to the original setup file.
<b>Save Setup As...</b>	Saves the setup that you are editing to the specified setup file.  This opens the file selection dialog box, and saves the present setup to the specified setup file.
<b>Save Data As...</b>	Saves the present setup data and measurement data to the specified measurement data file.  This opens the file selection dialog box, and saves the present setup data and measurement data to the specified measurement data file.
<b>Change Device ID...</b>	Changes the device ID recorded in the measurement data file.

This opens the Change Device ID dialog box, and changes the device ID recorded in the selected measurement data file(s). See “Change Device ID Dialog Box” on page 4-59.

**Recent Setup Files**

Lists a maximum of 10 names of the setup files that were recently edited, as menu items. You can easily open a setup file by using them.

**Exit** Exits the I/V measurement software. Unsaved data is destroyed.

**Edit Menu**

Displays the following menu items to edit the setup.

**Cut** Moves the selected text to the clipboard.

**Copy** Copies the selected text to the clipboard.

**Paste** Pastes the text from the clipboard to the insertion point.

**On-screen keyboard...** Displays the on-screen keyboard.

**View Menu**

Displays the following menu items for the display setting.

**Go to Palette** Displays the Software Palette in fullscreen mode.

**Main Window** Displays the following menu item.

**Fullscreen** Changes the display style of the main window.

If this is marked, the main window does not have the titlebar and is displayed in fullscreen mode.

If this is unmarked, the main window has the titlebar and is displayed in the regular window style.

This is initially marked.


**Color Settings...** Opens the Color Setting dialog box to set the color for parts in this software. See “Color Setting Dialog Box” on page 4-59.

**Measurement Menu**

Displays the following menu items for controlling the measurement.

**Start** Starts a measurement. During the measurement, the measurement status indicator on the front panel lights up.

**Repeat** Starts a repeat measurement. During the measurement, the measurement status indicator on the front panel lights up. This allows you to observe the measurement result with changing the setup.

To stop the measurement, select the Measurement > Stop menu, click the Stop Measurement button  on the toolbar, or press the Stop key on the front panel.

**Stop** Stops the measurement.

### Configuration Menu

Displays the following menu item to administrate the configuration of the built-in modules in the mainframe and test fixture.

**Module...** Opens the Module Configuration dialog box. See “Module Configuration Dialog Box” on page 4-78.

### Help Menu

Displays the following menu item.

**About...** Opens the About Box dialog box. See “About Box Dialog Box” on page 4-59.

## Toolbar


Figure 4-10

### Toolbar





The toolbar has four tool button groups. The following shows the tool buttons in the tool button groups.

#### File tool button group

 **Open** Opens an existing setup file or measurement data file.





This opens the file selection dialog box, destroys the setup that you are editing, and then opens the file selected in the dialog box.

 **Save** Saves the setup that you are editing to the original setup file.





 **Exit** Exits the I/V measurement software. Unsaved data is destroyed.



Edit tool button group

- |   |                           |  |
|---|---------------------------|--|
|  | <b>Cut</b>                | Moves the selected text to the clipboard.                  |
|  | <b>Copy</b>               | Copies the selected text to the clipboard.                 |
|  | <b>Paste</b>              | Pastes the text from the clipboard to the insertion point. |
|  | <b>On-screen keyboard</b> | Displays the on-screen keyboard.                           |

Measurement tool button group

- |   |                           |   |
|---|---------------------------|---|
|    | <b>Start Measurement</b>  | Starts a measurement. During the measurement, the measurement status indicator on the front panel lights up.  |
|    | <b>Repeat Measurement</b> | Starts a repeat measurement. During the measurement, the measurement status indicator on the front panel lights up.<br>This allows you to observe the measurement result with changing the setup.<br><br>To stop the measurement, select the Measurement > Stop menu, click the Stop Measurement button  on the toolbar, or press the Stop key on the front panel. |
|  | <b>Stop Measurement</b>   | Stops the measurement.  |

View tool button group

- |   |                      |   |
|---|----------------------|---|
|  | <b>Go to Palette</b> | Displays the Software Palette in fullscreen mode. |
|---|----------------------|---|

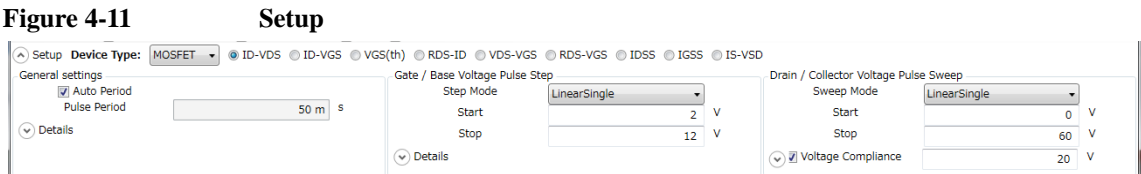
## Work Area

In this area, set the measurement conditions and observe the measurement results. This is separated to the following areas.

- “Setup” on page 4-38
- “Characteristics” on page 4-52
- “Connections” on page 4-55

## Setup

Figure 4-11



This is an area to select the device type and its measured I/V characteristics, and enter your measurement conditions.

### Device Type

Select the device type of your DUT from below.

- MOSFET
- IGBT
- Diode
- Generic

Select the Generic to execute more general measurements for device other than above types.

### MOSFET

You can select one of the following I/V characteristics measurements for “MOSFET” device type.

- ID-VDS  
Creates new settings to measure the output characteristics.
- ID-VGS  
Creates new settings to measure the transfer characteristics.
- VGS(th)

Creates new settings to measure the threshold voltage.

- RDS-ID

Creates new settings to measure the drain-source resistance characteristics for the drain current.

- VDS-VGS

Creates new settings to measure the drain-source voltage characteristics for the gate-source voltage.

- RDS-VGS

Creates new settings to measure the drain-source resistance characteristics for the gate-source voltage.

- IDSS

Creates new settings to measure the drain leak current characteristics for the drain-source voltage.

- IGSS

Creates new settings to measure the gate leak current characteristics for the gate-source voltage.

- IS-VSD

Creates new settings to measure the forward characteristics of the body diode for the source-drain voltage.

## IGBT

You can select one of the following I/V characteristics measurements for “IGBT” device type.

- IC-VCE

Creates new settings to measure the output characteristics.

- IC-VGE

Creates new settings to measure the transfer characteristics.

- VGE(th)

Creates new settings to measure the threshold voltage.

- VCE-VGE

Creates new settings to measure the collector-emitter voltage characteristics for the gate-emitter voltage.

- VCE(sat)

## GUI Reference

### I/V Measurement Software

Creates new settings to measure the collector-emitter saturation voltage characteristics for the collector current.

- ICES

Creates new settings to measure the collector leak current characteristics for the collector-emitter voltage.

- IGES

Creates new settings to measure the gate leak current characteristics for the gate-emitter voltage.

- IF-VF

Creates new settings to measure the free-wheel diode forward characteristics.

#### Diode

You can select one of the following I/V characteristics measurements for “Diode” device type.

- IF-VF

Creates new settings to measure the forward bias characteristics.

- IR-VR

Creates new settings to measure the reverse bias characteristics.

#### Generic

Set your measurement conditions in “General settings” on page 4-40, “Gate/Base drive settings” on page 4-42, and “Drain/Collector drive settings” on page 4-42 for “Generic” device type.

#### General settings

In this area, you can set the following measurement conditions for DC output measurement or pulse output measurement.

For DC output measurement:

- Step Time

Specify the period between steps for the staircase sweep.  
Setting range: 500  $\mu$ s to 5 s

- Aperture

Specify the measurement time at each step for the staircase sweep.  
Setting range: 2  $\mu$ s to 20 ms

- Hold Time

Specify the hold time of the sweep start voltage. At the sweep start point, the start voltage is forced for more than the specified time.

Setting range: 0 to 655.35 s

For pulse output measurement:

- Auto Period

Enable or disable the automatic adjustment for the pulse period. To enable this, mark the check box.

- Pulse Period

Specify the pulse period.

Setting range: 5 ms to 5 s

If the Auto Period is enabled, this is automatically adjusted to minimum period corresponding to the pulse width.

- Aperture


Specify the measurement time at each pulse.

Setting range: 2  $\mu$ s to 20 ms

- Hold Time

Specify the hold time of the sweep start voltage. At the sweep start point, the start voltage is forced for more than the specified time.

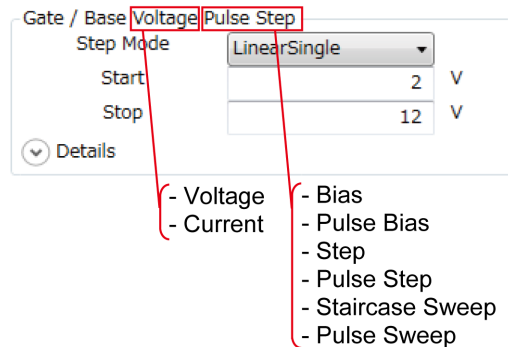
Setting range: 0 to 655.35 s

The following parameter can be shown or hidden by clicking the chevron  of the Details.

- Aperture
- Hold Time

### Gate/Base drive settings

Set the output voltage/current to the gate/base terminal. One of the following types is automatically selected depending on the selected characteristics measurement. The selected type is displayed on the title of this terminal setting area as shown in the following figure.



For the setting items of the types, see below.

- “Bias” on page 4-43  
Outputs the constant bias voltage/current.
- “Pulse Bias” on page 4-43  
Outputs the voltage or current pulse that the peak output is constant.
- “Step” on page 4-44  
Outputs the constant voltage/current that the level is changed every time a sweep measurement is finished.
- “Pulse Step” on page 4-45  
Outputs the voltage/current pulse that the peak level is changed every time a sweep measurement is finished.
- “Staircase Sweep” on page 4-47  
Outputs the staircase-swept voltage/current.
- “Pulse Sweep” on page 4-48  
Outputs the staircase-swept pulse voltage/current.

### Drain/Collector drive settings

Set the output voltage/current to the drain/collector terminal. One of the following types is automatically selected depending on the selected characteristics measurement. The selected type is displayed on the title of this terminal setting area.

For the setting items of the types, see below.

- “Bias” on page 4-43  
Outputs the constant bias voltage/current.


- “Pulse Bias” on page 4-43  
Outputs the voltage or current pulse that the peak output is constant.
- “Step” on page 4-44  
Outputs the constant voltage/current that the level is changed every time a sweep measurement is finished.
- “Pulse Step” on page 4-45  
Outputs the voltage/current pulse that the peak level is changed every time a sweep measurement is finished.
- “Staircase Sweep” on page 4-47  
Outputs the staircase-swept voltage/current.
- “Pulse Sweep” on page 4-48  
Outputs the staircase-swept pulse voltage/current.

## **Bias**

The terminal outputs the constant voltage or current.

Set the following parameters.

- Source  
Specify an output voltage/current value.

The following parameters can be shown or hidden by clicking the chevron  of the Details.

- Resource/Output Mode/Output Sequence  
You can change the settings of this terminal using the pull-down menu. For details, see “Resource/Output Mode/Output Sequence” on page 4-50.
- Compliance  
Specify a current/voltage compliance value.  
If the output exceeds this, the sweep measurement is terminated.
- Voltage Compliance  
Specify a voltage compliance value for UHCU.  
To enable this, mark the check box.  
If the output exceeds this, the sweep measurement is terminated.  
Available for UHCU.

## **Pulse Bias**

The terminal outputs the voltage or current pulse that the peak output is constant.


Set the following parameters.

- Source

## GUI Reference

### I/V Measurement Software

Specify a pulse peak voltage/current value.

The following parameters can be shown or hidden by clicking the chevron  of the Details.

- Resource/Output Mode/Output Sequence  
You can change the settings of this terminal using the pull-down menu. For details, see “Resource/Output Mode/Output Sequence” on page 4-50.
- Base  
Specify a pulse base voltage/current value.
- Compliance  
Specify a current/voltage compliance value.  
If the output exceeds this, the sweep measurement is terminated.
- Voltage Compliance  
Specify a voltage compliance value for UHCU.  
To enable this, mark the check box.  
If the output exceeds this, the sweep measurement is terminated.  
Available for UHCU.
- Peak Delay  
Specify a delay time from the beginning point of the pulse period to the raising point.
- Peak Width  
Specify a period of the pulse peak.

### Step

The terminal outputs the constant voltage or current that the level is changed every time a sweep measurement is finished.

Set the following parameters.


- Step Mode  
Select one from the following level change operation.
  - LinearSingle: Constant level is changed by a constant step value.
  - ListSingle: Constant level is changed according to the listed levels.
- Start  
Specify the first step value.  
Available for the “LinearSingle” Step Mode.



- Stop

Specify the last step value.

Available for the “LinearSingle” Step Mode.

The following parameters can be shown or hidden by clicking the chevron  of the Details.

- Resource/Output Mode/Output Sequence

You can change the settings of this terminal using the pull-down menu. For details, see “Resource/Output Mode/Output Sequence” on page 4-50.

- Number of Step


Specify the number of steps.

Available for the “LinearSingle” Step Mode.


- List

Create the list of the output levels.

Available for the “ListSingle” Step Mode.

To insert a new step entry before the selected step value, click the Insert button .

To move the selected step value up/down, click the Move button  .

To delete the selected step value, click the Delete button .

- Compliance

Specify a current/voltage compliance value.

If the output exceeds this, the sweep measurement is terminated.

- Power Compliance

Specify the power compliance value.

To enable this, mark the check box.

If the output exceeds this, the sweep measurement is terminated.

Not available for HVSMU.

- Voltage Compliance

Specify a voltage compliance value for UHCU.

To enable this, mark the check box.

If the output exceeds this, the sweep measurement is terminated.

Available for UHCU.

## Pulse Step

The terminal outputs the voltage or current pulse that the peak level is changed every time a sweep measurement is finished.

## GUI Reference

### I/V Measurement Software

Set the following parameters.

- Step Mode

Select one from the following level change operations.

- LinearSingle: Peak level is changed by a constant step value.
- ListSingle: Peak level is changed according to the listed levels.

- Start


Specify the first pulse peak value.  
Available for the “LinearSingle” Step Mode.


- Stop


Specify the last pulse peak value.  
Available for the “LinearSingle” Step Mode.


- List

Create the list of the output levels.  
Available for the “ListSingle” Step Mode.

To insert a new step entry before the selected step value, click the Insert button .

To move the selected step value up/down, click the Move button .

To delete the selected step value, click the Delete button .

The following parameters can be shown or hidden by clicking the chevron  of the Details.

- Resource/Output Mode/Output Sequence

You can change the settings of this terminal using the pull-down menu. For details, see “Resource/Output Mode/Output Sequence” on page 4-50.

- Base

Specify a pulse base voltage/current value.

- Number of Step

Specify the number of steps.  
Available for the “LinearSingle” Step Mode.

- Compliance


Specify a current/voltage compliance value.  
If the output exceeds this, the sweep measurement is terminated.

- Power Compliance  
Specify the power compliance value.  
To enable this, mark the check box.  
If the output exceeds this, the sweep measurement is terminated.  
Not available for HVSMU.
- Voltage Compliance  
Specify a voltage compliance value for UHCU.  
To enable this, mark the check box.  
If the output exceeds this, the sweep measurement is terminated.  
Available for UHCU.
- Peak Delay  
Specify a delay time from the beginning point of the pulse period to the raising point.
- Peak Width  
Specify a period of the pulse peak.

### Staircase Sweep

The terminal outputs the staircase-swept voltage/current.  
Set the following parameters.

- Sweep Mode  
Select one from the following sweep modes.
  - LinearSingle (Sweep from start to stop in a linear incremental step)
  - LogSingle (Sweep from start to stop in a logarithmic incremental step)
  - LinearDouble (Sweep from start to stop to start in a linear incremental step)
  - LogDouble (Sweep from start to stop to start in a logarithmic incremental step)
- Start  
Specify the sweep start value.
- Stop  
Specify the sweep stop value.

The following parameters can be shown or hidden by clicking the chevron  of the Details.

- Resource/Output Mode/Output Sequence

## GUI Reference

### I/V Measurement Software

You can change the settings of this terminal using the pull-down menu. For details, see “Resource/Output Mode/Output Sequence” on page 4-50.


- **Number of Step**  
Specify the number of sweep steps from start to stop.
- **Compliance**  
Specify a current/voltage compliance value.  
If the output exceeds this, the sweep measurement is terminated.
- **Power Compliance**  
Specify the power compliance value.  
To enable this, mark the check box.  
If the output exceeds this, the sweep measurement is terminated.  
Not available for HVSMU.
- **Voltage Compliance**  
Specify a voltage compliance value for UHCU.  
To enable this, mark the check box.  
If the output exceeds this, the sweep measurement is terminated.  
Available for UHCU.

### **Pulse Sweep**

The terminal outputs the staircase-swept pulse voltage/current.

Set the following parameters.

- **Sweep Mode**  
Select one from the following sweep modes.
  - **LinearSingle** (Sweep from start to stop in a linear incremental step)
  - **LogSingle** (Sweep from start to stop in a logarithmic incremental step)
  - **LinearDouble** (Sweep from start to stop to start in a linear incremental step)
  - **LogDouble** (Sweep from start to stop to start in a logarithmic incremental step)
- **Start**  
Specify the sweep start value.
- **Stop**  
Specify the sweep stop value.

The following parameters can be shown or hidden by clicking the chevron  of the Details.

- Resource/Output Mode/Output Sequence  
You can change the settings of this terminal using the pull-down menu. For details, see “Resource/Output Mode/Output Sequence” on page 4-50.
- Base  
Specify a pulse base voltage/current value.
- Number of Step  
Specify the number of sweep steps from start to stop.
- Compliance  
Specify a current/voltage compliance value.  
If the output exceeds this, the sweep measurement is terminated.
- Power Compliance  
Specify the power compliance value.  
To enable this, mark the check box.  
If the output exceeds this, the sweep measurement is terminated.  
Not available for HVSMU.
- Voltage Compliance  
Specify a voltage compliance value for UHCU.  
To enable this, mark the check box.  
If the output exceeds this, the sweep measurement is terminated.  
Available for UHCU.
- Peak Delay  
Specify a delay time from the beginning point of the pulse period to the raising point.
- Peak Width  
Specify a period of the pulse peak.

**Resource/Output Mode/Output Sequence**

Depending on the selected characteristics measurement, the pre-defined output mode and sequence are automatically selected. If necessary, you can change the measurement resource, the output mode, and the output sequence. Table 4-3 shows the available alternatives for the gate/base terminal, and Table 4-4 shows the available alternatives for the drain/collector terminal.

**Table 4-3 Available Resource/Output Mode/Output Sequence for Gate/Base Terminal**

Measurement Resource	Output Mode	Output Sequence
<ul style="list-style-type: none"> <li>• MPSMU</li> </ul> <p>MPSMU is connected to this terminal.</p>	<ul style="list-style-type: none"> <li>• V</li> </ul> <p>Specifies the DC voltage output.</p> <ul style="list-style-type: none"> <li>• VPulse</li> </ul> <p>Specifies the pulse voltage output.</p> <ul style="list-style-type: none"> <li>• I</li> </ul> <p>Specifies the DC current output.</p> <ul style="list-style-type: none"> <li>• IPulse</li> </ul> <p>Specifies the pulse current output.</p>	<ul style="list-style-type: none"> <li>• Constant</li> </ul> <p>Specifies the constant bias output sequence.</p> <ul style="list-style-type: none"> <li>• Step</li> </ul> <p>Specifies the step bias output sequence.</p> <ul style="list-style-type: none"> <li>• Sweep</li> </ul> <p>Specifies the sweep output sequence.</p>

**Table 4-4 Available Resource/Output Mode/Output Sequence for Drain/Collector Terminal**

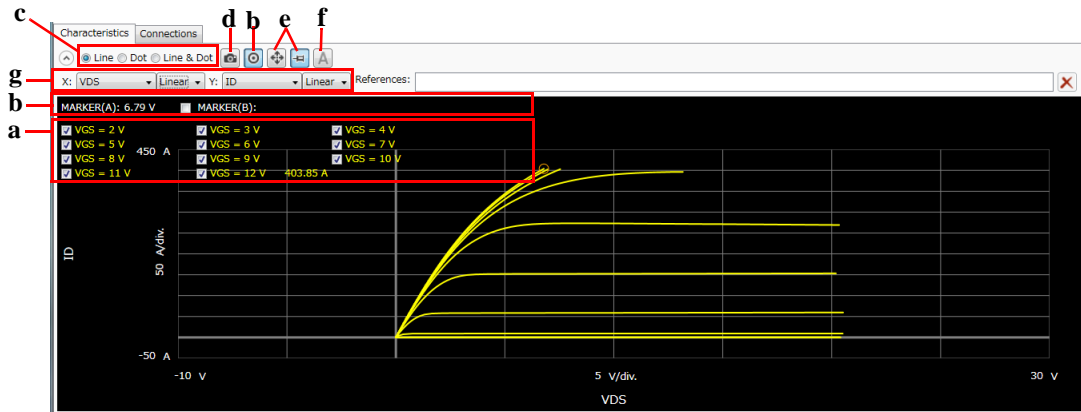
Measurement Resource	Output Mode	Output Sequence
<ul style="list-style-type: none"> <li>• Open No connection. This terminal is opened.</li> <li>• HVSMU HVSMU is connected to this terminal.</li> <li>• MPSMU MPSMU is connected to this terminal.</li> </ul>	<ul style="list-style-type: none"> <li>• V Specifies the DC voltage output.</li> <li>• VPulse Specifies the pulse voltage output.</li> <li>• I Specifies the DC current output.</li> <li>• IPulse Specifies the pulse current output.</li> </ul>	<ul style="list-style-type: none"> <li>• Constant Specifies the constant bias output sequence.</li> <li>• Step Specifies the step bias output sequence.</li> <li>• Sweep Specifies the sweep output sequence.</li> </ul>

The combinations of the Output Mode and Output Sequence decide the types as shown in the following table.

Type	Output Mode	Output Sequence
Bias	V or I	Constant
Pulse Bias	VPulse or IPulse	Constant
Step	V or I	Step
Pulse Step	VPulse or IPulse	Step
Staircase Sweep	V or I	Sweep
Pulse Sweep	VPulse or IPulse	Sweep

## Characteristics

Figure 4-12 Characteristics



This page shows the graph of the specified I/V characteristics as the measurement result. To display this page, click the Characteristics tab.

### a. Displaying Characteristic Curves


The data for the X and Y-axes are assigned according to the I/V characteristics specified in the Setup.


If the graph has multiple characteristic curves for different measurement conditions, the measurement conditions are displayed on the graph with the check boxes. Marking the check box displays the characteristic curve for the measurement condition. You can mark multiple check boxes for the measurement conditions.

You can change the minimum and maximum values on the X and Y-axes by clicking the value.

### b. Markers

This graph supports two kinds of markers: Domain marker and Trace marker. You can switch these markers by clicking the Marker button shown in the bottom part of the graph.

 : Marker button when the Domain marker is used.

 : Marker button when the Trace marker is used.

The Domain marker can read multiple characteristic values for the X-axis position.

The Domain marker supports two markers (A and B). Marker A is always available. To use the Marker B, mark the check box for the Marker B. The Marker B is a break line. To move the marker position, use the rotary knob or mouse.



The marker annotation on the graph has X-axis values for markers, and a difference value ( $\Delta$ ) between the Marker B and A (B–A). And, each curve annotation has Y-axis values and difference values ( $\Delta$ ) between the Marker B and A (B–A).


The Trace marker can read the characteristic value with tracing each characteristic curve. It is useful when you want to read the characteristic value on double sweep result.



The marker annotation on the graph has X-axis value for the marker. And, the traced curve annotation has Y-axis value.


### c. Curve Representation

The curves can be represented as Line, Dot, or combination (Line & Dot). Select any curve representation using the radio buttons shown in the bottom part of the graph.

### d. Reference Traces


You can register the presently-displayed curves as reference traces to compare with other measurement results on the graph. If you register them as reference traces, the reference traces are displayed as break lines on the graph when you open other measurement data files or execute the next measurement. To register as the reference traces, click the Capture button  shown in the bottom part of the graph.

You can register a maximum of 10 reference traces. The measurement data files registered as the reference traces are listed in the References field under the Capture button . You can show or hide the reference traces using the check boxes at the head of the measurement data file names. The References field can be shown or hidden by clicking the chevron  under the graph.

To remove unnecessary reference traces, select the measurement data file in the References field, and then click the Remove button .


The registration of the reference traces is cleared when you exit the I/V measurement software.


### e. Auto Scale

Clicking the Auto Scale button  fits the measurement data at that time in the graph scale.


If the auto scale mode is selected by using the Scale mode button, the measurement data is automatically fit according to the progress of the measurement.

If the fixed scale mode is selected by using the Scale mode button, the scale is fixed until changing the scale manually or clicking the Auto Scale button.

 : Scale mode button during selecting the auto scale mode.

 : Scale mode button during selecting the fixed scale mode.


#### f. Trace Labels

The step values for the characteristic curves can be shown or hidden by clicking the Trace Label button .

In the case that multiple curves are displayed on the IV-VDS characteristic graph of MOSFET, IC-VCE characteristic graph of IGBT, and so on, the step value display is useful to identify which curve is for which step value.

#### g. X/Y Data

You can select the data and scale for the X and Y-axes. As default, the data for the X and Y-axes are assigned according to the I/V characteristics specified in the Setup.

The X/Y data field can be shown or hidden by clicking the chevron  under the graph.

Select one from the following scales.

- Linear  
Linear scale
- PositiveLog  
Logarithm scale for positive data
- NegativeLog  
Logarithm scale for negative data

Select data for X and Y-axes corresponding to the specified device type. The following shows data corresponding to the device type.

For MOSFET:

- VDS: Drain-source voltage
- ID: Drain current
- RDS: Drain-source resistance
- VGS: Gate-source voltage
- IG: Gate current
- IS: Forward direction current of body diode (source current)
- VSD: Forward direction voltage of body diode (source-drain voltage)

For IGBT:

- VCE: Collector-emitter voltage
- IC: Collector current
- VGE: Gate-emitter voltage

- IG: Gate current

For Diode:

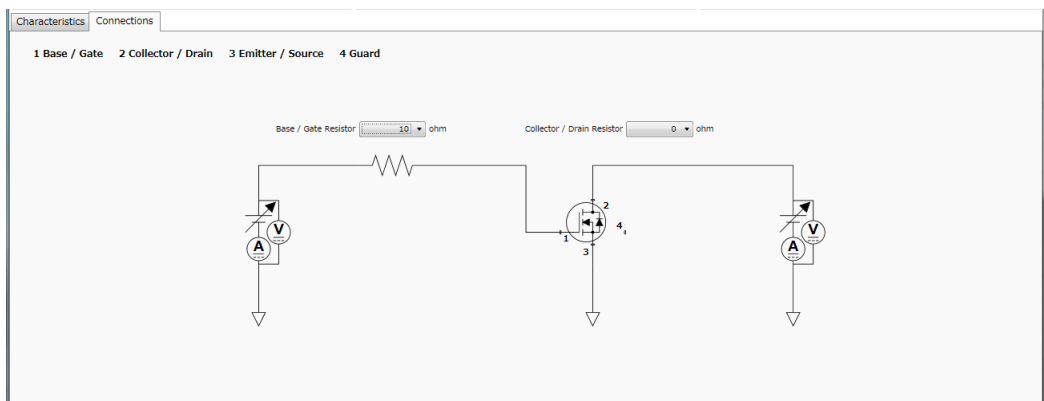
- VF: Forward direction voltage
- IF: Forward direction current
- VR: Reverse direction voltage
- IR: Reverse direction current

For Generic: same as data for MOSFET

## Connections

Figure 4-13

### Connections



This page shows the measurement circuit that is automatically connected according to your specified measurement conditions. To display this page, click the Connections tab.

On the measurement circuit, the measurement terminals, the measurement resources, and the built-in capacitance and resistance are displayed. The following shows the relationship between the terminal numbers and the measurement terminals.

- 1: Base/Gate terminal
- 2: Collector/Drain terminal
- 3: Emitter/Source terminal
- 4: Guard terminal

---

**NOTE**

---

If DUT is a diode, connect the cathode terminal to 2. Collector/Drain terminal, and the anode terminal to 3. Emitter/Source terminal.

**Base/Gate Resistor**

If the MCSMU is specified to the Base/Gate terminal as the measurement resource, you can select one from the following base/gate resistances.

- 0  $\Omega$
- 10  $\Omega$
- 100  $\Omega$
- 1 k $\Omega$

The base/gate resistance is effective to restrain the oscillation of DUT that occurs during the ultra high current measurement and so on.

**Collector/Drain Resistor**

If the MVSMU is specified to the Collector/Drain terminal as the measurement resource, you can select one from the following collector/drain resistances.

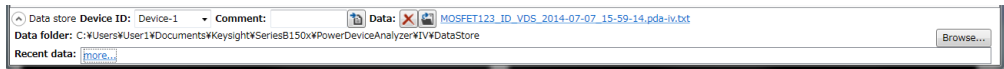
- 0  $\Omega$
- 100 k $\Omega$

The collector/drain resistance is effective to restrain the over current that occurs during the breakdown measurement and so on.

## Data List

Figure 4-14

### Data List



The data list area provides the following functions regarding the saving of the measurement data files.


- Set the device ID to be recorded to the measurement data file  
See “Device ID” on page 4-57.
- Enter a comment to be recorded to the measurement data file  
See “Comment” on page 4-57.
- Operations for the latest measurement data file  
See “Data” on page 4-58.
- Access to the measurement data files that were automatically saved  
See “Data store” on page 4-58.

The setup data and measurement data are automatically saved to a new measurement data file at the end of the measurement. At this time, you can also record a device ID to identify your DUT and a comment. And, the destination folder of the measurement data file for auto-saving is predefined. You can set the device ID and comment, and change the destination folder using this area.

### Device ID

Enter device ID string to the Device ID field. The maximum 10 recently-entered device IDs can be kept as history, and you can also select one from the history list.


The entered device ID is automatically saved to the measurement data file at the end of the measurement.

You can also change the device ID in the latest measurement data file after the measurement here. To change it, change the device ID in the Device ID field, and then click the Apply button .

### Comment



Enter a comment string to the Comment field.

The entered comment is automatically saved to the measurement data file at the end of the measurement.

You can also change the comment in the latest measurement data file after the measurement here. To change it, change the comment in the Comment field, and then click the Apply button .


## Data

The Data field shows the latest auto-saved or last-opened measurement data file name. You can do the following operations.

- Open the measurement data file by clicking the Open button .
- Rename the measurement data file by clicking the measurement data file name.
- Delete the measurement data file by clicking the Delete button .

## Data store

Using the following fields, you can change the destination folder of the auto-saved measurement data file, and access the auto-saved measurement data files.

The following fields can be shown or hidden by clicking the chevron  next to “Data store”.

**Data folder** Shows the absolute path of the auto-saved measurement data file. To change this, click the Browse button to open the folder selection dialog box. Select your desired folder in the dialog box.

For the initial setting of the data folder, see “Summary of Files” on page 4-60.

**Recent data** Shows up to 10 auto-saved measurement data files that were automatically saved recently, in the hyper-link format. Clicking the hyper-link opens the selected measurement data file. This destroys the presently-editing data.

If the number of the auto-saved measurement data files is over ten, this field shows “more...”. Clicking this opens the file selection dialog box. Select a measurement data file to open.

## Dialog Boxes

### Change Device ID Dialog Box

The Change Device ID dialog box is used to change the device ID in all selected measurement data files at once.

- Device ID field** Enter a new device ID. You can also select it from the history.
- Add... button** Opens the file selection dialog box to select the measurement data file(s) that you want to change the device ID. The selected files are displayed into the list.
- Remove button** Excludes the selected measurement data file from the list.
- Execute button** Changes the device ID.
- Close button** Closes this dialog box.

This dialog box is opened by selecting the main menu File > Change Device ID....

### Color Setting Dialog Box

The Color Setting dialog box is used to set colors of parts in this software.

The graph elements supported by this dialog box are graph background, X and Y-axes, graph grid, graph text, marker, and trace. Clicking the color pattern opens the dialog box for selecting a color.

The setting in the Color Setting dialog box is saved as a user setting.

- Apply button** Applies the present setting to the graph.
- Reset button** Resets to the default setting.
- OK button** Applies the present setting to the graph, and closes this dialog box.
- Cancel button** Closes this dialog box without applying the present setting.

This dialog box is opened by selecting the main menu View > Color Settings....

### About Box Dialog Box

The About Box dialog box displays the model number, the software revision number, download URL for software updating, and so on.

This dialog box is opened by selecting the main menu Help > About....

## Summary of Files

The following shows the summary of the files handled by the I/V measurement software.

**Table 4-5**      **Summary of Files**

<b>File Type</b>	<b>Description</b>	<b>Extension</b>	<b>Folder as Initial Setting</b>
Setup File	Setup data You can save this if needed.	*.pda-iv	(You can specify the folder when saving the data)
Measurement Data File	Setup data and measurement data including the device ID and comment  This is automatically saved after the measurement. You can optionally save this.	*.pda-iv.txt	C:\Users\ <user name="">\Documents\Keysight\SeriesB150x\PowerDeviceAnalyzer\IV\DataStore (You can change this)</user>

### File name of Measurement Data File on Auto-saving

An auto-saved measurement data file is named as the following rule.

1. Concatenates the device ID, date and time on save by an underscore (\_).
2. Concatenates the file extension (.pda-iv.txt) to the end of the “step 1” string.
3. If the “step 2” file name duplicates the existing file name, concatenates the serial number from 2 enclosed by brackets and the file extension to the end of the “step 1” string.



## Power Loss Calculation Software

Power loss calculation software provides:

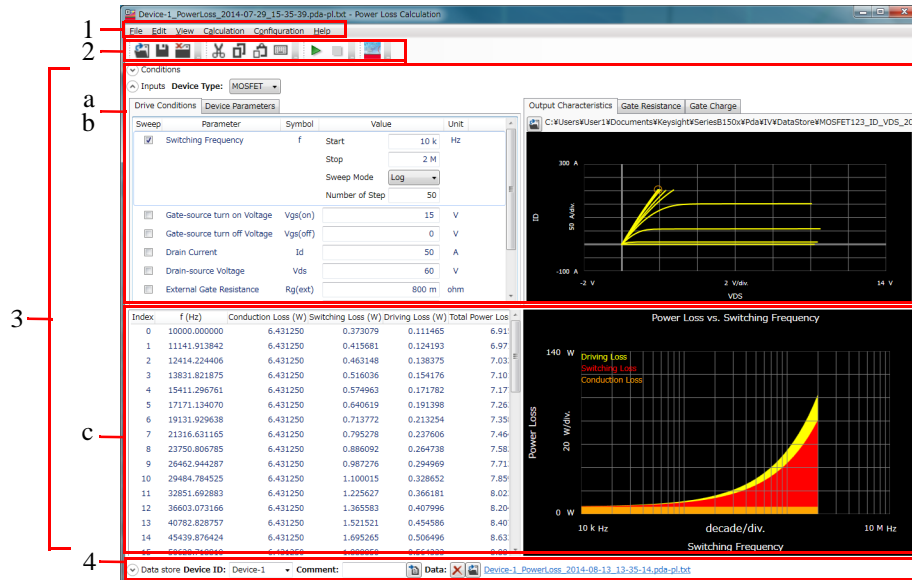
- Calculation of switching device power loss for:
  - Hard switching mode
  - Soft switching mode
- Inputs to characterize the following parameters:
  - Gate resistance
  - On resistance
  - Gate charge
  - Gate switching charge
  - Equivalent output capacitance (energy related)
  - Equivalent output capacitance (time related)
  - Input parameter assistance using related measurement data including:
    - Display of source measurement data
- Switching condition parameter input
  - Support of parameter sweep for one parameter
- Power loss calculation results of:
  - Total power loss
  - Conductive power loss
  - Driving power loss
  - Switching power loss (inductive load)
  - Graph representation of loss components for optional parameter sweep

## GUI Overview

The GUI (Graphical User Interface) of the Power loss calculation software is comprised of the following areas.

Figure 4-15

### Power Loss Calculation Software GUI



1. “Main Menu” on page 4-63  
This provides the functions needed for various operations in the menu format.
2. “Toolbar” on page 4-65  
This provides the functions that are very frequently used in the button format.
3. “Work Area” on page 4-67  
This area provides the functions to set the calculation conditions and observe the calculation results. This is separated to the following areas.
  - a. “Conditions” on page 4-67
  - b. “Inputs” on page 4-67
  - c. “Results” on page 4-72
4. “Data List” on page 4-74

This area provides the functions regarding the saving of the calculation data files.

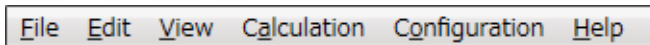
For the dialog boxes displayed during this software operation, see “Dialog Boxes” on page 4-76.

For the files handled by this software, see “Summary of Files” on page 4-77.

## Main Menu

Figure 4-16

### Main Menu



The following shows the structure of the main menu.

### File Menu

Displays the following menu items to operate the setup file and calculation data file. For the kinds of the files and file extensions, see “Summary of Files” on page 4-77.

- |                            |  |
|----------------------------|--|
| <b>New</b>                 | Creates a new setup.<br><br>This destroys the setup that you are editing, and creates a new setup.   |
| <b>Open...</b>             | Opens an existing setup file or calculation data file.<br><br>This opens the file selection dialog box, destroys the setup that you are editing, and then opens the file selected in the dialog box.                                     |
| <b>Save</b>                | Saves the setup that you are editing to the original setup file.   |
| <b>Save Setup As...</b>    | Saves the setup that you are editing to the specified setup file.<br><br>This opens the file selection dialog box, and saves the present setup to the specified setup file.  |
| <b>Save Data As...</b>     | Saves the present setup data and calculation data to the specified calculation data file.<br><br>This opens the file selection dialog box, and saves the present setup data and calculation data to the specified calculation data file. |
| <b>Change Device ID...</b> | Changes the device ID recorded in the calculation data file.   |

This opens the Change Device ID dialog box, and changes the device ID recorded in the selected calculation data file(s). See “Change Device ID Dialog Box” on page 4-76.

**Recent Setup Files**

Lists a maximum of 10 names of the setup files that were recently edited, as menu items. You can easily open a setup file by using them.

**Exit** Exits the power loss calculation software. Unsaved data is destroyed.

**Edit Menu**

Displays the following menu items to edit the setup.

**Cut** Moves the selected text to the clipboard.

**Copy** Copies the selected text to the clipboard.

**Paste** Pastes the text from the clipboard to the insertion point.

**On-screen keyboard...** Displays the on-screen keyboard.

**View Menu**

Displays the following menu items for the display setting.

**Go to Palette** Displays the Software Palette in fullscreen mode.

**Main Window** Displays the following menu item.

**Fullscreen** Changes the display style of the main window.

If this is marked, the main window does not have the titlebar and is displayed in fullscreen mode.

If this is unmarked, the main window has the titlebar and is displayed in the regular window style.


This is initially marked.

**Color Settings...** Opens the Color Setting dialog box to set the color for parts in this software. See “Color Setting Dialog Box” on page 4-76.

**Calculation Menu**

Displays the following menu items for controlling the calculation.

**Start** Starts a calculation.

To stop the present calculation, select the Calculation > Stop menu, click the Stop Calculation button  on the toolbar, or press the Stop key on the front panel.

**Stop** Stops the measurement.

## Help Menu

Displays the following menu item.

**About...** Opens the About Box dialog box. See “About Box Dialog Box” on page 4-76.

## Toolbar

Figure 4-17

### Toolbar



The toolbar has four tool button groups. The following shows the tool buttons in the tool button groups.

#### File tool button group



#### **Open**

Opens an existing setup file or calculation data file.

This opens the file selection dialog box, destroys the setup that you are editing, and then opens the file selected in the dialog box.



#### **Save**

Saves the setup that you are editing to the original setup file.



#### **Exit**

Exits the power loss calculation software. Unsaved data is destroyed.

#### Edit tool button group



#### **Cut**

Moves the selected text to the clipboard.



#### **Copy**

Copies the selected text to the clipboard.




#### **Paste**


Pastes the text from the clipboard to the insertion point.


GUI Reference  
Power Loss Calculation Software

 **On-screen keyboard** Displays the on-screen keyboard.

Calculation tool button group

 **Start Calculation** Starts a measurement. During the measurement, the measurement status indicator on the front panel lights up.

To stop the calculation, select the Calculation > Stop menu, click the Stop Calculation button  on the toolbar, or press the Stop key on the front panel.

 **Stop Calculation** Stops the calculation.

View tool button group

 **Go to Palette** Displays the Software Palette in fullscreen mode.

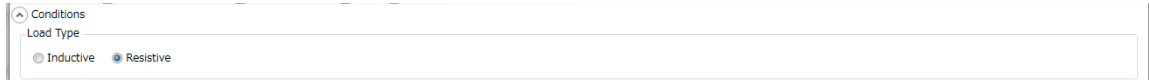
## Work Area

In this area, set the calculation conditions and observe the calculation results. This is separated to the following areas.


- “Conditions” on page 4-67
- “Inputs” on page 4-67
- “Results” on page 4-72

## Conditions

**Figure 4-18** Conditions



This is an area to specify your assumption to calculate the power loss on your switching device.

This area can be shown or hidden by clicking the chevron  of the Conditions.

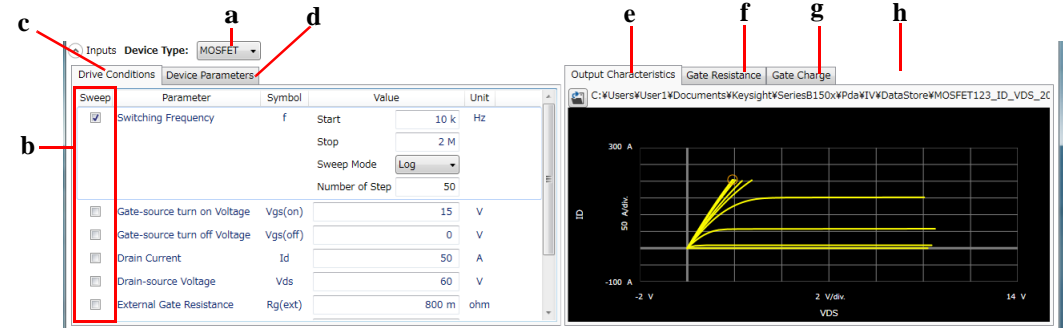
## Load Type

Select the assumed load type to calculate the power loss. You can select one from the following load types.

- Inductive: Inductive load
- Resistive: Resistive load

## Inputs

**Figure 4-19** Inputs



## GUI Reference


### Power Loss Calculation Software

This is an area to specify the device type of your DUT, and driving condition and device characteristic parameters that are used as the input data for calculation. The driving condition parameters and device characteristic parameters are separated by tabs.

Other than manually entering the parameter values with referring the device data sheet, you can also enter them using existing measurement data files. This area is equipped with the functions to read existing measurement data files, display the characteristic curve graphs, and extract some parameter values from them. The following measurement data files are readable.

- I/V measurement data file
- Capacitance measurement data file
- Gate charge measurement data file

They are separated by tabs.

This area can be hidden or shown by clicking the chevron  of the Inputs.

#### **a. Device Type**

Select the device type of your DUT from below.

- MOSFET

#### **b. Sweep Parameter**

Select one parameter that is swept to observe the loss changes for the changes of this parameter, from the driving condition parameters and device characteristic parameters. To select it, mark the check box of the parameter. As the default, the Switching Frequency parameter in the Driving parameters is selected.

Specify the following items for the selected parameter as the sweep parameter.

- Start  
Specify the sweep start value.
- Stop  
Specify the sweep stop value.
- Sweep Mode  
Select one from the following sweep modes.
  - Linear (Sweep from start to stop in a linear incremental step)
  - Log (Sweep from start to stop in a logarithmic incremental step)
- Number of Step  
Specify the number of sweep steps from start to stop.



### c. Drive Conditions

Specify the driving condition parameter values.

- **f**: Switching Frequency  
Specify the switching frequency.
- **V<sub>gs(on)</sub>**: Gate-source turn on Voltage  
Specify the gate-source voltage required to turn the device on.
- **V<sub>gs(off)</sub>**: Gate-source turn off Voltage  
Specify the gate-source voltage required to turn the device off.
- **I<sub>d</sub>**: Drain Current  
Specify the On-state drain current.
- **V<sub>ds</sub>**: Drain-source Voltage  
Specify the Off-state drain-source voltage.
- **R<sub>g(ext)</sub>**: External Gate Resistance  
Specify the gate resistance included in the external driving circuit.
- **I<sub>rms</sub>**: Effective Drain Current  
Specify the effective drain current (the root mean square of the load current).  
The effective drain current (**I<sub>rms</sub>**) is the product of the drain current (**I<sub>d</sub>**) and the duty cycle (**D**).
- **D**: Duty Cycle  
Specify the duty cycle within the range from 0 to 1.

### d. Device Parameters

Specify the device characteristic parameter values.

- **Q<sub>g(on)</sub>**: Gate Charge at on  
Specify the On-state gate charge.  
**Q<sub>g(on)</sub> – Q<sub>g(off)</sub>** is regarded as the gate charge required to turn the device on.
- **Q<sub>g(off)</sub>**: Gate Charge at off  
Specify the Off-state gate charge.  
**Q<sub>g(on)</sub> – Q<sub>g(off)</sub>** is regarded as the gate charge required to turn the device on.
- **R<sub>g</sub>**: Gate Resistance  
Specify the gate resistance.
- **Q<sub>sw</sub>**: Gate Switching Charge (**C<sub>rss</sub>**)


## GUI Reference

### Power Loss Calculation Software

Specify the required gate charge (Mirror Charge) so that the drain-source voltage is same as the gate-source voltage when the device state changes from Off to On.

- $V_{gs(pl)}$ : Gate Plateau Voltage  
Specify the gate plateau voltage.
- $R_{ds(on)}$ : On Resistance  
Specify the On-state resistance.

#### e. Output Characteristics

Specify the measurement data file taken by the I/V measurement software. To read the file, click the Load Measurement Data button  in the top left corner. The file selection dialog box opens to read the file. The file name to be read is displayed next to the Load Measurement Data button. And, the output characteristic data is displayed on the graph.

The measurement data file that has any of the following output characteristics is readable.


- ID-VDS
- RDS-ID
- VDS-VGS
- RDS-VGS

The following parameter value is extracted from the  $V_{gs(on)}$  parameter value specified in the Drive Conditions and the output characteristic data to be read.

- Device Parameters
  - $R_{ds(on)}$ : On Resistance

You can change the minimum and maximum values on the X and Y-axes by clicking the value.

#### f. Gate Resistance

Specify the  $R_g$  characteristic measurement data file taken by the capacitance measurement software. To read the file, click the Load Measurement Data button  in the top left corner. The file selection dialog box opens to read the file. The file name to be read is displayed next to the Load Measurement Data button. And, the  $R_g$  characteristic data is displayed on the graph.


The following parameter value is extracted from the  $V_{gs(off)}$  parameter value specified in the Drive Conditions and the  $R_g$  characteristic data to be read.

- Device Parameters

- Rg: Gate Resistance

You can change the minimum and maximum values on the X and Y-axes by clicking the value.

### **g. Reverse Transfer Capacitance**


Specify the Crss characteristic measurement data file taken by the capacitance measurement software. To read the file, click the Load Measurement Data button  in the top left corner. The file selection dialog box opens to read the file. The file name to be read is displayed next to the Load Measurement Data button. And, the Crss characteristic data is displayed on the graph.

The following parameter value is extracted from the Vgs(off) and Vds(off) parameter values specified in the Drive Conditions and the Crss characteristic data to be read.

- Device Parameters
  - Qsw: Gate Switching Charge

You can change the minimum and maximum values on the X and Y-axes by clicking the value.

### **h. Gate Charge**

Specify the measurement data file taken by the gate charge measurement software. To read the file, click the Load Measurement Data button  in the top left corner. The file selection dialog box opens to read the file. The file name to be read is displayed next to the Load Measurement Data button. And, the gate charge characteristic data is displayed on the graph.

The following parameter values are extracted from the gate charge characteristic data to be read.

- Drive Conditions
  - Vgs(on): Gate-source turn on Voltage
  - Vgs(off): Gate-source turn off Voltage
  - Id: Drain Current
  - Vds: Drain-source Voltage
- Device Parameters
  - Qg(on): Gate Charge at on
  - Qg(off): Gate Charge at off
  - Qsw: Gate Switching Charge (Crss)

## GUI Reference

### Power Loss Calculation Software

- V<sub>gs(pl)</sub>: Gate Plateau Voltage

You can change the minimum and maximum values on the X and Y-axes by clicking the value.

## Results

Figure 4-20



This area shows the power loss data in the list and the trend chart formats, that was calculated along your parameter settings specified in the Inputs.

### a. List

Shows the loss data for the swept parameter values as the calculation result in the list format.

- Index

Shows the index number of the sweep step.

- Sweep parameter

Shows the sweep parameter value specified in the Inputs.

- Conduction Loss

Shows the conduction loss as the calculation result.

This is calculated from the following expression.

$$R_{ds(on)} \times I_{rms}^2$$

- Switching Loss

Shows the switching loss as the calculation result.

This is calculated from either of the following expressions.

When the Load Type specified in the Conditions is “Inductive”:

$$\frac{1}{2} \times f \times Vds \times Id \times \{Rg + Rg(ext)\} \times Qsw \times \left\{ \frac{1}{Vgs(on) - Vgs(pl)} + \frac{1}{Vgs(pl) - Vgs(off)} \right\}$$

When the Load Type is “Resistive”:

$$\frac{1}{6} \times f \times Vds \times Id \times \{Rg + Rg(ext)\} \times Qsw \times \left\{ \frac{1}{Vgs(on) - Vgs(pl)} + \frac{1}{Vgs(pl) - Vgs(off)} \right\}$$

- **Driving Loss**

Shows the driving loss as the calculation result.

This is calculated from the following expression.

$$f \times \{Qg(on) - Qg(off)\} \times \{Vgs(on) - Vgs(off)\}$$

- **Total Power Loss**

Shows the total sum of the conduction loss, switching loss, and driving loss.

## b. Trend Chart

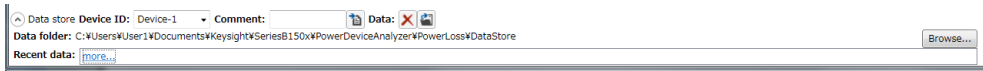
Shows the loss data for the swept parameter values as the calculation result in the trend chart format. Where, the sweep parameter is assigned to the data for the X-axis, and the conduction loss, switching loss, and driving loss are assigned to the data for the Y-axis and are accumulated in this order.

You can change the minimum and maximum values on the X and Y-axes by clicking the value.

## Data List

Figure 4-21

### Data List



The data list area provides the following functions regarding the saving of the calculation data files.


- Set the device ID to be recorded to the calculation data file  
See “Device ID” on page 4-74.
- Enter a comment to be recorded to the calculation data file  
See “Comment” on page 4-74.
- Operations for the latest calculation data files  
See “Data” on page 4-75.
- Access to the calculation data files that were automatically saved  
See “Data store” on page 4-75.

The setup data and calculation data are automatically saved to a new calculation data file at the end of the calculation. At this time, you can also record a device ID to identify your DUT and a comment. And, the destination folder of the calculation data file for auto-saving is predefined. You can set the device ID and comment, and change the destination folder using this area.

### Device ID

Enter device ID string to the Device ID field. The maximum 10 recently-entered device IDs can be kept as history, and you can also select one from the history list.


The entered device ID is automatically saved to the calculation data file at the end of the calculation.

You can also change the device ID in the latest calculation data file after the calculation here. To change it, change the device ID in the Device ID field, and then click the Apply button .

### Comment



Enter a comment string to the Comment field.

The entered comment is automatically saved to the calculation data file at the end of the calculation.

You can also change the comment in the latest calculation data file after the calculation here. To change it, change the comment in the Comment field, and then click the Apply button .


## Data

The Data field shows the latest auto-saved or last-opened calculation data file name. You can do the following operations.

- Open the calculation data file by clicking the Open button .
- Rename the calculation data file by clicking the calculation data file name.
- Delete the calculation data file by clicking the Delete button .

## Data store

Using the following fields, you can change the destination folder of the auto-saved calculation data file, and access the auto-saved calculation data files.

The following fields can be shown or hidden by clicking the chevron  next to “Data store”.

**Data folder** Shows the absolute path of the auto-saved calculation data file. To change this, click the Browse button to open the folder selection dialog box. Select your desired folder in the dialog box.

For the initial setting of the data folder, see “Summary of Files” on page 4-77.

**Recent data** Shows up to 10 auto-saved calculation data files that were automatically saved recently, in the hyper-link format. Clicking the hyper-link opens the selected calculation data file. This destroys the presently-editing data.

If the number of the auto-saved calculation data files is over ten, this field shows “more...”. Clicking this opens the file selection dialog box. Select a calculation data file to open.

## Dialog Boxes

### Change Device ID Dialog Box

The Change Device ID dialog box is used to change the device ID in all selected calculation data files at once.

- |                        |   |
|------------------------|---|
| <b>Device ID field</b> | Enter a new device ID. You can also select it from the history.   |
| <b>Add... button</b>   | Opens the file selection dialog box to select the calculation data file(s) that you want to change the device ID. The selected files are displayed into the list. |
| <b>Remove button</b>   | Excludes the selected calculation data file from the list.  |
| <b>Execute button</b>  | Changes the device ID.  |
| <b>Close button</b>    | Closes this dialog box.   |

This dialog box is opened by selecting the main menu File > Change Device ID....

### Color Setting Dialog Box

The Color Setting dialog box is used to set colors of parts in this software.

The graph elements supported by this dialog box are graph background, X and Y-axes, graph grid, graph text, three trends on the trend charge, and traces on the characteristic graphs. Clicking the color pattern opens the dialog box for selecting a color.

The setting in the Color Setting dialog box is saved as a user setting.

- |                      |   |
|----------------------|---|
| <b>Apply button</b>  | Applies the present setting to the graph.                             |
| <b>Reset button</b>  | Resets to the default setting.  |
| <b>OK button</b>     | Applies the present setting to the graph, and closes this dialog box. |
| <b>Cancel button</b> | Closes this dialog box without applying the present setting.          |

This dialog box is opened by selecting the main menu View > Color Settings....

### About Box Dialog Box

The About Box dialog box displays the model number, the software revision number, download URL for software updating, and so on.

This dialog box is opened by selecting the main menu Help > About....



## Summary of Files

The following shows the summary of the files handled by the power loss calculation software.

**Table 4-6 Summary of Files**

File Type	Description	Extension	Folder as Initial Setting
Setup File	Setup data You can save this if needed.	*.pda-pl	(You can specify the folder when saving the data)
Calculation data File	Setup data and calculation data including the device ID and comment  This is automatically saved after the calculation. You can optionally save this.	*.pda-pl.txt	C:\Users\ <user name="">\Documents\Keysight\SeriesB150x\PowerDeviceAnalyzer\PowerLoss\DataStore (You can change this)</user>

### File name of calculation data File on Auto-saving

An auto-saved calculation data file is named as the following rule.

1. Concatenates the device ID and date and time on save by an underscore (\_).
2. Concatenates the file extension (.pda-pl.txt) to the end of the “step 1” string.
3. If the “step 2” file name duplicates the existing file name, concatenates the serial number from 2 enclosed by brackets and the file extension to the end of the “step 1” string.

## Common GUI Components

This section describes the following GUI components commonly used in the Keysight Easy Test Navigator software.

- “Module Configuration Dialog Box” on page 4-78

### Module Configuration Dialog Box

You can do the following operations in the Module Configuration dialog box.

- Checking the revision of the firmware
- Setting the power line cycle
- Checking the status of the hardware modules
- Resetting the hardware modules
- Executing the self-test
- Executing the self-calibration
- Executing the self-diagnostics

This dialog box is opened by selecting the main menu Configuration > Module....

**Firmware Revision** Shows the revision of the firmware.

**Line Frequency** Select the power line frequency from below. This is used as the PLC value for the measurement time setting.

- 50 Hz
- 60 Hz

**Module Status** Shows the module’s model numbers and the result of the self-test, self-calibration, and self-diagnostics for the modules as the status.

The following tables shows the configuration and status.

**Table 4-7 Configuration and Status**

Configuration	Status
GNDU : B1500-66505	<ul style="list-style-type: none"> <li>• Pass It is passed.</li> <li>• Fail It is failed in the self-test or self-calibration.</li> <li>• Unavailable It is not acknowledged.</li> </ul>
MPSMU (SMU1) : B1511B	
MFCMU : B1520A	
HVSMU (SMU2) : B1513C	
Device Capacitance Selector	<ul style="list-style-type: none"> <li>• Pass It is passed.</li> <li>• Fail It is failed in the self-diagnostics.</li> <li>• Unavailable <sup>a</sup> It is not acknowledged.</li> </ul>

a. This also occurs when it is turned off.

**Operation Buttons** You can do the following operations using the buttons below.

- Resetting the hardware modules
- Executing the self-test
- Executing the self-calibration
- Executing the self-diagnostics

**Reset button** Initializes and re-acknowledges all the modules.

**Self Test button** Executes the self-test for all the modules.

**Self Calibration button** Executes the self-calibration for all the modules.

**Diagnosis button** Executes the self-diagnostics for all the output selectors.

Connect the output terminals according to the displayed instructions during the diagnostics execution.

GUI Reference  
Common GUI Components

**Error Log**

Shows the error messages when errors occur for the above button operations. The error messages are cleared when you do any new operation.



This information is subject to change without notice.  
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