Agilent B2900 Series
Precision Source/Measure Unit

User's Guide

Agilent Technologies

Notices

Manual Part Number

B2910-90010

Edition

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

Declares under sole responsibility that the product as originally delivered

Product Name: Precision Source/Measure Unit

Model Number: Agilent Model B2901A / B2902A / B2911A / B2912A

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

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

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

and conforms with the following product standards

EMC	Standard	Limit
	IEC 61326-1:2005 / EN 61326-1:2006	
	CISPR 11:2003 / EN55011:1998+A1:1999+A2:2002	Group 1 Class A
	IEC 61000-4-2:2008 / EN 61000-4-2:1995+A1:1998+A2:2001	4 kV CD, 8 kV AD
	IEC 61000-4-3:2006+A1:2007 / EN 61000-4-3:2002+A1:2002	3 V/m / 80 MHz-1 GHz / 1.4-2 GHz, 1 V/m / 2-2.7 GHz
	IEC 61000-4-4:2004 / EN 61000-4-4:2004	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-5:2008 / EN 61000-4-5:1995+A1:2001	0.5 kV line-line, 1 kV line-ground
	IEC 61000-4-6:2008 / EN 61000-4-6:1996+A1:2001+A2:2006	3 V, 0.15-80 MHz
	IEC 61000-4-11:2004 / EN 61000-4-11:2004	0 % for 1/0.5 cycle, 0 % for 250/300 cycles, 70 % for 25/30 cycles
	Canada: ICES/NMB-001:2004	
	Australia/New Zealand: AS/NZS CISPR 11:2004	
Safety	IEC 61010-1:2001 / EN 61010-1:2001	
	Canada: CAN/CSA-C22.2 No. 61010-1-04, C/US	

Supplementary Information:

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

This DoC applies to above-listed products placed on the EU market after:
Year of the CE marking '11

January 31, 2011
Date

川路 利行

Toshiyuki Kawaji

QA Manager
Agilent Technologies

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

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

Safety Summary

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

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

NOTE

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

This instrument is an INDOOR USE product.

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

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

- *DANGEROUS PROCEDURE WARNINGS*

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

WARNING

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

- *BEFORE APPLYING POWER*

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

- *GROUND THE INSTRUMENT*

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

- *DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE*

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

- *KEEP AWAY FROM LIVE CIRCUITS*

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

- *DO NOT SERVICE OR ADJUST ALONE*

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

- *DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT*

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

- *IN CASE OF DAMAGE*

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

Safety Symbols

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


Direct current.

Alternating current.


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


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


Grounded terminal which indicates the earth potential.

On supply.


Off supply.


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

In position of a bi-stable push switch.


Out position of a bi-stable push switch.


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


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


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

CAT I IEC Measurement Category I

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

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

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 C-Tick 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.

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

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

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

Plastic Material Coding Identification

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 Chassis ground terminal.

- Voltage/Current Measurement Safety

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

- Protection Limits

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

- Source/Measure Terminals

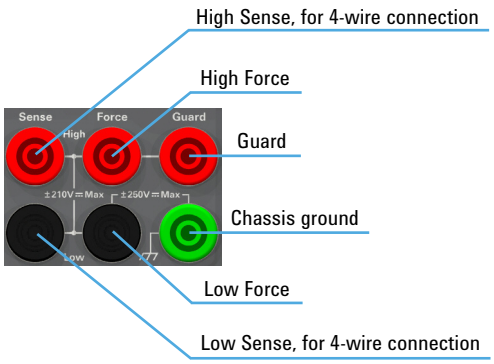
  Source/measure unit, SMU, can simultaneously perform DC voltage or current output and measurement. Typical SMU has the Force, Sense, and Guard terminals as shown below. Normally the Force, Sense, and Guard are the same potential. Voltage marked around the terminals indicates the Protection Limits.

  Force and Sense must be connected to a terminal of a device under test (DUT) for the 4-wire connection (Kelvin connection) which is effective for high current measurement and low resistance measurement. For the 2-wire connection to ease the connections, connect Force only. Do not connect Sense. It must be opened.

  Guard should be connected to the guard shield which covers the DUT high side wiring for reducing leakage current caused by the wire. Or else, the Guard must be opened.

  Chassis ground (green terminal) should be connected to the ground shield which covers the DUT including the guard shield to minimize the affect of noise. Or else, the chassis ground should be opened.

  The following image is the source and measurement terminals of Agilent B2900. For the B2900, the High Force, High Sense, and Guard are the same potential. And the Low Force and Low Sense are the same potential.



High Voltage Shock Hazard

Agilent B2900 can force dangerous voltages (±210 V) at the High Force, Guard, and High Sense terminals. To prevent electric shock hazard, the following safety precautions must be observed during the use of Agilent B2900.

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

Gefahr durch Hochspannung

Von den Geräten Agilent B2900 können Spannungen an den Anschlüssen “High Force, Guard und High Sense” von bis zu 210 V ausgehen. Um elektrischem Schlag vorzubeugen, ist bei der Benützung der Geräte Agilent B2900 folgendes zu beachten.

- Verwenden Sie ein dreiphasiges AC-Stromkabel für die Gerätsteckvorrichtung (Eingang) und schließen Sie das Instrument an eine Erdung an (Sicherheitserdung).
- Bereiten Sie das Abschirmungsgehäuse vor, dass die Oberfläche eines zu testenden Geräts abdeckt und mit einem Verriegelungsstromkreis ausgestattet ist, der bei geöffneter Tür unterbrochen wird.
- Vor der Messung verbinden Sie den Verriegelungsstromkreis mit dem Interlock-Anschluss dieses Instruments.
- Prüfen Sie in regelmäßigen Abständen, dass die Verriegelungsfunktion ordnungsgemäß funktioniert.
- Bevor Sie die Verbindungen zu den Anschlüssen High Force, Guard und High 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 “On/Off” drücken. Stellen Sie sicher, dass die Statusanzeige “On/Off” nicht leuchtet.
  - Stellen Sie sicher, dass die Anzeige “High Voltage” nicht leuchtet.
  - Öffnen Sie die Tür des Abschirmungsgehäuses (öffnen des Interlock-Anschlusses).
  - Entladen Sie alle Kondensatoren, wenn die Kapazität mit einer SMU verbunden ist.
- Warnen Sie Mitarbeiter in der Umgebung des Instruments vor den Gefahren.

Danger de choc dû à une haute tension

Une tension dangereuse (max. ± pour; 210 Vdc) émanant du dispositif Agilent B2900 peut être sortie aux bornes de force, d'appareil de protection ou de détection. Les précautions suivantes doivent être obserées contre commotion électrique accidentelle.

- Utilisez un câble d'alimentation CA à trois conducteurs vers le coupleur secteur (entrée) et branchez l'instrument sur une mise électrique à la terre (prise de terre de sécurité).
- Préparez le boîtier de protection qui couvre l'interface avec le dispositif à tester et équipez-le d'un circuit de sécurité qui s'ouvre lors de l'ouverture d'une porte.
- Avant de procéder aux mesures, connectez le circuit de sécurité à la borne Interlock de l'instrument.
- Vérifiez régulièrement le bon fonctionnement de la fonction de sécurité.
- Avant de toucher les connexions des bornes High Force, Guard et High 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 On/Off ; vérifiez que l'indicateur d'état On/Off est éteint.
    - Vérifiez que le témoin High Voltage est éteint.
    - Ouvrez la trappe d'accès au boîtier de protection (ouvrez la borne Interlock).
    - Déchargez les éventuels condensateurs si la capacité est connectée à une unité SMU.
- Informez les personnes travaillant à proximité de l'instrument des conditions.

高電圧感電注意

Agilent B2900 のフォース、ガード、センス端子には、危険電圧が出力されることがあります（最大 ±210 Vdc）。感電事故防止のため、必ず以下の事柄を守ってください。

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

Product Stewardship

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

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

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

  Do not dispose in domestic household waste.

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

  www.agilent.com/environment/product/

- LCD Fluorescent Lamp

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

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

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

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

  http://www.lamprecycle.org

  http://www.eiae.org

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

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

- Perchlorate Information

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

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

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

In This Manual

This manual describes the front panel operation, installation, and functions of the Agilent Technologies B2900 Precision Source/Measure Unit, SMU. This manual consists of the following chapters.

- Chapter 1, “Getting Started”

  This chapter briefly explains how to use the Agilent B2900 by the front panel operation.

- Chapter 2, “Introduction”

  This chapter describes overview, specifications, accessories, and options of the Agilent B2900.

- Chapter 3, “Installation”

  This chapter explains how to install the Agilent B2900, and how to connect the device under test to a test fixture.

- Chapter 4, “Front Panel Reference”

  This chapter provides the reference information of the Agilent B2900 front panel keys and graphical user interface.

- Chapter 5, “Front Panel Operations”

  This chapter explains how to use the Agilent B2900 in the local mode.

- Chapter 6, “Function Details”

  This chapter explains the several functions and initial settings of the Agilent B2900.

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

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1 Getting Started

This chapter describes basic operations for Agilent B2900. Before learning the details of B2900, let us briefly cover the use of the B2900 source/measure unit. The operations require only B2900 and the power cord. To get started with the operations, open the measurement terminals.

This chapter consists of the following sections.

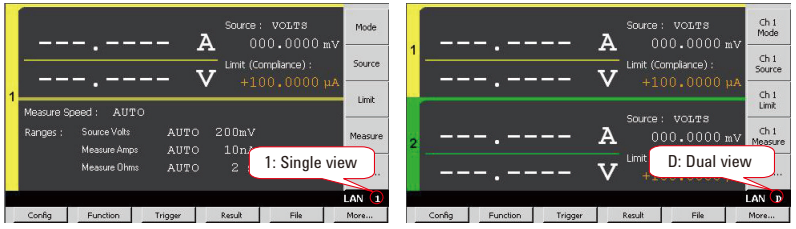
- “Applying DC Output”
- “Performing Spot Measurement”
- “Performing Sweep Measurement”
- “Operation Tips”
- “Operation Summary”

NOTE

Turning B2900 on

1. Connect the power cord from the AC input connector (receptacle) on B2900’s rear panel to an AC power outlet at your site.
2. Press the line switch on the front panel.

B2900 boots up and performs a self-test. After B2900 boots normally, the front panel LCD displays the following view. It will be the Single view for the 1-channel model or the Dual view for the 2-channel model.



NOTE

Connecting your DUT

If you want to connect your device under test, see “Connecting a DUT” on page 3-10.

Applying DC Output

B2900 can be used as a DC voltage or current source. The following procedure configures B2900 as a voltage source and applies a voltage of +500 mV.

Step 1. Setting the Source mode (voltage output)

1. Press the **Mode** assist key on a 1-ch model, or the **Ch1 Mode** assist key on a 2-ch model.

   The field pointer appears on the Source mode, and the status changes to EDIT (green). The status information will show EDIT.

2. Press the **VOLTS (V)** assist key. Or use the rotary knob or arrow keys ◀ and ▶ to specify the mode, and press the knob to fix the setting.

   The status changes to MOVE (blue). The status information will show MOVE.

Step 2. Setting the Source value (voltage output value)

1. Press the **Source** assist key on a 1-ch model, or the **Ch1 Source** assist key on a 2-ch model. Or, use the rotary knob or arrow keys to move the field pointer onto the Source value and press the knob. The field pointer appears on the Source value, and the status changes to EDIT (green).

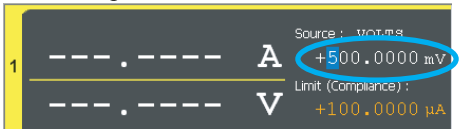
2. Turn the rotary knob clockwise to increase the value, or counter clockwise to decrease the value. Set the desired value.

   When you press an arrow key, a digit pointer will appear on a digit. Turning the knob will change the value of the digit, or move the decimal point if the pointer is on it.

3. Press the rotary knob to fix the value. The status changes to MOVE (blue).

The numeric/alpha keys and the unit assist keys are also available for setting the Source value in the same way as for setting the Limit value, shown in the next step.

This example sets the Source value to +500 mV.

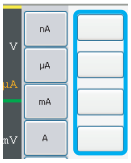


Step 3. Setting the Limit value (compliance current)

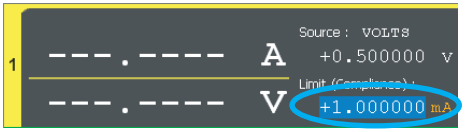
1. Press the **Limit** assist key on a 1-ch model, or the **Ch1 Limit** assist key on a 2-ch model. Or, use the rotary knob or arrow keys to move the field pointer onto the Limit value and press the knob. The field pointer appears on the Limit value, and the status changes to EDIT (green).

2. Use the rotary knob, arrow keys, or numeric/alpha keys to set the value.

3. Press one of the unit assist keys to set the unit and fix the value. The status changes to MOVE (blue).



This example sets the Limit value to 1 mA.



Step 4. Enabling the channel

Press the Ch 1 

switch to enable channel 1. This turns the switch green. Channel 1 starts applying the voltage specified by the Source value.

Step 5. Disabling the channel

Press the Ch 1 

switch to disable channel 1. This turns off the switch light.

Performing Spot Measurement

B2900 can be used as a DC voltage or current meter. The following procedure performs one point current measurement.

Step 1. Setting the measurement mode (current measurement)

Press the **Measure** assist key on a 1-ch model, or the **Ch1 Measure** assist key on a 2-ch model. And press the **AMPS (I)** assist key.

The rotary knob and arrow keys are also available for setting the measurement mode, in the same way as for setting the Source mode under “Applying DC Output”.

Step 2. Enabling the channel

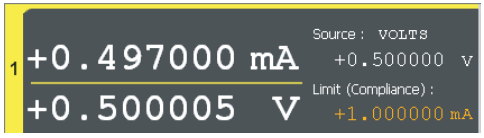
Press the Ch 1 On/Off switch to enable channel 1. This turns the switch green. Channel 1 starts applying the voltage specified by the Source value.

Step 3. Starting measurement

- Press the Trigger key to start a single (one shot) measurement. Spot measurement is performed once.
- Press the Auto key to start a repeat (continuous) measurement. Spot measurement is performed repeatedly.

The measurement results will be displayed in the left half of the LCD.

The following example shows the measurement results for a 1 kΩ resistor connected between the High Force and Low Force terminals of channel 1.



Step 4. Disabling the channel

Press the Ch 1 On/Off switch to disable channel 1. This turns off the switch light.

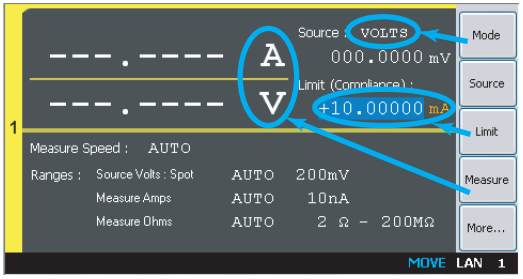
Performing Sweep Measurement

B2900 supports sweep measurements. The following example applies a staircase sweep voltage and measures the current at each step voltage.

Step 1. Press the View key to display the Single view.

Step 2. Set the Source mode, Limit value, and measurement mode as shown in "Applying DC Output" and "Performing Spot Measurement".

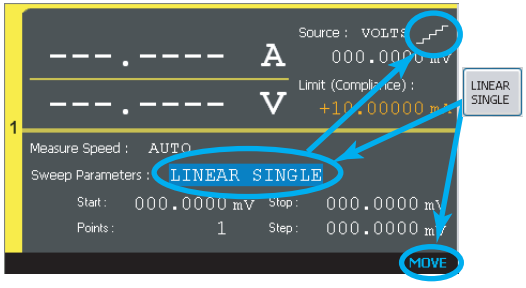
This example sets the voltage output, a 10 mA limit value, and both current and voltage measurements.



Step 3. Setting the Sweep parameters

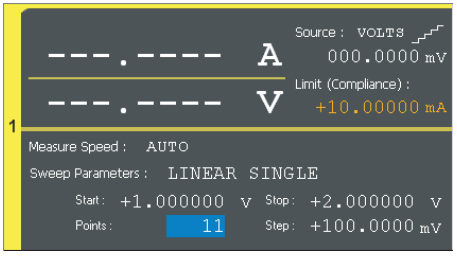
1. Press the **More** assist key to change the assist keys.
2. Press the **Show Sweep** assist key to display the Sweep setup parameters.
3. Press the rotary knob to change the status to EDIT (green).
4. Press the **LINEAR SINGLE** assist key to set the linear single sweep mode.

   The source shape indicator shows the staircase icon, and the status changes to MOVE (blue).



5. Use the rotary knob, arrow keys, or numeric/alpha keys to set the Start (sweep start value), Stop (sweep stop value), and Step (sweep step value) or Points (number of sweep steps).

This example sets Start to 1 V, Stop to 2 V, and Points to 11.



Step 4. Press the View key to display the Graph view.

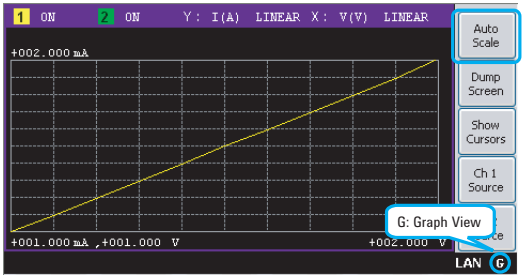
Step 5. Enabling the channel

Press the Ch 1 On/Off switch to enable channel 1. This turns the switch green. Channel 1 starts applying the voltage specified by the Source value.

Step 6. Press the Trigger key to start a single (one shot) measurement. Sweep measurement is performed once. And the measurement results will be displayed on the graph.

Step 7. Press the **Auto Scale** assist key to fit the trace in the graph scale.

The following example shows the measurement results for a 1 kΩ resistor connected between the High Force and Low Force terminals of channel 1.



Step 8. Disabling the channel

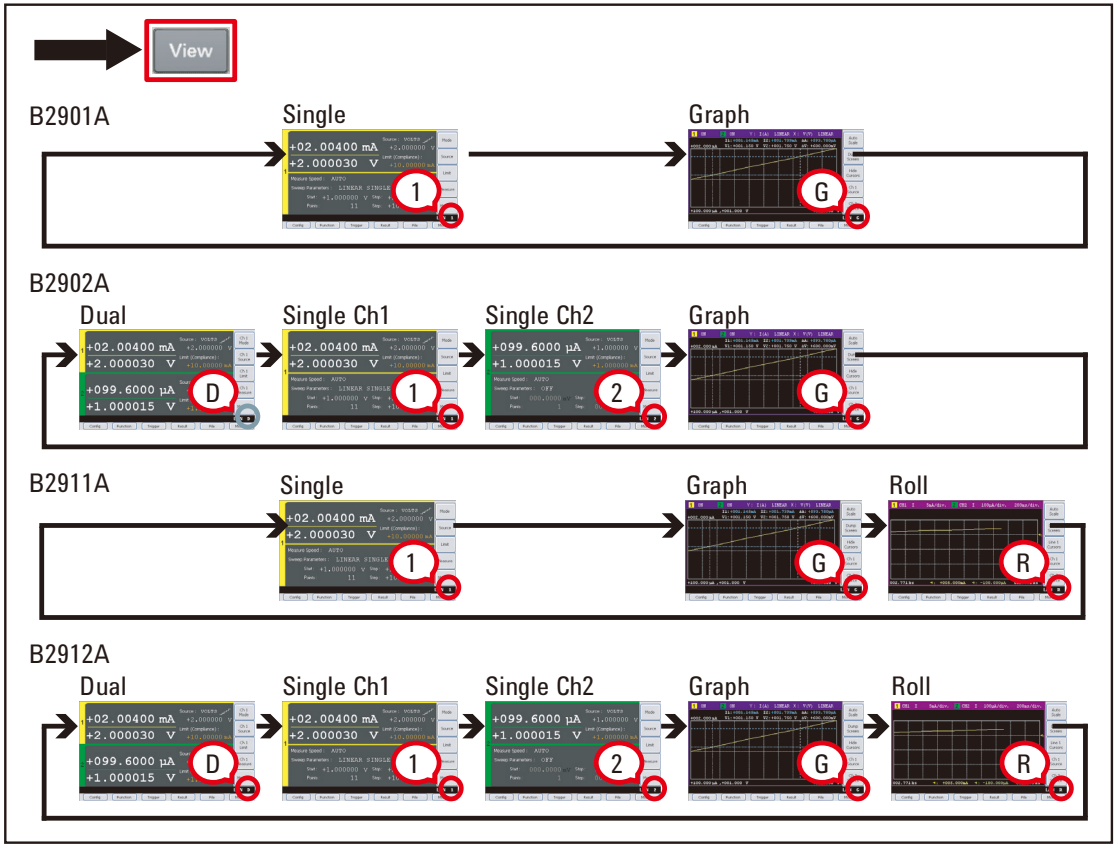
Press the Ch 1 On/Off switch to disable channel 1. This turns off the switch light.

Operation Tips

This section introduces key operation and status information on B2900.

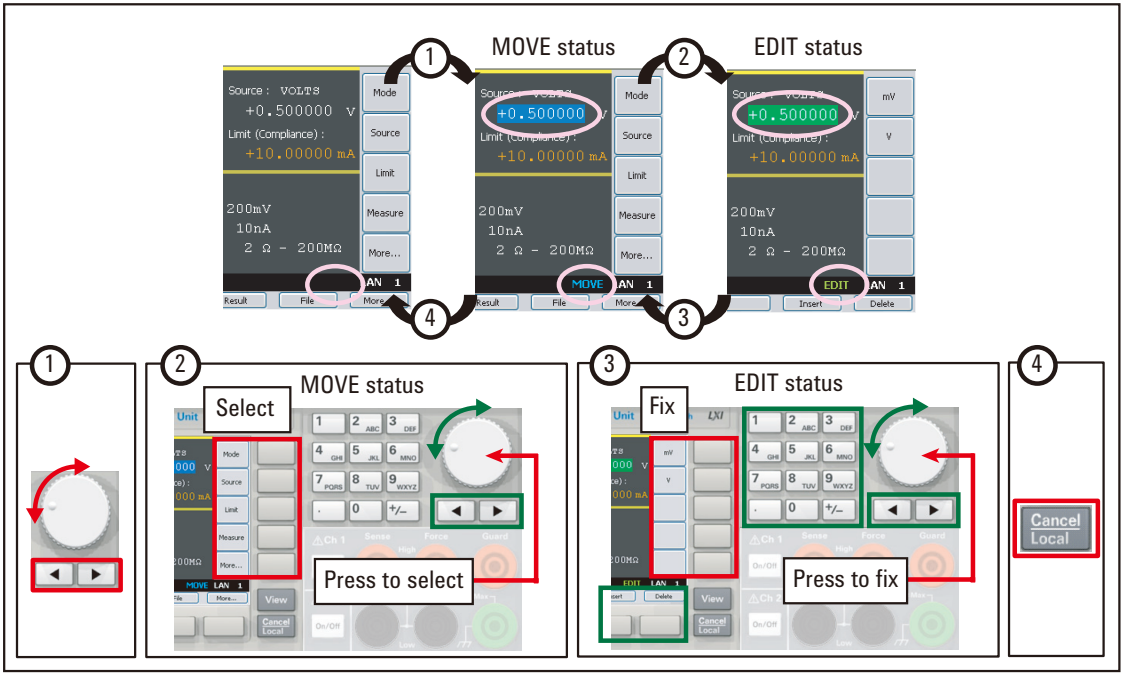
- “Changing the View Mode”
- “Editing the Setup”
- “Status Information”

Figure 1-1 Changing the View Mode



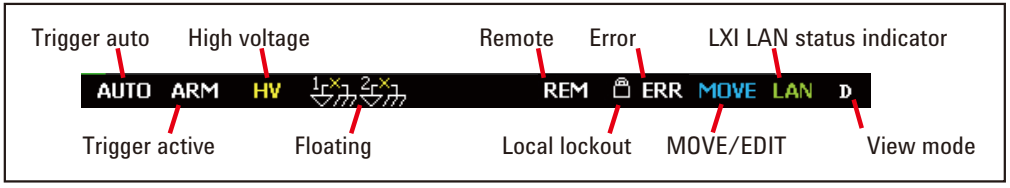
For details about the View mode, see “Display and Assist Keys” on page 4-5.

Figure 1-2 **Editing the Setup**



For more information about the front panel keys, see “Hard Keys and Rotary Knob” on page 4-3.

Figure 1-3 **Status Information**



For details about the status information, see “Status Information” on page 4-22.

Operation Summary

This section summarizes front panel operations on B2900.

- “Basic Operations”
- “Channel Setup”
- “Source Setup”
- “Measurement Setup”
- “Display Setup”
- “File Operations”
- “Miscellaneous Functions”
- “Interface Setup”
- “System Setup and Operations”

For details about front panel operations, see Chapter 4, “Front Panel Reference.”

Table 1-1 Basic Operations

Task	Relevant front panel key
To turn the B2900 on/off	Line switch
To change the display mode	**View** key
To enable/disable the specified channel	Ch 1 **On/Off** switch or Ch 2 **On/Off** switch
To cancel the previous setup operation	**Cancel/Local** key
To return to the upper menu of a function key or softkey	**Cancel/Local** key
To return to the local status from the remote status	**Cancel/Local** key
To start a single (one shot) measurement	**Trigger** key
To start a repeat (continuous) measurement	**Auto** key
To move the field pointer	Rotary knob or arrow keys
To move the digit pointer	Rotary knob or arrow keys
To switch the EDIT/MOVE status	Rotary knob on a setup field
To select the setup value	Assist keys, rotary knob, or arrow keys

Table 1-2 Channel Setup

Task	Relevant front panel key
To enable/disable the specified channel	Ch 1 **On/Off** switch or Ch 2 **On/Off** switch
To select the sensing type; 2-wire or 4-wire	Config > Source > Connection function keys
To select the low terminal status; grounded or floating	Config > Source > Connection function keys
To enable/disable high capacitance mode	Config > Source > Connection function keys
To enable/disable over voltage/current protection	Config > Source > Connection function keys
To enable/disable resistance compensation	Config > Measure > R Compen function keys
To enable/disable 2-channel synchronous operation	Config > Common > Group function keys

Table 1-3 Source Setup

Task	Relevant front panel key
To enable/disable source output	Ch 1 **On/Off** switch or Ch 2 **On/Off** switch
To select source output mode	Mode, Ch1 Mode, or Ch2 Mode assist key
To set source output value	Source, Ch1 Source, or Ch2 Source assist key
To set limit/compliance value	Limit, Ch1 Limit, or Ch2 Limit assist key
To set constant source ranging mode	Speed assist key or Hide Sweep/Pulse/Trigger assist key on Single view
To set sweep source	Show Sweep assist key on Single view
To set list sweep source	Edit assist key in the EDIT status for the LIST sweep Start/Stop/Points field
To set sweep source ranging mode	Config > Source > Sweep function keys
To set sweep direction	Config > Source > Sweep function keys
To set source output value after sweep	Config > Source > Sweep function keys
To set pulse source	Show Pulse assist key on Single view
To set source wait time	Config > Common > Wait function keys
To set output filter	Config > Source > Filter function keys
To select output-off status	Config > Source > Connection function keys
To enable/disable automatic output ON	Config > Source > Connection function keys
To enable/disable automatic output OFF	Config > Source > Connection function keys

Table 1-4 Measurement Setup

Task	Relevant front panel key
To enable/disable the specified channel	Ch 1 **On/Off** switch or Ch 2 **On/Off** switch
To select measurement mode	Measure, Ch1 Measure, or Ch2 Measure assist key
To set measurement speed	Speed assist key on Single view

Task	Relevant front panel key
To set measurement ranging mode	Speed assist key or Hide Sweep/Pulse/Trigger assist key on Single view
To define automatic ranging operation	Config > Measure > Ranging function keys
To set measurement wait time	Config > Common > Wait function keys

Table 1-5 Display Setup

Task	Relevant front panel key
To change the display mode	**View** key
To change the color set	Display > Color function keys
To enable zoom-in	Display > Zoom > ON function keys
To disable zoom-in	Zoom Out assist key for the zoom-in display status
To change the data digits	Display > Digits function keys
To enable/disable the front panel display in the remote condition	Display > Remote function keys

Table 1-6 File Operations

Task	Relevant front panel key
To save a measurement result data to USB memory	File > Save > Measure function keys
To save a math result data to USB memory	File > Save > Math function keys
To save a limit test result data to USB memory	File > Save > Limit Test function keys
To save a trace buffer data to USB memory	File > Save > Trace function keys
To save a system setting data to USB memory	File > Save > Config function keys
To save a graph screen damp to USB memory	Dump Screen assist key on Graph or Roll view
To load a system setting data from USB memory	File > Load > Config function keys
To load a list sweep data from USB memory	Load assist key in the EDIT status for the LIST sweep Start/Stop/Points field

Table 1-7 Miscellaneous Functions

Task	Relevant front panel key
To see measurement result	Result > Measure function keys
To use math expression	Function > Math function keys
To see math result	Result > Measure function keys
To set limit test	Function > Limit Test function keys
To see limit test result	Result > Limit Test function keys
To set trace buffer	Function > Trace function keys
To see trace statistical result	Result > Trace function keys
To select program memory	Program > Catalog function keys
To control program memory	Program > Control function keys
To set trigger parameters easily	Show Trigger assist key on Single view
To set trigger parameters in detail	Function > Trigger > Config function keys
To control trigger system	Function > Trigger > Initiate/Abort/Immediate function keys

Table 1-8 Interface Setup

Task	Relevant front panel key
To specify measurement data elements	I/O > Format > Measure function keys
To specify math and limit test data elements	I/O > Format > Math/Limit function keys
To specify trace statistical data elements	I/O > Format > Trace function keys
To select data output format	I/O > Format > Data Type function keys
To enable/disable byte swap of binary data	I/O > Format > Byte Swap function keys
To set LAN configuration	I/O > LAN > Config function keys
To see status of LAN interface	I/O > LAN > Status function keys
To reset all of LAN connections	I/O > LAN > Reset function keys

Task	Relevant front panel key
To sets LAN settings to the default settings	I/O > LAN > Default function keys
To see status of USB interface	I/O > USB function keys
To set GPIB address	I/O > GPIB function keys
To see status of GPIB interface	I/O > GPIB function keys
To set configuration of Digital I/O	I/O > DIO > Config function keys
To read/write a value set to Digital I/O	I/O > DIO > R/W function keys

Table 1-9 System Setup and Operations

Task	Relevant front panel key
To set power line frequency	System > PLC function keys
To initialize B2900	System > Reset function keys
To perform self-calibration	System > Cal/Test > Self-Cal function keys
To perform self-test	System > Cal/Test > Self-Test function keys
To check errors	System > Error > Log function keys
To clear errors	System > Error > Clear function keys
To clear time stamp	System > Timestamp > Clear function keys
To set automatic clear of time stamp	System > Timestamp > Auto CLR function keys
To set start-up operation	System > More > Start-up function keys
To enable/disable beep and sound	System > More > Sound function keys
To select remote control command set	System > More > SCPI function keys
To set date and time	System > More > Info. > Date/Time function keys
To perform firmware update	System > More > Info. > Update > Firmware function keys
To perform demonstration	System > More > Info. > Demo. function keys

2 Introduction

This chapter describes the basic functions and features of the Agilent B2900, and consists of the following sections.

- “Agilent B2900 Series”
- “Front View”
- “Rear View”
- “Source/Measure Unit”
- “Specifications”
- “Operation and Functions”
- “Software and Drivers”
- “Accessories”
- “Options”

Agilent B2900 Series

Agilent B2900 is a series of precision SMU (source/measure unit, SMU). B2900 provides the LCD, front panel keys, and rotary knob for applying voltage/current or measuring voltage/current/resistance. B2900 also supports several functions, such as sweep output, pulse output, arbitrary waveform generation, limit test, trace buffer, math expressions, and graph plot. Hence, B2900 can be used as a DC (constant) voltage/current source, sweep voltage/current source, pulse generator, arbitrary waveform generator, and multimeter.

The product lineup of the Agilent B2900 series includes the following products.

Table 2-1 **Agilent B2900 Series**

Model No.	Number of SMU channels	Effective set and measure value			
		Minimum resolution		Maximum current	Maximum voltage
		Set	Measure		
B2901A	1	1 pA, 1 µV	0.1 pA, 0.1 µV	DC: ± 3.03 A Pulse: ± 10.5 A	± 210 V
B2902A	2				
B2911A	1	0.01 pA, 0.1 µV			
B2912A	2				

B2900 is a LAN eXtended Interface Class C (LXI-C) compliant instrument.

Front View

This section describes the front view of the Agilent B2900 series.

- Line switch

  Turns the instrument on or off.

- Display

  Displays the source setup, measurement result, status information, etc. For details, see Chapter 4, “Front Panel Reference.”

- Trigger key

  Starts a single (one shot) measurement or initiates trigger system. If a repeat (continuous) measurement is in progress, stops the repeat measurement.

  The single measurement is performed with the DC bias output, staircase sweep output, pulsed bias output, or pulsed sweep output set to the channel. One single measurement can contain the maximum of 100000 measurement points.

  Once a single measurement starts, the data buffer (maximum 100000 data) is cleared, and the last single measurement result is stored in the buffer. The measurement result is displayed on the Single view, Dual view, Graph view, or Roll view.

NOTE

If measurement is not performed properly, check the trigger setting. The trigger type must be set to AUTO, or the trigger count (Count) must be set properly. See “Trigger parameters” on page 4-15.

- Auto key

  Starts a repeat measurement. If a repeat measurement is in progress, stops the repeat measurement.

  The repeat measurement is performed with the DC bias output of the Source value. And the measurement result is displayed on the Single view, Dual view, or Roll view. The repeat measurement result is not stored in the buffer.

- USB-A connector

  Used to connect a USB memory. After disconnecting the USB memory, wait 10 seconds before connecting it again or new one.

CAUTION Turning the instrument off while the USB memory is being accessed may damage the device.

- Function keys

  Six function keys are available below the display. They are assigned to the softkeys, Config, Function, Trigger, Result, File, Program, I/O, System, and More. For details, see Chapter 4, "Front Panel Reference."

- Assist keys

  Five assist keys are available to the right of the display. They are assigned to several softkeys, such as Mode, Source, Limit, Measure, and More. The softkey assignment depends on the display mode (Single, Graph, Roll, or Dual). For details, see Chapter 4, "Front Panel Reference."

- View key

  Changes the display mode. Pressing the key changes the mode as shown below.

  On B2901A Single → Graph → (return to Single)

  On B2902A Dual → Single for channel 1 → Single for channel 2 → Graph → (return to Dual)

  On B2911A Single → Graph → Roll → (return to Single)

  On B2912A Dual → Single for channel 1 → Single for channel 2 → Graph → Roll → (return to Dual)

- Cancel / Local key

  Cancels the setup operation if the instrument is in the local status. Returns the instrument to the local status if it is in the remote status.

- Numeric/alpha keys

  Used to enter the value of setup parameters such as the source output value, limit (compliance) value, and message, specified by the field pointer.

- Rotary knob

  If the field pointer is in the MOVE (blue) status, turning the knob moves the pointer. Pressing the knob fixes the pointer position and changes the pointer status to EDIT (green).

  If the field pointer is in the EDIT (green) status, turning the knob changes the value of the setup parameter specified by the pointer. Pressing the knob fixes the value and changes the pointer status to MOVE (blue).

- Left and right keys

  If the field pointer is in the MOVE (blue) status, pressing the key moves the pointer.

  If the field pointer is in the EDIT (green) status, pressing the key changes the value of the setup parameter specified by the pointer.

  If the field pointer is in the EDIT (green) status on a numeric value entry field, pressing the key changes the pointer to a digit pointer.

- On/Off switch(es)

  Used to enable or disable the SMU channel. Turns the channel off if it is in the output status even if it is in the remote status. One switch on 1-channel models, and two switches on 2-channel models.

  The switch turns green if the channel is enabled.

  The switch turns red if the channel is in the high voltage state.

- Channel 1 source/measure terminals

  Terminals for SMU channel 1. High Force, Low Force, High Sense, Low Sense, Guard, and chassis ground. For details, see “Connecting a DUT” on page 3-10

CAUTION Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal. Doing so will damage the B2900.

CAUTION Do not apply current to the chassis ground terminal. Doing so will damage the B2900.

Rear View

This section describes the rear view of the Agilent B2900 series.

⚠ • Channel 2 source/measure terminals

  Only on 2-channel models. Terminals for SMU channel 2. High Force, Low Force, High Sense, Low Sense, Guard, and chassis ground. For details, see “Connecting a DUT” on page 3-10

CAUTION Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal. Doing so will damage the B2900.

CAUTION Do not apply current to the chassis ground terminal. Doing so will damage the B2900.

- GPIB interface connector

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

- Cooling fan
- AC input connector

  AC power cord is connected to this receptacle.

- LAN interface connector

  Connects to 10/100 Base-T interface. Left LED indicates activity. Right LED indicates link integrity.

- USB-B connector

  Connects to USB interface.

- Digital I/O connector

  D-sub 25 pin female connector for general purpose I/O (GPIO). Can be used as trigger input/output terminals or as an interface to a handler or the likes. For details, see “Using Digital I/O” on page 3-29

  Pins 16 and 24 and pins 17 and 25 are reserved for the interlock function. If the terminals are open, the instrument output is limited to ±42 V. Be sure to connect the terminals to the Agilent 16442B test fixture or another DUT interface before performing measurements. If you do not use 16442B, you need to install an interlock circuit. For details on how to install the interlock circuit, see “Installing the Interlock Circuit” on page 3-19.

WARNING **Dangerous voltage of up to the maximum voltage of SMUs may be present at the High Force, High Sense, and Guard terminals if the Interlock terminal is closed.**

NOTE

Serial Number

You will need the instrument’s *serial number* when using the Agilent Technologies telephone assistance program. The serial number label is attached to the bottom of the instrument.

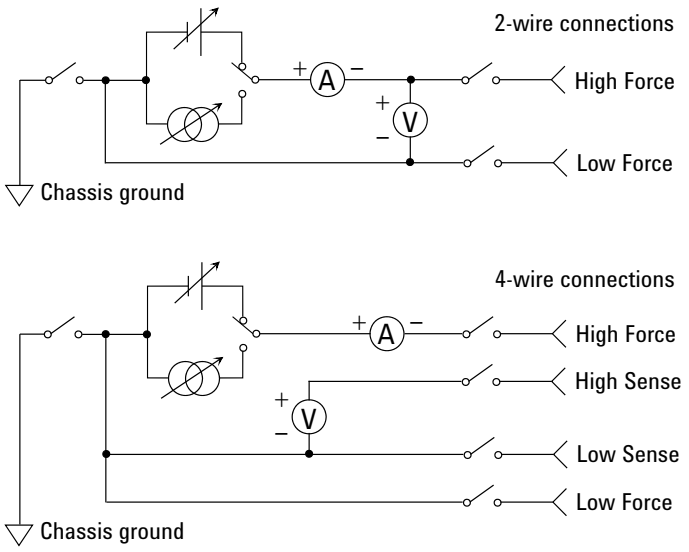
Source/Measure Unit

The source/measure unit (SMU) can apply voltage or current, and can measure current or voltage.

Figure 2-1 shows a simplified SMU circuit diagrams. The SMU can perform the following operations.

- Applies voltage and measures current
- Applies current and measures voltage
- Applies voltage and measures voltage
- Applies current and measures current

Figure 2-1 **Simplified SMU Circuit Diagram**



Measurement Parameters

B2900 supports the following measurement parameters.

- Current
- Voltage
- Resistance
- Power

Resistance data is given by Resistance=Vmeas/Imeas.

Power data is given by Power=Vmeas×Imeas.

In the above formula, Vmeas is the voltage measurement data, and Imeas is the current measurement data.

For using the resistance compensation, see “Resistance Compensation” on page 6-16.

Limit/Compliance

B2900 has a compliance feature that limits the output voltage or current to prevent damage to the device under test. When the SMU applies voltage, you can specify the current limit/compliance. When the SMU applies current, you can specify the voltage limit/compliance. For details about limit/compliance, see “Limit/Compliance” on page 6-3.

Output and Measurement Ranges

This section describes typical specifications of the Agilent B2900 series.

- Maximum voltage and current: see Figure 2-2.
- Maximum power: 31.8 W
- Output/measurement value and resolution: see Table 2-2 to Table 2-7.

Figure 2-2 **Maximum Voltage and Current**

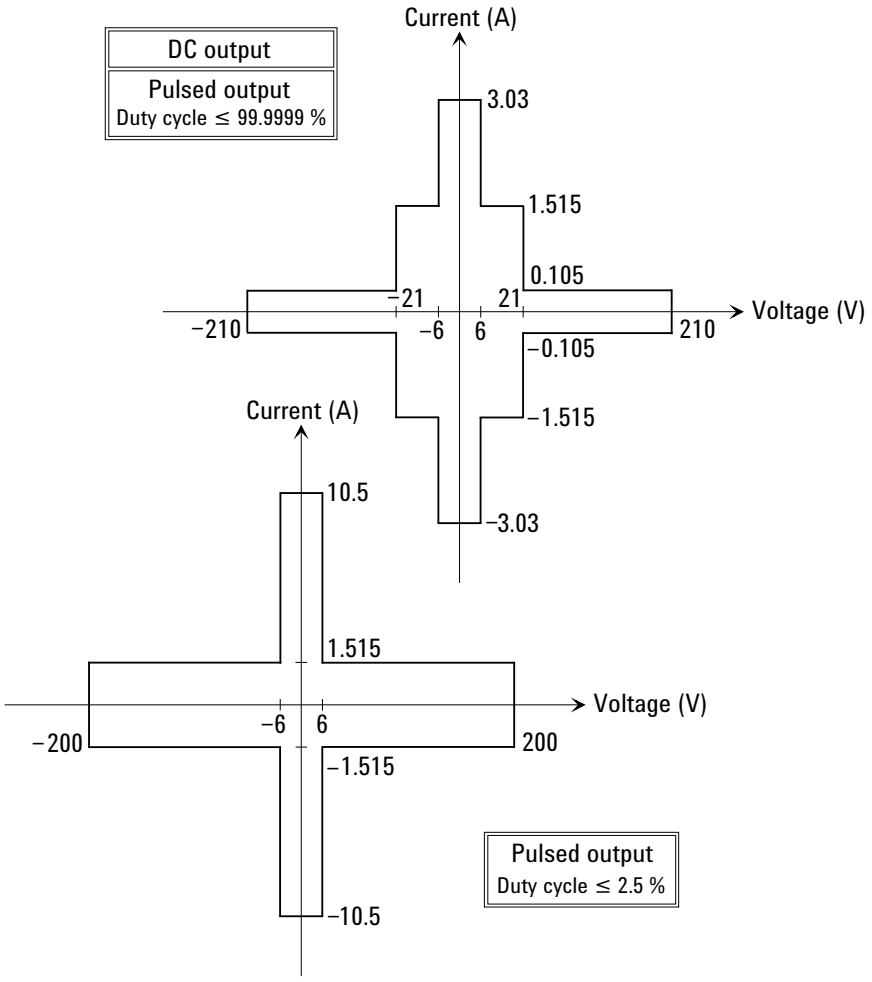


Table 2-2 Current Output Range

Range value	Setting resolution		DC output current or pulse peak/base current [a] [b]	Maximum voltage		Pulse width t [c]
	B2901A B2902A	B2911A B2912A		DC output	Pulsed output	
10 nA [d]	—	10 fA	0 ≤ |I| ≤ 10.5 nA	±210 V	±210 V	50 µs ≤ t ≤ t_{max}
100 nA	1 pA	100 fA	0 ≤ |I| ≤ 105 nA			
1 µA	10 pA	1 pA	0 ≤ |I| ≤ 1.05 µA			
10 µA	100 pA	10 pA	0 ≤ |I| ≤ 10.5 µA			
100 µA	1 nA	100 pA	0 ≤ |I| ≤ 105 µA			
1 mA	10 nA	1 nA	0 ≤ |I| ≤ 1.05 mA			
10 mA	100 nA	10 nA	0 ≤ |I| ≤ 10.5 mA			
100 mA	1 µA	100 nA	0 ≤ |I| ≤ 105 mA			
1 A	10 µA	1 µA	0 ≤ |I| ≤ 105 mA			
			105 mA < |I| ≤ 1.05 A	±21 V	±21 V	
			0 ≤ |I| ≤ 1.05 A	—	±200 V	50 µs ≤ t ≤ 2.5 ms
				—	±180 V	50 µs ≤ t ≤ 10 ms
1.5 A			0 ≤ |I| ≤ 105 mA	±210 V	±210 V	50 µs ≤ t ≤ t_{max}
			105 mA < |I| ≤ 1.515 A	±21 V	±21 V	
			0 ≤ |I| ≤ 1.515 A	—	±200 V	50 µs ≤ t ≤ 2.5 ms
			0 ≤ |I| ≤ 1.05 A	—	±180 V	50 µs ≤ t ≤ 10 ms
3 A	100 µA	10 µA	0 ≤ |I| ≤ 105 mA	±210 V	±210 V	50 µs ≤ t ≤ t_{max}
			105 mA < |I| ≤ 1.515 A	±21 V	±21 V	
			1.515 A < |I| ≤ 3.03 A	±6 V	±6 V	
10 A			0 ≤ |I| ≤ 10.5 A	—	±6 V	50 µs ≤ t ≤ 1 ms
			0 ≤ |I| ≤ 1.515 A	—	±200 V	50 µs ≤ t ≤ 2.5 ms
			0 ≤ |I| ≤ 1.05 A	—	±180 V	50 µs ≤ t ≤ 10 ms

a. Table 2-4 shows the limitations when using Channels 1 and 2 for DC output or Pulsed output with 50 µs ≤ t ≤ t_{max} (=99.9999 ks).
b. Maximum base current is 500 mA for the pulse with 50 µs ≤ t ≤ 1 ms, and 50 ms for the pulse with 50 µs ≤ t ≤ 2.5 ms or 50 µs ≤ t ≤ 10 ms.
c. Maximum duty cycle is 99.9999 % for the pulse with 50 µs ≤ t ≤ t_{max}, and 2.5 % for the pulse with 50 µs ≤ t ≤ 1 ms, 50 µs ≤ t ≤ 2.5 ms, or 50 µs ≤ t ≤ 10 ms.
d. Available for the B2911A and B2912A. Not available for the B2901A and B2902A.

Table 2-3 Voltage Output Range

Range value	Setting resolution		DC output voltage or pulse peak/base voltage	Maximum current [a]		Pulse width t [b]
	B2901A B2902A	B2911A B2912A		DC output	Pulsed output	
0.2 V	1 µV	0.1 µV	0 ≤ |V| ≤ 0.21 V	±3.03 A	±3.03 A with 50 µs ≤ t ≤ t_{max} ±10.5 A with 50 µs ≤ t ≤ 1 ms	
2 V	10 µV	1 µV	0 ≤ |V| ≤ 2.1 V			
20 V	100 µV	10 µV	0 ≤ |V| ≤ 6 V			
			6 V < |V| ≤ 21 V	±1.515 A	±1.515 A with 50 µs ≤ t ≤ t_{max}	
200 V	1 mV	100 µV	0 ≤ |V| ≤ 6 V	±3.03 A	±3.03 A with 50 µs ≤ t ≤ t_{max} ±10.5 A with 50 µs ≤ t ≤ 1 ms	
			6 V < |V| ≤ 21 V	±1.515 A	±1.515 A	50 µs ≤ t ≤ t_{max}
			21 V < |V| ≤ 210 V	±105 mA	±105 mA	
			0 ≤ |V| ≤ 180 V	—	±1.05 A	50 µs ≤ t ≤ 10 ms
			0 ≤ |V| ≤ 200 V	—	±1.515 A	50 µs ≤ t ≤ 2.5 ms

a. Table 2-4 shows the limitations when using Channels 1 and 2 for DC output or Pulsed output with 50 µs ≤ t ≤ t_{max} (=99.9999 ks).
b. Maximum duty cycle is 99.9999 % for the pulse with 50 µs ≤ t ≤ t_{max}, and 2.5 % for the pulse with 50 µs ≤ t ≤ 1 ms, 50 µs ≤ t ≤ 2.5 ms, or 50 µs ≤ t ≤ 10 ms.

Table 2-4 **Limitations for using Channels 1 and 2**

Channel 1 voltage V1	Channel 2 voltage V2	Current limit [a]
0 < |V1| ≤ 6 V	0 < |V2| ≤ 6 V	I1 + I2 ≤ 4 A
	6 V < |V2| ≤ 21 V	I1 + I2 × 1.6 ≤ 4 A
6 V < |V1| ≤ 21 V	0 < |V2| ≤ 6 V	I1 + I2 × 0.625 ≤ 2.5 A
	6 V < |V2| ≤ 21 V	I1 + I2 ≤ 2.5 A

a. I1: Channel 1 current, I2: Channel 2 current

Table 2-5 **Current Measurement Range**

Range value	Current measurement value	Resolution
10 nA [a]	0 ≤ |I| ≤ 10.6 nA	10 fA
100 nA	0 ≤ |I| ≤ 106 nA	100 fA
1 µA	0 ≤ |I| ≤ 1.06 µA	1 pA
10 µA	0 ≤ |I| ≤ 10.6 µA	10 pA
100 µA	0 ≤ |I| ≤ 106 µA	100 pA
1 mA	0 ≤ |I| ≤ 1.06 mA	1 nA
10 mA	0 ≤ |I| ≤ 10.6 mA	10 nA
100 mA	0 ≤ |I| ≤ 106 mA	100 nA
1 A	0 ≤ |I| ≤ 1.06 A	1 µA
1.5 A	0 ≤ |I| ≤ 1.53 A	
3 A	0 ≤ |I| ≤ 3.06 A	10 µA
10 A [b]	0 ≤ |I| ≤ 10.6 A	

a. Available for the B2911A and B2912A. Not available for the B2901A and B2902A.
b. Available for pulse mode. Not available for DC mode.

Table 2-6 **Voltage Measurement Range**

Range value	Voltage measurement value	Resolution
0.2 V	0 ≤ |V| ≤ 0.212 V	0.1 µV
2 V	0 ≤ |V| ≤ 2.12 V	1 µV
20 V	0 ≤ |V| ≤ 21.2 V	10 µV
200 V	0 ≤ |V| ≤ 212 V	100 µV

Table 2-7 **Resistance Measurement Range**[1]

Range value	Resistance measurement value	Display resolution	Test current
2 Ω	0 < R ≤ 2 Ω	1 µΩ	1A
20 Ω	2 Ω < R ≤ 20 Ω	10 µΩ	100 mA
200 Ω	20 Ω < R ≤ 200 Ω	100 µΩ	10 mA
2 kΩ	200 Ω < R ≤ 2 kΩ	1 mΩ	1 mA
20 kΩ	2 kΩ < R ≤ 20 kΩ	10 mΩ	100 µA
200 kΩ	20 kΩ < R ≤ 200 kΩ	100 mΩ	10 µA
2 MΩ	200 kΩ < R ≤ 2 MΩ	1 Ω	1 µA
20 MΩ	2 MΩ < R ≤ 20 MΩ	10 Ω	100 nA
200 MΩ	20 MΩ < R ≤ 200 MΩ	100 Ω	10 nA

1. The resistance measurement range is effective for the resistance measurements set to the AUTO mode which is selected by the :SENS:RES:MODE command.

Specifications

This chapter lists specifications and supplemental information for the Agilent B2900 series. The specifications are the standards against which the B2900 is tested. When the B2900 is shipped from the factory, it meets the specifications.

Specification Conditions

The source and measurement accuracy are specified under the conditions listed below.

1. Temperature: 23 °C ± 5 °C
2. Humidity: 30 % to 80 % RH
3. After 60 minutes warm-up
4. Ambient temperature change less than ± 3 °C after self-calibration execution
5. Calibration period: 1 year
6. Measurement speed: 1 PLC (Power Line Cycle)

Maximum Voltage and Current

- Voltage output range: See Figure 2-2, Table 2-3, and Table 2-4.
- Current output range: See Figure 2-2, Table 2-2, and Table 2-4.

Source Specifications

- Voltage source specifications: See Table 2-8.
- Current source specifications: See Table 2-9.

Measurement Specifications

- Voltage measurement specifications: See Table 2-10.
- Current measurement specifications: See Table 2-11.

Table 2-8 Voltage Source Specifications

Range	Programming resolution		Accuracy (gain error (% of reading) + offset error)	Noise [a] (peak-peak) 0.1 Hz to 10 Hz	Maximum voltage (over range)
	B2901A B2902A	B2911A B2912A			
±200 mV	1 µV	0.1 µV	±(0.015 % + 225 µV)	≤ 10 µV	±210 mV
±2 V	10 µV	1 µV	±(0.02 % + 350 µV)	≤ 20 µV	±2.1 V
±20 V	100 µV	10 µV	±(0.015 % + 5 mV)	≤ 200 µV	±21 V
±200 V	1 mV	100 µV	±(0.015 % + 50 mV)	≤ 2 mV	±210 V

a. Supplemental characteristics

Table 2-9 Current Source Specifications

Range	Programming resolution		Accuracy (gain error (% of reading) + offset error)	Noise [a] (peak-peak) 0.1 Hz to 10 Hz	Maximum current (over range)
	B2901A B2902A	B2911A B2912A			
±10 nA[b]	—	10 fA	±(0.10 % + 50 pA)	≤ 1 pA	±10.5 nA
±100 nA	1 pA	100 fA	±(0.06 % + 100 pA)	≤ 2 pA	±105 nA
±1 µA	10 pA	1 pA	±(0.025 % + 500 pA)	≤ 25 pA	±1.05 µA
±10 µA	100 pA	10 pA	±(0.025 % + 1.5 nA)	≤ 60 pA	±10.5 µA
±100 µA	1 nA	100 pA	±(0.02 % + 25 nA)	≤ 2 nA	±105 µA
±1 mA	10 nA	1 nA	±(0.02 % + 200 nA)	≤ 6 nA	±1.05 mA
±10 mA	100 nA	10 nA	±(0.02 % + 2.5 µV)	≤ 200 nA	±10.5 mA
±100 mA	1 µA	100 nA	±(0.02 % + 20 µV)	≤ 600 nA	±105 mA
±1 A	10 µA	1 µA	±(0.03 % + 1.5 mA)	≤ 70 µA	±1.05 A
±1.5 A	10 µA	1 µA	±(0.05 % + 3.5 mA)	≤ 100 µA	±1.515 A
±3 A	100 µA	10 µA	±(0.4 % + 7 mA)	≤ 120 µA	±3.03 A
±10 A[c]	100 µA	10 µA	±(0.4 % + 25 mA)[d]	—	±10.5 A

a. Supplemental characteristics
b. 10 nA range is not available for B2901A/B2902A.
c. 10 A range is available only for pulse mode, not available for DC mode.
d. Measurement speed: 0.01 PLC

Table 2-10 **Voltage Measurement Specifications**

Range	Measurement resolution		Accuracy (gain error (% of reading) + offset error)
	B2901A B2902A	B2911A B2912A	
±200 mV	0.1 µV	0.1 µV	±(0.015 % + 225 µV)
±2 V	1 µV	1 µV	±(0.02 % + 350 µV)
±20 V	10 µV	10 µV	±(0.015 % + 5 mV)
±200 V	100 µV	100 µV	±(0.015 % + 50 mV)

Table 2-11 **Current Measurement Specifications**

Range	Measurement resolution		Accuracy (gain error (% of reading) + offset error)
	B2901A B2902A	B2911A B2912A	
±10 nA[a]	—	10 fA	±(0.10 % + 50 pA)
±100 nA	100 fA	100 fA	±(0.06 % + 100 pA)
±1 µA	1 pA	1 pA	±(0.025 % + 500 pA)
±10 µA	10 pA	10 pA	±(0.025 % + 1.5 nA)
±100 µA	100 pA	100 pA	±(0.02 % + 25 nA)
±1 mA	1 nA	1 nA	±(0.02 % + 200 nA)
±10 mA	10 nA	10 nA	±(0.02 % + 2.5 µV)
±100 mA	100 nA	100 nA	±(0.02 % + 20 µV)
±1 A	1 µA	1 µA	±(0.03 % + 1.5 mA)
±1.5 A	1 µA	1 µA	±(0.05 % + 3.5 mA)
±3 A	10 µA	10 µA	±(0.4 % + 7 mA)
±10 A[b]	10 µA	10 µA	±(0.4 % + 25 mA)[c]

a. 10 nA range is not available for B2901A/B2902A.
b. 10 A range is available only for pulse mode, not available for DC mode.
c. Measurement speed: 0.01 PLC

Source Supplemental Characteristics

- Temperature coefficient (0 °C to 18 °C and 28 °C to 50 °C):

  ±(0.1 × Accuracy specification) / °C

- Maximum output power and source/sink limits:

  31.8 W. ±6 V@ ±3.03 A, ±21 V@ ±1.515 A, ±210 V@ ±105 mA, four quadrant source or sink operation.

- Current limit/compliance:

  Accuracy is same as current source. Minimum value is 1 % of range, or 1 nA in 10 nA range.

- Voltage limit/compliance:

  Accuracy is same as voltage source. Minimum value is 1 % of range, or 20 mV in 200 mV range.

- Over range:

  101 % of source range for 1.5 A and 3 A ranges. 105 % of source range other than 1.5 A and 3 A ranges. No over range for 200 V range with current exceeding 105 mA pulse only condition.

- Over temperature protection:

  Turns off all channel outputs and locks the causal channel at over temperature sensed internally.

- Voltage output settling time:

  Time required to reach within 0.1 % of final value at open load condition. Step is +10 % to +90 % range.

  200 mV and 2 V ranges: < 50 µs

  20 V range: < 110 µs

  200 V range: < 700 µs

- Current output settling time:

  Time required to reach within 0.1 % (0.3 % for 3 A range) of final value at short condition. Step is +10 % to +90 % range.

  10 nA and 100 nA ranges: < 10 ms

  1 μA range: < 500 μs

  10 μA and 100 μA ranges: < 250 μs

  1 mA to 3 A ranges: < 80 μs

- Noise 10 Hz to 20 MHz (V source): 3 mVrms, 20 V range
- V source overshoot:

  < ±(0.1 % + 10 mV) Step is +10 % to +90 % range, resistive load.

- I source overshoot:

  < ±0.1 % (0.3 % for 3 A range) Step is +10 % to +90 % range, resistive load.

- Voltage source range change overshoot:

  ≤ 250 mV. 100 kΩ load, 20 MHz bandwidth

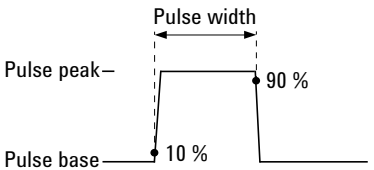
- Current source range change overshoot:

  ≤ 250 mV/R load, 20 MHz bandwidth

Pulse Source Supplemental Characteristics

- Minimum programmable pulse width: 50 μs
- Pulse width programming resolution: 1 μs
- Pulse width definition:

  The time from 10 % leading to 90 % trailing edge as follows.



- Maximum duty cycle and pulse width: See Table 2-12.
- Minimum pulse width at the given voltage, current, and settling conditions: See Table 2-13.

Measurement Supplemental Characteristics

- Temperature coefficient (0 °C to 18 °C and 28 °C to 50 °C):

  ±(0.1 × Accuracy specification) / °C

- Over range:

  102 % of measurement range for 1.5 A and 3 A ranges. 106 % of measurement range other than 1.5 A and 3 A ranges.

- Voltage measurement range change overshoot:

  < 250 mV. 100 kΩ load, 20 MHz bandwidth

- Current measurement range change overshoot:

  < 250 mV/R load, 20 MHz bandwidth

- Derating accuracy for measurement speed less than 1 PLC:

  Add % of range using Table 2-14 for measurement with PLC < 1.

Triggering and Timing Specifications

Triggering (Supplemental Characteristics)

- Digital I/O trigger in to trigger out: ≤ 5 µs
- Digital I/O trigger in to source change: ≤ 5 µs
- LXI trigger in to source change: ≤ 200 µs

Timer

- Trigger timing resolution: 1 µs to 100 ms
- Timer accuracy: ±50 ppm
- Arm/trigger delay: 0 to 100000 s
- Arm/trigger interval:
  - B2901A/B2902A: 20 µs to 100000 s
  - B2911A/B2912A: 10 µs to 100000 s
- Arm/trigger event: 1 to 100000
- Time stamp: TIMER value automatically saved when each measurement is triggered.

Table 2-12 Maximum Duty Cycle and Pulse Width

Maximum duty cycle	Pulse width	Maximum voltage	Maximum peak current	Maximum base current
99.9999 %	50 µs to 99999.9 s	6 V	3.03 A[a]	3.03 A[a]
		21 V	1.515 A[a]	1.515 A[a]
		210 V	0.105 A	0.105 A
2.5 %	50 µs to 1 ms	6 V	10.5 A	500 mA
	50 µs to 10 ms	180 V	1.05 A	50 mA
	50 µs to 2.5 ms	200 V	1.515 A	50 mA

a. Max current limitation: For 21 V/1.515 A and 6 V/3.03 A ranges, total max current is limited as shown in Table 2-4 for using 2 channels. Max current is not limited for using 1 channel only.

Table 2-13 Minimum Pulse Width at the Given Voltage, Current, and Settling Conditions

Source value	Limit value	Load	Source settling (% of range)	Minimum pulse width
200 V	1.5 A	200 Ω	0.1 %	1 ms
6 V	10.5 A	0.6 Ω	0.1 %	0.2 ms
1.5 A	200 V	65 Ω	0.1 %	2.5 ms
10.5 A	6 V	0.5 Ω	0.1 %	0.2 ms

Table 2-14 Derating Accuracy with PLC Setting < 1 PLC

PLC setting	Voltage range		Current range			
	0.2 V	2 V to 200 V	10 nA	100 nA	1 µA to 100 mA	1 A to 3 A
0.1 PLC	0.01 %	0.01 %	0.1 %	0.01 %	0.01 %	0.01 %
0.01 PLC	0.05 %	0.02 %	1 %	0.1 %	0.05 %	0.02 %
0.001 PLC	0.5 %	0.2 %	5 %	1 %	0.5 %	0.2 %

Other Supplemental Characteristics

Output Characteristics

- Sensing modes: 2-wire or 4-wire (remote-sensing) connections
- Low terminal connection: Chassis grounded or floating
- Output connectors:

  Banana jack. Triaxial connections are recommended for sourcing and measuring less than 1 nA. A banana jack to triaxial adapter is available for low current measurement.
- Output location: Channel 1 at front and channel 2 at rear
- Maximum load:
  - Normal mode: 0.01 μF
  - High capacitance mode: 50 μF
- DC floating voltage: Maximum ±250 V DC between Low Force and chassis ground
- Guard offset voltage (V source): < 4 mV
- Remote sense operation range:
  - Maximum voltage between High Force and High Sense: 3 V
  - Maximum voltage between Low Force and Low Sense: 3 V
- Common mode isolation: > 1 GΩ, < 4500 pF
- Maximum sense lead resistance: 1 kΩ for rated accuracy
- Sense input impedance: > 10 GΩ

High Capacitance Mode

The high capacitance mode permits the measurement of devices with capacitances greater than the normal mode maximum load value of 0.01 µF. In high capacitance mode, the maximum allowed value of the load capacitance is 50 µF.

- Voltage output settling time:

  Time required to reach within 0.1 % of final value with 4.7 µF capacitive load on a fixed range at specified current limit value.

  200 mV and 2 V Ranges: 600 µs, at 1 A limit

  20 V Range: 1.5 ms, at 1 A limit

  200 V Range: 20 ms, at 100 mA limit

- Current measurement settling time:

  Time required to reach within 0.1 % of final value after voltage source is stabilized on fixed range. Vout is 5 V unless noted.

  1 µA range: 230 ms

  10 µA and 100 µA ranges: 23 ms

  1 mA and 10 mA ranges: 0.23 ms

  100 mA to 3 A ranges: 100 µs

- Mode change delay:

  - Delay into High Capacitance mode:

    1 µA range: 230 ms

    10 µA and 100 µA ranges: 23 ms

    1 mA to 3 A ranges: 1 ms

  - Delay out of High Capacitance mode:

    All ranges: 10 ms

- Noise 10 Hz to 20 MHz (20 V range): 4.5 mVrms
- Voltage source range change overshoot (20 V range or below):

  < 250 mV, 20 MHz bandwidth

- High Capacitance mode working conditions:
  - V/I mode: Voltage source mode only
  - Range: Current measurement range is limited to fixed range only. 10 nA and 100 nA ranges are not available.
  - Current limit: ≥ 1 μA

Resistance Measurement

Resistance measurement can be performed under either auto or manual test conditions. Auto resistance measurement is performed in current source and voltage measurement mode. The total auto resistance measurement error is shown in Table 2-15. The total error of a manual resistance measurement can be calculated using the voltage and current accuracy information as shown below.

- Source I mode, manual ohm measurement (4-wire):

  Total error = Vmeasure / Isource = R reading × (gain error of V range + gain error of I range + offset error of I range / I source value × 100) % + (offset error of V range / I source value)

  where, gain error and offset error can be given by Table 2-9 and Table 2-10.

- Source V mode, manual ohm measurement (4-wire):

  Total error = Vsource / Imeasure = 1/ [1/R reading × (gain error of I range + gain error of V range + offset error of V range / V source value × 100) % + (offset error of I range / V source value)]

  where, gain error and offset error can be given by Table 2-8 and Table 2-11.

- Measurement speed = 1 PLC
- Applicable for temperature: 23 °C ± 5 °C
- Example of total error calculation:

  I source value = 1 mA at 1 mA range

  V measure range = 2 V range

  Total error (% reading + offset) = (0.02 % + 0.02 % + 200 nA/1 mA × 100) % + (350 μV/1mA) = 0.06 % + 0.35 Ω

System Speeds

- Maximum sweep operation reading rates (reading/second) for 50 Hz: See Table 2-16.

Table 2-15 **Typical Performance of Auto Resistance Measurement (4-wire), 2 V range**

Range	Display resolution	Test current	Current range	Total error (% reading + offset)
2 Ω	1 μΩ	1A	1A	0.2 % + 0.00035 Ω
20 Ω	10 μΩ	100 mA	100 mA	0.06 % + 0.0035 Ω
200 Ω	100 μΩ	10 mA	10 mA	0.065 % + 0.035 Ω
2 kΩ	1 mΩ	1 mA	1 mA	0.06 % + 0.35 Ω
20 kΩ	10 mΩ	100 μA	100 μA	0.065 % + 3.5 Ω
200 kΩ	100 mΩ	10 μA	10 μA	0.06 % + 35 Ω
2 MΩ	1 Ω	1 μA	1 μA	0.095 % + 350 Ω
20 MΩ	10 Ω	100 nA	100 nA	0.18 % + 3.5 kΩ
200 MΩ	100 Ω	10 nA	100 nA	1.08 % + 35 kΩ

Table 2-16 **Maximum Sweep Operation Reading Rates (reading/second) for 50 Hz**

Measure speed	Measure to memory	Measure to GPIB	Source measure to memory	Source measure to GPIB
< 0.001 PLC	20000	12500	19500	12500
0.01 PLC	4500	3950	4500	3950
0.1 PLC	500	490	500	490
1 PLC	49	49	49	49

Operation reading rate varies with number of sweep steps 1 to 2500.

General Specifications

- Environment

  For use in indoor facilities

- Temperature range

  Operating 0 °C to +55 °C

  Storage −30 °C to +70 °C

- Humidity range

  Operating 30 % to 80 %RH, non-condensing

  Storage 10 % to 90 %RH, non-condensing

- Altitude

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

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

- Power requirement: 90 V to 264 V, 47 Hz to 63 Hz
- Maximum volt-amps (VA): 250 VA
- Cooling

  Forced air. Side intake and rear exhaust.

- Regulatory compliance

  EMC IEC61326-1 / EN61326-1
  AS/NZS CISPR 11

  Safety IEC61010-1 / EN61010-1
  CAN/CSA-C22.2 No. 61010-1-04, C/US

- Certifications: CE, cCSAus, C-Tick
- Dimensions

  Without handle and feet: 88 mm (H) × 213 mm (W) × 450 mm (D)

  Bench configuration (with handle and feet): 180 mm (H) × 260 mm (W) × 480 mm (D)

- Weight

  B2901A/B2911A: 5.0 kg

  B2902A/B2912A: 6.4 kg

Operation and Functions

Front Panel Interface

4.3” color TFT WQVGA (480×272, with LED backlight) provides a graphical user interface (GUI) with the following features.

- 4-view modes (Single, Dual, Graph, Roll view)
- Easy-to-use key operations
- Easy access to basic and advanced source/measurement capabilities

Single view

Single view provides basic and advanced settings and display capabilities for the selected channel from the front panel of the instrument. No additional controller or software is required.

Dual view

Dual view provides the basic settings and display capabilities for both channels 1 and 2. Up to 6½ digits can be displayed in the Dual view mode. This mode is available only for the B2902A and B2912A.

Graph View

Graph View displays measurement results on XY graphs (such as I-V and I-t/V-t curves) on up to 2 channels. This is useful for quick evaluation of device characteristics, especially those obtained from sweep measurements.

Roll View

Roll view draws I-t or V-t curves similar to the curves drawn by a strip chart recorder. Up to 1000 acquired data points can be displayed and updated while the measurement is still in progress. Roll view’s continuous measurement capability is especially useful for monitoring low frequency phenomena. Roll view is available only for the B2911A and B2912A.

Easy-to-use Key Operations

- Numeric/alpha keys, assist keys, and rotary knob for easy operation
- Numeric/alpha keys enable direct input of alphanumeric values.
- Assist key guides operation on the front panel.

Easy Access to Source/Measurement Capabilities

- Settings:
  - V/I source mode
  - Source value
  - Limit (Compliance) value
  - Sweep parameters
  - Pulse parameters
  - Measure speed
  - Range setting
  - Trigger setting
- Result Displays:
  - Numeric results fully up to 6½ digits both in Single and Dual view modes
  - Characterization in Graph view and Roll view
  - Data list
- Advanced Capabilities:
  - Limit testing by user definable limits working with component handlers
  - Trace memory for accumulating measurement (or math) result and collecting their statistics
- File Operations (USB memory):

  Save:
  - System configuration
  - Measurement/Math result
  - Limit test result
  - Trace data
  - Graph screen dump

  Load:
  - System configuration
  - List sweep data

Source/Measurement Capabilities

Sweep Measurement

- Number of steps: 1 to 2500
- Sweep mode: linear, logarithmic (log), or list
- Sweep direction: single or double
- Type: DC or pulse
- Minimum programmable value to create list sweep waveform:

  B2901A/B2902A: 20 µs with 1 µs resolution

  B2911A/B2912A: 10 µs with 1 µs resolution

Digitizing/Sampling Measurement

Digitizing/sampling measurement can be performed by appropriate setting of measure speed and trigger interval.

Minimum trigger interval (maximum speed of measurement):

B2901A/B2902A: 20 µs (50000 points/s)

B2911A/B2912A: 10 µs (100000 points/s)

Data Buffers

Data buffers are array of measurement elements. Each elements hold the following values.

- Measured voltage
- Measured current
- Measured resistance
- Time stamp
- Measurement status
- Source setting

Maximum buffer size: 100000 points/channel

Program and Interface Capabilities

Programming Language

The B2900 supports SCPI (Standard Commands for Programmable Instruments).

- Default command set: Supports all of the advanced features of the B2900.
- Conventional command set: Supports industry standard conventional SCPI command set for basic compatibility.

Program Memory

Program memory allows you to store long strings of SCPI command lines once into the built-in volatile memory and then recall those strings multiple times while the program is executing using a single SCPI command. By storing the command strings in memory, the time that would have been spent sending those same commands over a communication bus is eliminated. For tests that utilize lots of repeated code (such as subroutines), program memory can dramatically reduce test times.

- Maximum number of characters of program name: 32 with alphabets, numbers, hyphens, and underscores
- Maximum memory size: 100 KB (2500 lines typical)

LXI

LXI Class-C compliant. The B2900 follows specified LAN protocols and adhere to LXI requirements such as a built-in Web control server and IVI-COM driver.

- Ethernet: 10/100Base-T
- USB2.0: USB-TMC488 protocol (rear × 1)
- GPIB: IEEE-488.2 compliant

USB File System

USB 2.0 high-speed mass storage (MSC) class device (front × 1)

Digital I/O Interface

- Connector: 25-pin female D
- Input/output pins: 14 open drain I/O bits
- Absolute maximum input voltage: 5.25 V
- Absolute minimum input voltage: −0.25 V
- Maximum logic low input voltage: 0.8 V
- Minimum logic high input voltage: 2.0 V
- Maximum source current: 1 mA, Vout = 0 V
- Maximum sink current: 50 mA, Vout = 5 V
- 5 V power supply pin:

  Limited to 600 mA, solid state fuse protected
- Safety interlock pin:

  One active high pin and one active low pin. Activation of both pin enables output voltage > 42 V.

Software and Drivers

- Agilent B2900A Quick I/V Measurement Software

  The B2900 includes PC-based Agilent B2900A Quick I/V Measurement Software. This powerful software makes it easy to quickly setup and perform I/V measurements and to display the measurement data in a table or graph without the need to perform any programming. The software allows you to control up to four SMU channels over a GPIB or LAN connection, or one B2900 unit via a USB connection.

  Operating System: Windows 7 (64 bit/32 bit), XP SP3 (32 bit)

  Other requirements: Microsoft .NET framework 4.0 or later and Agilent IO Libraries 16.0 or later

- Agilent B2900A Graphical Web Interface

  The Agilent B2900A Graphical Web Interface is a web browser based instrument control panel. It enables you to set up and perform a measurement easily and quickly from a web browser using the built-in web server. This allows you to control one B2900 unit over a LAN connection.

- IVI-C or IVI-COM drivers

  Compatible with Windows 7 (64 bit/32 bit), XP SP2 (32 bit) IO Libraries 16.0 or later. Supports Agilent VEE, Microsoft Visual Studio (Visual Basic, Visual C++, Visual C#), National Instruments LabWindows and LabVIEW.

- LabVIEW driver (VI)

  National Instruments LabVIEW 7.0 or later. LabView drivers are available at NI.COM.

NOTE

For the latest system requirements, go to www.agilent.com and type in B2900A in the Search field at the top of the page.

Accessories

Furnished Accessories

The Agilent B2900 is furnished with the following accessories.

- Quick Reference, 1 ea.
- Product Reference CD-ROM, 1ea.
- Agilent IO Libraries CD-ROM, 1ea.
- Power cord, 1 ea.
- USB cable, 1 ea.

The Product Reference CD-ROM stores Agilent B2900A Quick I/V Measurement Software, sample programs, user manuals, and application notes.

Available Accessories

Table 2-17 lists the available accessories for the Agilent B2900.

Table 2-17 Available Accessories

Model Number	Option Item	Description
N1294A		Accessories
	N1294A-001	Banana to triaxial adapter for 2-wire connections
	N1294A-002	Banana to triaxial adapter for 4-wire connections
	N1294A-011	Interlock cable for 16442B, 1.5 m
	N1294A-012	Interlock cable for 16442B, 3.0 m
N1295A		Device/Component Test Fixture

Model Number	Option Item	Description
16442B		Test Fixture
	16442B-010	Add triaxial cables, 1.5 m, 4 ea.
	16442B-011	Add triaxial cables, 3 m, 4 ea.
	16442B-800	Extra blank Teflon™ board
	16442B-801	Universal socket module, 0.1 inch pitch, with 10 pins
	16442B-802	Universal socket module, 0.075 inch pitch, with 10 pins
	16442B-803	Universal socket module, 0.05 inch pitch, with 10 pins
	16442B-810	Extra pin set (for universal socket module, 10 pins.)
	16442B-811	Extra wire set (mini banana to pin plug, 6 ea.)
	16442B-812	Extra wire set (pin plug to pin plug, 6 ea.)
	16442B-813	Extra wire set (mini banana to mini clip, 6 ea.)
	16442B-814	Extra wire set (mini banana to mini banana, 6 ea.)
	16442B-821	Socket module, 4-pin TO package
	16442B-822	Socket module, 18-pin DIP package
	16442B-823	Extra socket module, 28-pin DIP package
	16442B-890	Extra accessory case
16493G		Digital I/O Connection Cable
	16493G-001	1.5 m length
	16493G-002	3.0 m length
16494A		Triaxial Cable
	16494A-001	1.5 m length
	16494A-002	3 m length
	16494A-003	80 cm length

Options

Table 2-18 lists the options for the Agilent B2900.

Table 2-18 Options

Option	Description
Calibration	
A6J	ANSI Z540 compliant calibration
UK6	Commercial calibration certificate with test data
Printed Manual (User's Guide)	
AB0	Traditional Chinese
AB2	Simplified Chinese
ABA	English
ABJ	Japanese
Rack Mount Kit	
1CM	Rack mount kit

3 Installation

This chapter describes how to install Agilent B2900 and accessories and consists of the following sections.

- “Inspecting the Shipment”
- “Installing the Agilent B2900”
- “Maintenance”
- “Connecting a DUT”
- “Installing the Interlock Circuit”
- “Connecting to the Interfaces”
- “Communicating Over the LAN”
- “Using Digital I/O”

WARNING ⚠ **There are potentially hazardous voltages (±210 V) present at the High Force, High Sense, and Guard terminals of Agilent B2900. To prevent electrical shock, the following safety precautions must be observed during the use of the B2900.**

- **Use a three-conductor AC power cord to connect the cabinet (if used) and the B2900 to an electrical ground (safety ground).**
- **If you do *not* use the Agilent 16442B test fixture, you must install and connect an interlock circuit that opens the interlock terminal when the shielding box access door is opened.**
- **Confirm periodically that the interlock function works normally.**
- **Before touching the connections on the High Force, High Sense, and Guard terminals, turn the B2900 off and discharge any capacitors. If you do *not* turn the B2900 off, complete *all* of the following items, regardless of the B2900 settings.**
  - **Press the On/Off switch, and confirm that the switch turns off.**
  - **Confirm that the On/Off switch does not turn red.**
  - **Open the shielding box access door (open the interlock terminal).**
  - **Discharge any capacitors connected to a channel.**
- **Warn persons working around the B2900 about dangerous conditions.**

Inspecting the Shipment

Perform the following inspections when the Agilent B2900 and accessories arrive at your site.

1. Before unpacking any component, 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 your nearest Agilent Sales and Support Office.

2. When you open the boxes that contain the B2900 and accessories, check the components against the contents lists attached to the boxes.

   If anything is missing, contact your nearest Agilent Sales and Support Office.

3. Verify the operation of B2900 as described in “Checking the Operation of Agilent B2900”.

   If any problem occurs, contact your nearest Agilent Sales and Support Office.

Checking the Operation of Agilent B2900

1. Make sure that the line switch is set to off.
2. Connect the power cord from the B2900’s rear panel AC input connector (receptacle) to an AC power outlet at your site.
3. Press the line switch to turn on the instrument.

   The initialization screen will appear on the B2900’s front panel display, and the power-on self-test is automatically executed.

   If the B2900 is operating normally, the front panel LCD displays as shown in Figure 3-1 or 3-2.

Figure 3-1 **Display Example for 1-ch Model**

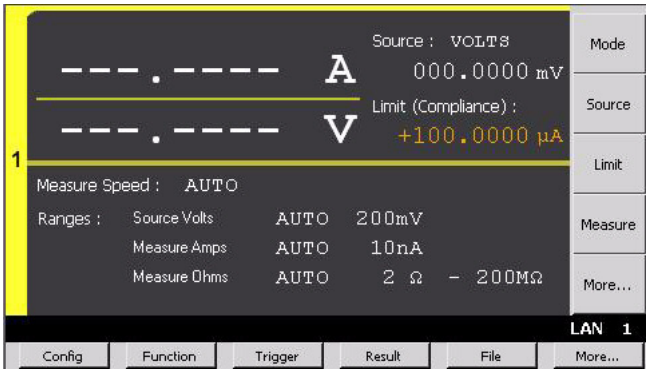
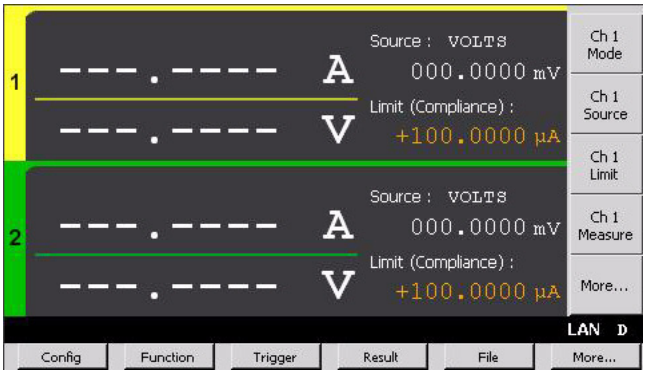


Figure 3-2 **Display Example for 2-ch Model**



Checking for Errors

Errors can be checked as described below.

1. Press the More > System > Error > Log function keys. This opens the Error Log dialog box.
2. Check the errors displayed on the dialog box.

   If no error is detected, “0, No Error” is displayed.
3. Press the OK softkey to close the dialog box.

Installing the Agilent B2900

This section describes information you must pay attention to when installing the Agilent B2900.

- "Safety Considerations"
- "Environment"
- "Connecting the Power Cord"
- "Setting the Power Line Frequency"
- "Bench Installation"
- "Rack Installation"

Safety Considerations

Refer to the Safety Summary page at the beginning of this guide for general safety information. Before installation or operation, check the B2900 and review this guide for safety warnings and instructions. Safety warnings for specific procedures are located at appropriate places throughout this guide.

Environment

WARNING **Do not operate the instrument in the presence of flammable gasses or fumes**

Environmental conditions for B2900 are documented in "General Specifications" on page 2-27. In principle, B2900 should only be operated indoors in a controlled environment.

The dimensions of B2900 are also given in "General Specifications". 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.

Connecting the Power Cord

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

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

NOTE

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

Connect the power cord to the IEC 320 connector on the rear of the instrument. If the wrong power cord was shipped with your instrument, contact your nearest Agilent 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.

Setting the Power Line Frequency

The power line frequency must be set properly for the AC power at your site. Press the following function keys to set the frequency to 50 Hz or 60 Hz.

- For setting to 50 Hz: More > System > PLC > 50 Hz
- For setting to 60 Hz: More > System > PLC > 60 Hz

Bench Installation

Do not block the air intake at the sides and the exhaust at the rear of the B2900. Minimum clearances for bench operation are 5 mm along the sides and 100 mm along the back.

For easier display viewing and measurement terminal access, you can tilt up the front of the instrument by turning the handle. To adjust the handle, grab the handle by the sides and pull outward. Then, rotate the handle to the desired position.

Rack Installation

NOTE Use the Rack Mount kit (Option 1CM) to rack mount the Agilent B2900.

Agilent B2900 can be mounted in a 19-inch EIA rack cabinet. It is designed to fit in two rack-units (2U) of space.

Remove the front and rear rubber bumpers and the handle before rack mounting the B2900.

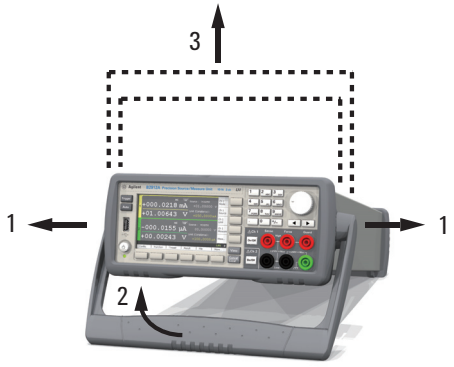
Do not block the air intake at the sides and the exhaust at the rear of the B2900.

Removing the Bumper

Stretch a corner of the rubber bumper and slide it off.

Removing the Handle

1. Grab the handle by the sides and pull outward. This will allow you to rotate the handle.
2. Rotate the handle to a vertical position. Then, position the instrument horizontally.
3. Pull outward and then lift the handle upward.



CAUTION When reattaching the handle, pay attention to its direction. Incorrect attachment may damage the hardware.

Maintenance

Maintenance should be performed periodically to keep the Agilent B2900 in good condition. If problems arise, contact your nearest Agilent Sales and Support Office.

- "Cleaning"
- "Self-test"
- "Self-calibration"
- "Calibration"

Cleaning

WARNING

SHOCK HAZARD: To prevent electric shock, unplug the B2900 before cleaning.

Use a dry cloth or a cloth slightly dampened with water to clean the external case parts. Do not use detergents or chemical solvents. Do not attempt to clean internally.

Self-test

Agilent B2900 provides the self-test function to check the operation. The self-test is automatically performed when the instrument is turned on. It is recommended to perform the self-test for the following condition or purpose. Before performing the self-test, turn the channel output off and disconnect test leads and cables from the terminals.

- If a channel is in the lock condition due to over temperature

  In this condition, the Emergency dialog box is displayed on the gray background screen, however this is not shown in the remote status if the remote display is set to OFF. And the ERR indicator turns on and the On/Off switch is not effective.

  Perform the self-test to unlock the channel. The channel can be used soon if the self-test does not report any problem.

- If you feel that the instrument may be defective
- For preventive maintenance

To perform self-test

The following procedure shows how to perform the self-test.

1. If it is in the remote state, press the Cancel / Local key.
2. Press the On/Off switch and confirm that the switch turns off.
3. Disconnect test leads and cables from the channel terminals.
4. Press the following function keys.

   More > System > Cal/Test > Self-Test

   Confirmation dialog box is opened.
5. Press the OK key. This starts the self-test.

Self-calibration

Agilent B2900 provides the self-calibration function to maintain the measurement performance. If the environmental temperature changes ±3 °C or more, perform the self-calibration. This is effective for the accurate measurements by minimizing the effect of thermal drift. The self-calibration must be performed after warming-up of 60 minutes. Before performing the self-calibration, turn the channel output off and disconnect test leads and cables from the terminals.

To perform self-calibration

The following procedure shows how to perform the self-calibration.

1. If it is in the remote state, press the Cancel / Local key.
2. Press the On/Off switch and confirm that the switch turns off.
3. Disconnect test leads and cables from the channel terminals.
4. Press the following function keys.

   More > System > Cal/Test > Self-Cal

   Confirmation dialog box is opened.
5. Press the OK key. This starts the self-calibration.

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 your nearest Agilent Sales and Support Office. Trained service personnel will perform the calibration and adjustments.

Connecting a DUT

This section describes how to connect a device under test (DUT) to the Agilent B2900 source/measure terminals.

NOTE

Set the channel output off when changing the connections. If not, the DUT may be damaged.

To set the channel output off, press the **On/Off** switch and confirm that the switch LED turns off.

This section includes the following descriptions.

- "2-Wire Connections or 4-Wire Connections"
- "Floating"
- "Using Test Leads"
- "Using the N1295A Test Fixture"
- "Using the 16442B Test Fixture"
- "Guarding"
- "Performing Low Current Measurements"

NOTE

Connecting the interlock circuit

B2900 provides an interlock function to prevent the user from receiving an electrical shock from high voltages over ±42 V. If the Digital I/O interlock terminal is open, B2900 *cannot* apply a high voltage.

For high voltage measurement, connect the interlock terminal to the interlock circuit as described in "Installing the Interlock Circuit" on page 3-19.

2-Wire Connections or 4-Wire Connections

When connecting a DUT, you can choose the connection type either 2-wire connections or 4-wire connections.

If you want to simplify the connections, use 2-wire connections by connecting the Force terminals only and opening the Sense terminals. The Force terminals can be used to apply and measure DC voltage or current.

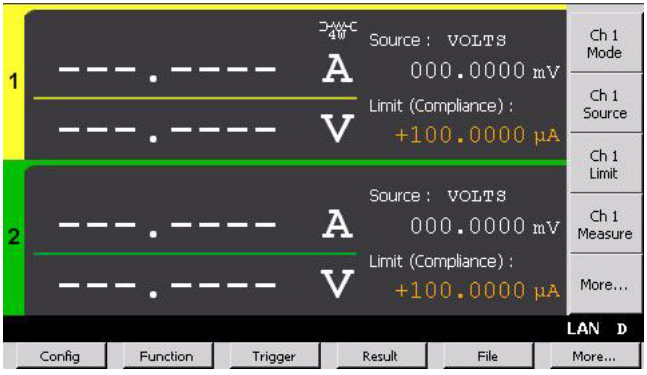
To make 4-wire connections, remote sensing, well known as Kelvin connections, use both Force and Sense terminals. Connecting the Force and Sense lines together at the terminal of the DUT minimizes the measurement error caused by the residual resistance of the test leads or cables. This connection is effective for low resistance measurements and high current measurements.

To specify the connection type (Sensing Type), perform the following procedure.

1. Press the Config > Source > Connection function keys. This opens the Output Connection dialog box.
2. Set the Sensing Type on this dialog box. Choose 2-WIRE for 2-wire connections, or 4-WIRE for 4-wire connections.
3. Press the OK softkey. For 4-wire connections, the following indicator appears on the Single view or the Dual view.

   4-wire connection indicator: 

Figure 3-3 **Dual View, 4-Wire Connection Setup for Channel 1**



Floating

With the default setting, Low Force and Low Sense terminals are connected to the chassis ground. However, they can be disconnected from the ground for floating measurements.

To specify the low terminal status, perform the following procedure. Setting is not saved. Turning off the instrument sets the status to the grounded.

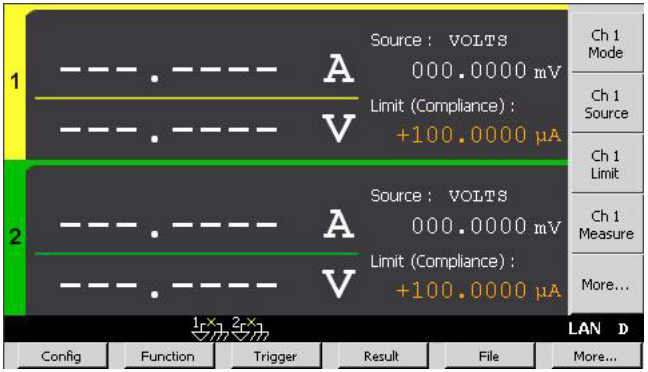
1. Press the Config > Source > Connection function keys. This opens the Output Connection dialog box.
2. Set the Low Terminal State on this dialog box. It must be FLOATING for the floating status, or GROUNDED for the grounded status.
3. Press the OK softkey.

   For the floating status, the following indicator appears on the status information area. And then the Low Force and Low Sense terminals can be connected to the maximum of ±250 V.

   Channel 1 floating status indicator: 

   Channel 2 floating status indicator: 

Figure 3-4 **Dual View, Floating Status for Channels 1 and 2**



CAUTION Do not apply current to the chassis ground. Doing so will damage the B2900.

WARNING **Potentially hazardous voltages of up to ±250 V may be present at the Low Force and Low Sense terminals. To prevent electrical shock, use accessories that comply with IEC 61010-2-031. The terminals and the extended conductors must be isolated by using insulation caps, sleeves, etc.**

Using Test Leads

B2900 source/measure terminals use banana jacks. For connecting a DUT, the following test leads are available. Figure 3-5 shows the connections for two-terminal device measurements.

- Agilent U8201A Combo Test Lead Kit

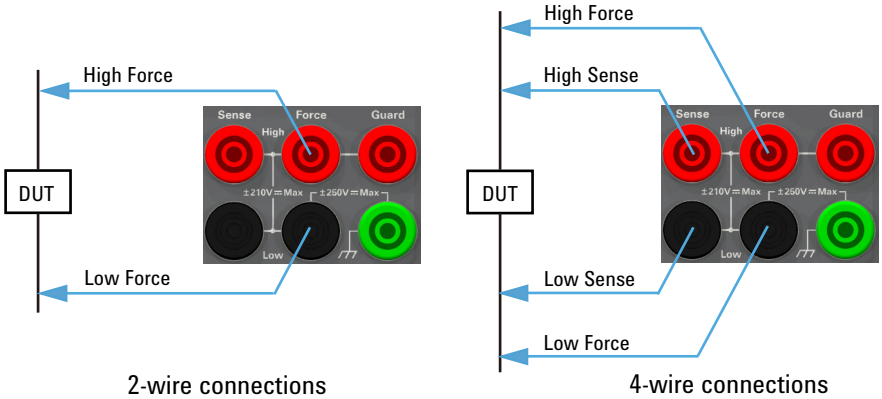
  Couple of test leads, test probes, alligator clips, SMT grabbers, fine-tips test probes, and banana plugs, CAT III 1000 V, 15 A maximum

  Two kits are required for 4-wire connections.

- Agilent 11059A Kelvin Probe Set

  Test leads for 4-wire connections, 42 V maximum

Figure 3-5 **Connecting a Two-Terminal Device**



Using the N1295A Test Fixture

Agilent N1295A is a test fixture which has four triaxial connectors and which supports two 2-wire connections.

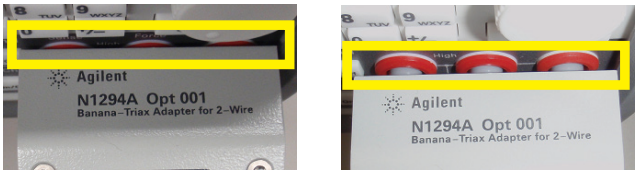
Requirements

- Agilent N1295A test fixture furnished with pin clip wire 4 ea. and pin plug wire 2 ea.
- Agilent N1294A-001 banana to triaxial adapter for 2-wire connections
- Triaxial cable, 2 ea. for one 2-wire connection

Connections

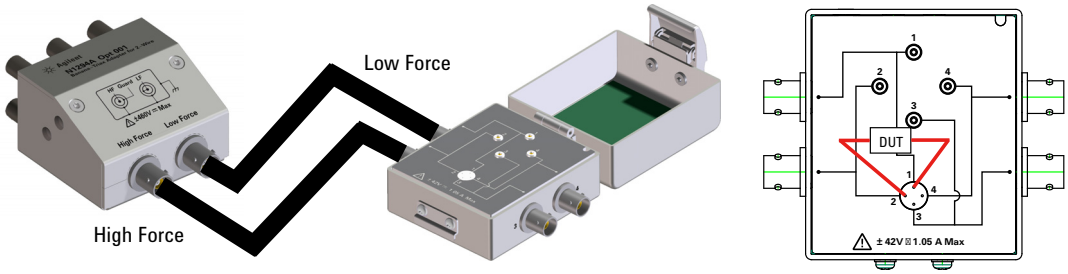
1. Attach the banana to triaxial adapter to the B2900 source/measure terminals. See Figure 3-6. If there is some space as “Bad connection”, the contact is not enough.
2. Connect the triaxial cables between the adapter and N1295A as shown in Figure 3-7.
3. Connect the DUT between terminals 1 and 2 for the example in Figure 3-7.

Figure 3-6 **Attaching Banana to Triaxial Adapter**



Good connection (no space) Bad connection

Figure 3-7 **Agilent N1295A Connection Example**



NOTE

Shielding

N1295A is equipped with a lid. To minimize the effect of ambient noise, close the lid when performing measurements.

CAUTION Maximum voltage and current

The test fixture and adapters must be used under the following limitations to prevent damage.

Agilent N1294A-001: ±250 V maximum, ±42 V maximum for connecting N1295A

Agilent N1294A-002: ±250 V maximum, ±42 V maximum for connecting N1295A

Agilent N1295A: ±42 V, 1.05 A maximum

Using the 16442B Test Fixture

Agilent 16442B is a test fixture which has six triaxial connectors for source/measure unit (SMU), the GNDU connector for the ground unit of a parameter/device analyzer, the Intlk connector for the interlock control, and six coaxial connectors for other instruments. See *Agilent 16442B User's Guide* for details and accessories of the 16442B.

Requirements

- Agilent 16442B test fixture furnished with pin clip wire, pin plug wire, etc.
- Agilent N1294A-001 banana to triaxial adapter for 2-wire connections
- Agilent N1294A-002 banana to triaxial adapter for 4-wire connections
- Triaxial cable, 2 ea. for 2-wire connections, and 3 ea. for 4-wire connections

NOTE Shielding

16442B is equipped with a lid. To minimize the effect of ambient noise, close the lid when performing measurements.

CAUTION Maximum voltage and current

The test fixture and adapters must be used under the following limitations to prevent damage.

Agilent N1294A-001: ±250 V maximum, ±200 V maximum for connecting 16442B

Agilent N1294A-002: ±250 V maximum, ±200 V maximum for connecting 16442B

Agilent 16442B: ±200 V, 1 A maximum for SMU input

Connections

1. Attach the banana to triaxial adapter to the B2900 source/measure terminals. See Figure 3-6. If there is some space as “Bad connection”, the contact is not enough.
2. Connect the triaxial cables between the adapter and the 16442B. Figure 3-8 shows a connection example.
3. Connect the DUT on the 16442B wiring panel by using the 16442B’s furnished accessories, socket module, blank board, and wire suitable for the DUT.

   Figure 3-9 shows the connection example for the connections of Figure 3-8.

   For 2-wire connections, connect the SMU 1 Force terminal to a DUT terminal, and connect the SMU 2 Force terminal to the other DUT terminal.

   For 4-wire connections, connect the SMU 1 Force and Sense terminals to a DUT terminal. And connect the SMU 3 Sense and Guard terminals to the other DUT terminal if the adapter’s Low Force/Low Sense connector is connected to the SMU 3 Sense connector. The Low Force signal appears on the Guard terminal.

Figure 3-8 **Connection Example between N1294A and 16442B**

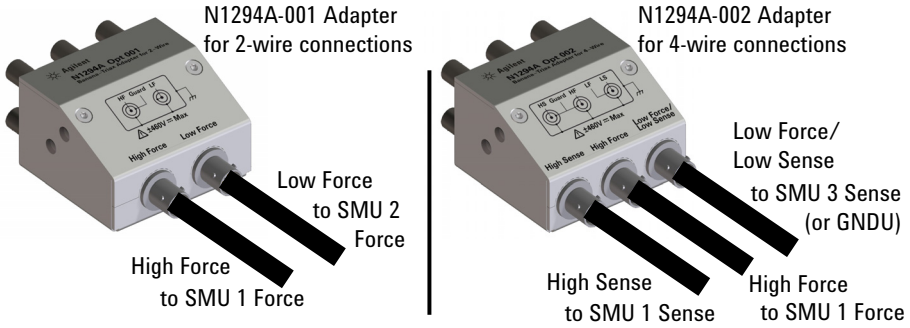
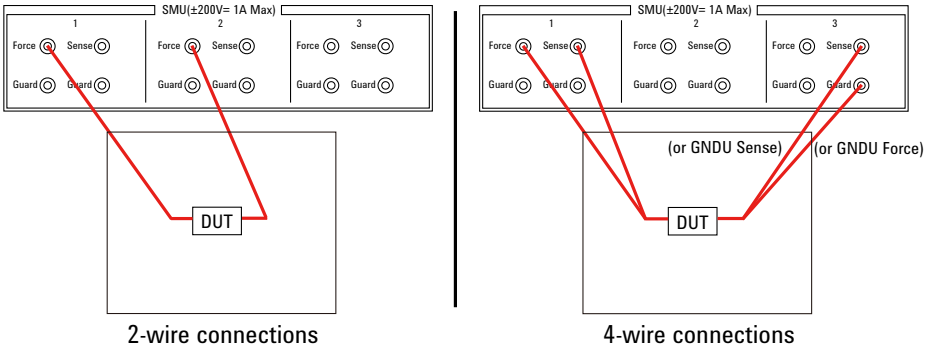


Figure 3-9 **Connection Example of 16442B Wiring Panel**



NOTE

Performing high voltage measurement

When the Digital I/O interlock terminal is open, B2900 cannot apply high voltage over ±42 V. To perform high voltage measurements, B2900 must be connected to the interlock circuit installed in 16442B.

Prepare the N1294A-011 or 012 interlock cable, and connect it between the B2900 Digital I/O connector and the 16442B Intlk connector. B2900 can apply a high voltage when the test fixture lid is closed.

WARNING

Potentially hazardous voltages of up to ±210 V may be present at the High Force, High Sense, and Guard terminals when the 16442B test fixture lid is closed. To prevent electrical shock, do *not* expose these lines.

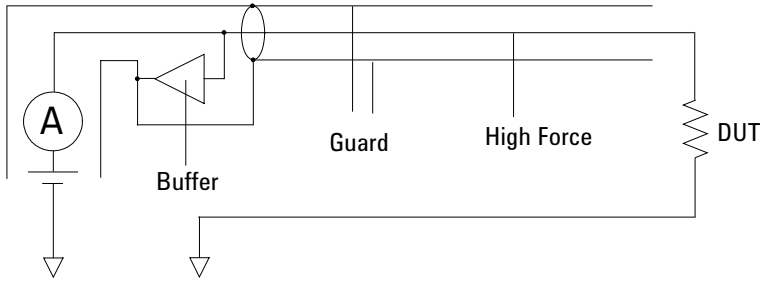
Guarding

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

Figure 3-10 shows the theory of guarding. The buffer amplifier (×1) keeps the potential of the Guard conductor at the same potential as the High Force conductor, so that the current does not flow between the High Force and Guard conductors. Therefore, the current measured by the instrument is the same as the current at the DUT terminal because no current is leaked.

For the connection examples shown in Figures 3-7 and 3-8, the guard is extended to the test fixture input connectors with triaxial cables.

Figure 3-10 **Guarding**



CAUTION Never connect the Guard terminal to any output, including circuit common, chassis ground, or any other guard terminal. Doing so will damage the B2900.

Performing Low Current Measurements

With the default setting, 10 nA and 100 nA measurement ranges are not used. For the low current measurements, the measurement range settings must be changed.

To change the measurement range

1. Press the View key to display the Single view.

   If the Range parameters are not displayed in the lower half of the Single view, press the More, Hide Sweep, Hide Pulse, or Hide Trigger assist key to display the Range parameters.

2. Change the setting of the Measure Amps field of the Range parameters.

   Set AUTO for the auto ranging or FIXED for the fixed range.

   Set 10 nA or 100 nA for the minimum or fixed measurement range.

Installing the Interlock Circuit

The interlock circuit is a simple electric circuit, as shown in Figure 3-11. The circuit electrically opens when an access door is opened, and closes when the door is closed.

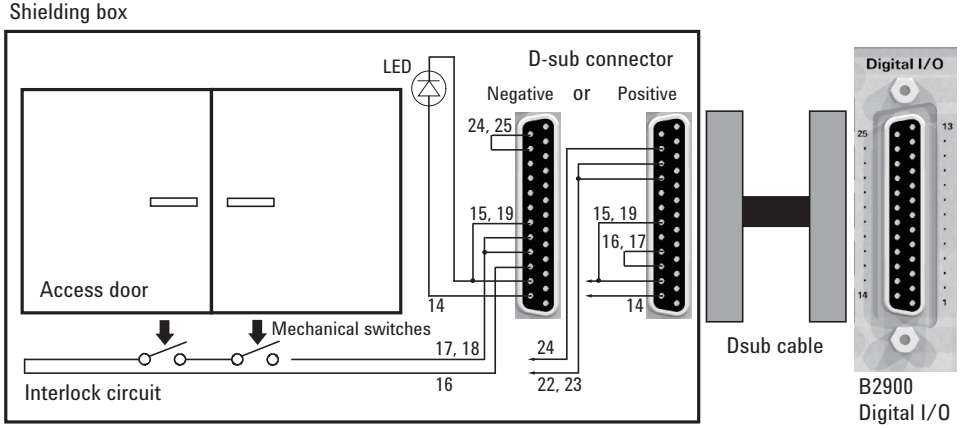
B2900 cannot apply high voltages over ±42 V when the Digital I/O interlock terminal is open. To perform high voltage measurements, the B2900 interlock terminal must be connected to the interlock circuit installed in the measurement environment such as the shielding box. The interlock circuit is important and necessary to prevent electrical shock when the user touches the measurement terminals.

WARNING **Potentially hazardous voltages of up to ±210 V may be present at the High Force, High Sense, and Guard terminals when the interlock circuit is closed. To prevent electrical shock, do *not* expose these lines.**

Requirements

- LED (Agilent part number 1450-0641), 1 ea.
- Mechanical switch (Agilent part number 3101-0302 or 3101-3241), 2 ea.
- 25-pin D-sub connector (for wiring, mounted on the shielding box), 1 ea.
- Connection wire
- 25-pin D-sub cable, 1 ea.

Figure 3-11 Interlock Circuit



Procedure

1. Mount two mechanical switches onto your shielding box, so that the switches close when the access door is closed, and open when the door is opened. See Figure 3-13 and Figure 3-14 for the switch dimensions.
2. Mount an LED onto your shielding box. See Figure 3-12 for the LED dimensions.

   The LED is used as a high voltage indicator which is lit when B2900 is in the high voltage output status.
3. Mount a D-sub connector onto your shielding box.
4. Use a wire and short the following pins of the D-sub connector. See Figure 3-11 for a connection example.

   For the negative logic: Pins 24 and 25

   For the positive logic: Pins 16 and 17
5. Use a wire and connect the two switches in series between the following pins of the D-sub connector. See Table 3-1 for the Digital I/O pin assignment.

   For the negative logic: Pins 16 and some ground pins

   The ground pins are pin numbers 15 and 17 to 21.

   For the positive logic: Pins 24 and some +5 V pins

   The +5 V pins are pin numbers 22, 23, and 25.
6. Use a wire and connect the LED between pin 14 and some ground pins of the D-sub connector. Then set pin 14 to HIGH VOLTAGE LAMP. See “DIO Configuration dialog box” on page 4-46.

Figure 3-12 **Dimensions of the LED (Agilent part number 1450-0641)**

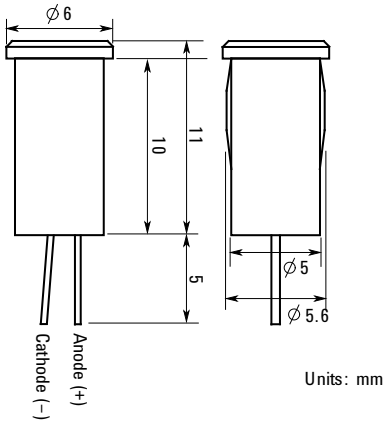


Figure 3-13 **Dimensions of the Interlock Switch (Agilent part number 3101-0302)**

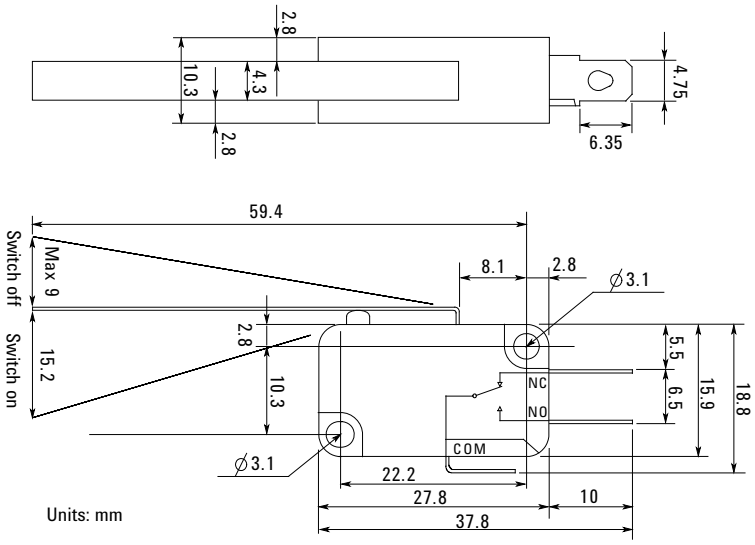
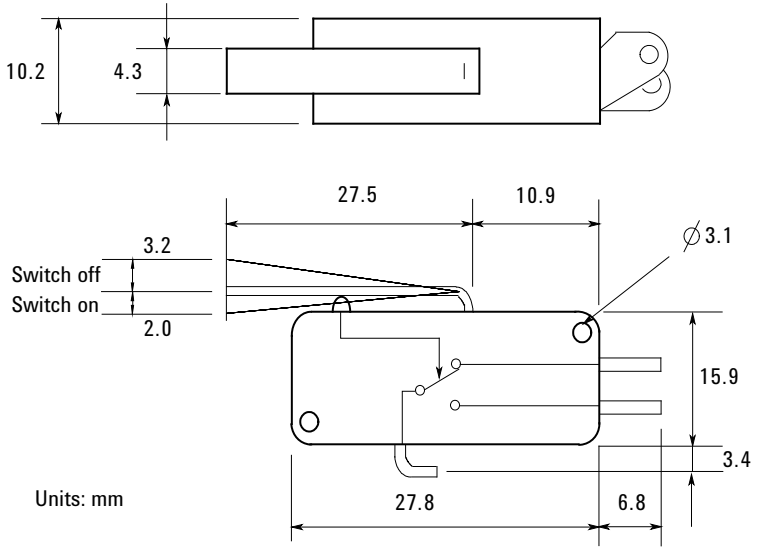


Figure 3-14 **Dimensions of the Interlock Switch (Agilent part number 3101-3241)**



Connecting to the Interfaces

CAUTION Electrostatic discharges greater than 1 kV near the interface connectors may cause the unit to reset and require operator intervention.

B2900 supports GPIB, LAN, and USB interfaces. All three interfaces are live at power-on. Connect your interface cable to the appropriate interface connector. Information on configuring the interfaces can be found later in this section.

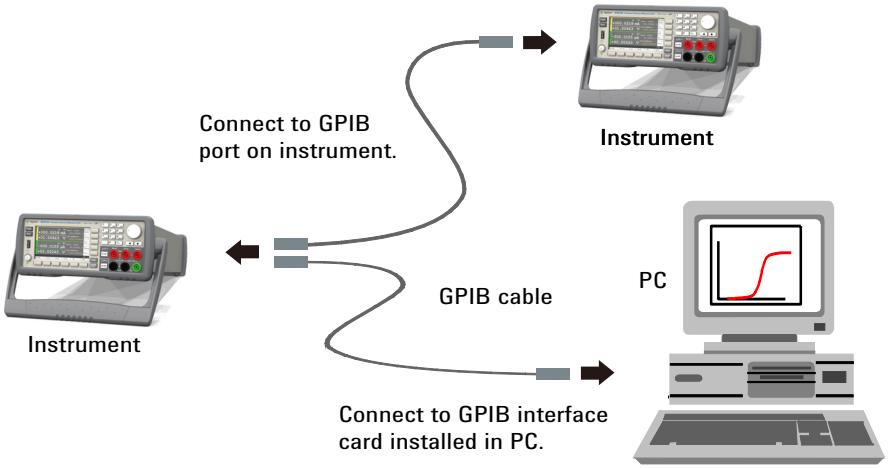
The front panel LAN indicator is lit when the LAN port is connected and configured.

B2900 provides Ethernet connection monitoring. With Ethernet connection monitoring, the instrument's LAN port is continually monitored and automatically reconfigured.

GPIB/USB Interfaces

NOTE For detailed information about GPIB and USB interface connections, refer to *Connectivity Guide* installed with the Agilent IO Libraries.

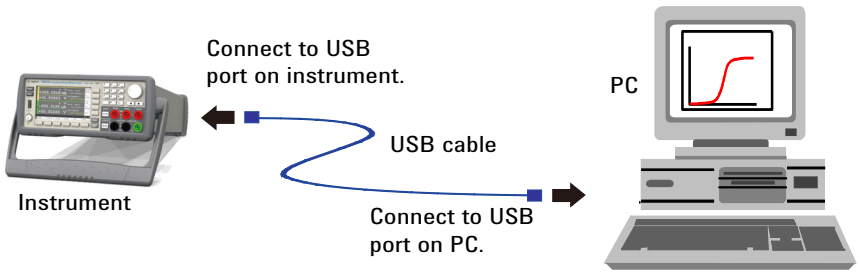
The following steps will help you quickly get started connecting your instrument to the GPIB (General Purpose Interface Bus). The following figure illustrates a typical GPIB interface system.



1. If you have not already done so, install the Agilent IO Libraries Suite from the CD shipped with your product.
2. If you do not have a GPIB interface card installed on your computer, turn off your computer and install the GPIB card.
3. Connect your instrument to the GPIB interface card using a GPIB interface cable.
4. Use the Connection Expert utility from the Agilent IO Libraries Suite to configure the installed GPIB interface card's parameters.
5. B2900 is shipped with its GPIB address set to 23. To view or change the GPIB address, press the More function key, then the I/O > GPIB softkeys. The GPIB Configuration dialog box appears.

   To change the GPIB address, use the rotary knob or the arrow keys, and press OK to set the value.
6. You can now use the Interactive IO within Connection Expert to communicate with your instrument, or program your instrument using various programming environments.

The following steps will help you quickly get started with connecting your USB-enabled instrument to the USB (Universal Serial Bus). The following figure illustrates a typical USB interface system.



1. If you have not already done so, install the Agilent IO Libraries Suite from the CD shipped with your product.
2. Connect the USB device port located on the back of your instrument to the USB port on your computer.
3. With the Connection Expert utility from the Agilent IO Libraries Suite running, the computer will automatically recognize the instrument. This may take several seconds. When the instrument is recognized, your computer will display the VISA alias, IDN string, and VISA address. This information is located in the USB folder.

You can also view the instrument's VISA address from the front panel. Press the More function key, then the I/O > USB softkeys. The VISA address is shown in the USB Status dialog box.

4. You can now use the Interactive IO within Connection Expert to communicate with your instrument, or program your instrument using various programming environments.

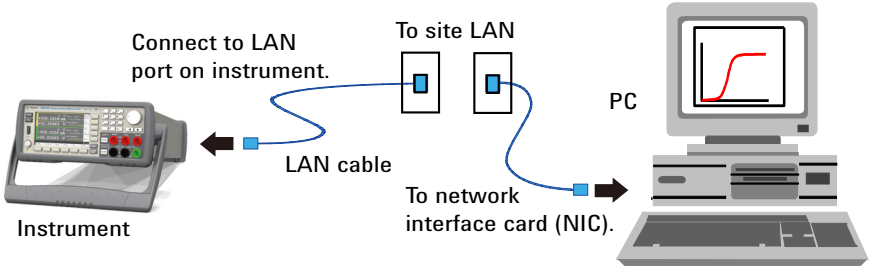
LAN Interface

NOTE For detailed information about LAN interface connections, refer to *Connectivity Guide* installed with the Agilent IO Libraries.

The following steps will help you quickly get started with connecting and configuring your instrument on a local area network.

Connecting to a Site LAN

A site LAN is a local area network in which LAN-enabled instruments and computers are connected to the network via routers, hubs, and/or switches. They are typically large, centrally-managed networks with services such as DHCP and DNS.



1. If you have not already done so, install the Agilent IO Libraries Suite from the CD shipped with your product.
2. Connect the instrument to the site LAN. The factory-shipped instrument LAN settings are configured to automatically obtain an IP address from the network using DHCP (DHCP is enabled). Note that this may take up to one minute. The DHCP server will register the instrument's hostname with the dynamic DNS server. The hostname as well as the IP address can then be used to communicate with the instrument. The front panel LAN indicator will turn green when the LAN port has been configured successfully, or turn red if the configuration fails.

NOTE If you need to manually configure any instrument LAN settings, see "LAN Configuration dialog box" on page 4-46 for information about configuring the LAN settings from the front panel of the instrument.

3. Use the Connection Expert utility from the Agilent IO Libraries Suite to add the B2900 and verify the connection. To add the instrument, you can request Connection Expert to discover the instrument. If the instrument cannot be found, add the instrument using the instrument's hostname or IP address.

NOTE If this does not work, refer to the troubleshooting section in the Agilent Technologies *USB/LAN/GPIB Interfaces Connectivity Guide*.

4. You can now use the Interactive IO within Connection Expert to communicate with your instrument, or program your instrument using various programming environments. You can also use the Web browser on your computer to connect to the instrument as described under "Using the Graphical Web Interface" on page 3-26.

Viewing the Active LAN Status

To view the currently active LAN settings, press the More function key, then the I/O > LAN > Status softkeys. The LAN status dialog box appears.

Note that the currently active LAN settings for the IP Address, Subnet Mask, and Default Gateway may be different from the settings specified in the LAN Configuration dialog box, depending on the configuration of the network. If the settings are different, it is because the network has automatically assigned its own settings.

Modifying the LAN Settings

As shipped from the factory, B2900's pre-configured settings should work in most LAN environments. If you need to manually configure these settings, press the More function key, then the I/O > LAN > Config softkeys. The LAN Configuration dialog box appears.

NOTE B2900 must be rebooted if the host name is changed.

For the LAN setup parameters, see "LAN Configuration dialog box" on page 4-46.

Communicating Over the LAN

Using the Graphical Web Interface

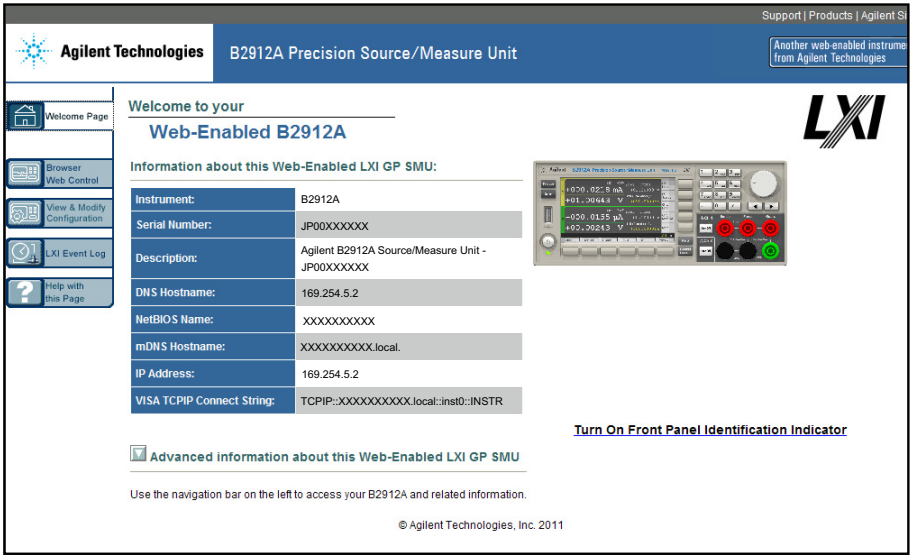
Your Agilent B2900 Source/Measure Unit has a built-in graphical web interface that lets you control it directly from an Web browser on your computer. Multiple simultaneous connections are allowed, but only from one computer. With additional connections, performance will be reduced. Multiple connections from multiple computers are not allowed.

With the graphical web interface, you can access the front panel control functions including the LAN configuration parameters. This is a convenient way to communicate with the B2900 without using I/O libraries or drivers.

NOTE

The built-in graphical web interface only operates over the LAN interface. It requires Internet Explorer 6+ or Firefox 2+. You will also need the Java Plug-in. This is included in the Java Runtime Environment. Refer to Sun Microsystem's website. If you are using Internet Explorer 7, open a separate browser window for each connection.

The graphical web interface is enabled when shipped.



To launch the graphical web interface:

1. Open a Web browser on your computer.
2. Enter the instrument's hostname or IP address into the browser's Address field to launch the graphical web interface. The B2900 home page will appear.
3. Click on the Browser Web Control button in the navigation bar on the left to begin controlling your instrument.
4. For additional help about any page, click "Help with this Page".

If desired, you can control the access to the graphical web interface using password protection. As shipped from the factory, the password is set to *agilent*. To change the password, click on the View & Modify Configuration button. Refer to the online help for additional information about setting the password.

Using Telnet

The Telnet utility (as well as sockets), is another way to communicate with B2900 without using I/O libraries or drivers. In all cases, you must first establish a LAN connection from your computer to the B2900 as previously described.

In an MS-DOS Command Prompt box, type "telnet *hostname* 5024" where *hostname* is the B2900's hostname or IP address, and 5024 is the instrument's telnet port. You should get a Telnet session box with a title indicating that you are connected to the B2900. Type the SCPI commands at the prompt.

Using Sockets

NOTE

Agilent B2900 allows any combination of up to four simultaneous data socket, control socket, or telnet connections to be made.

Agilent instruments are standardized on using port 5025 for SCPI socket services. A data socket on this port can be used to send and receive ASCII/SCPI commands, queries, and query responses. All commands must be terminated with a newline for the message to be parsed. All query responses will also be terminated with a newline.

The socket programming interface also allows control socket connections. The control socket can be used by a client to send device clear and to receive service requests. Unlike the data socket, which uses a fixed port number, the port number for a control socket varies and must be obtained by sending the following SCPI query to the data socket: `SYSTem:COMMunicate:TCPip:CONTrol?`

Once the port number is obtained, a control socket connection can be opened. As with the data socket, all commands to the control socket must be terminated with a newline, and all query responses returned on the control socket will be terminated with a newline.

To send a device clear, send the string “DCL” to the control socket. When the B2900 has finished performing the device clear, it will echo the string “DCL” back to the control socket.

Service requests are enabled for control sockets using the Service Request Enable register. Once service requests have been enabled, the client program listens on the control connection. When SRQ becomes true, the instrument will send the string “SRQ +nn” to the client. The “nn” is the status byte value, which the client can use to determine the source of the service request.

Using Digital I/O

B2900A has a Digital I/O connector, D-sub 25 pin female, for general purpose input/output (GPIO). It can be used for:

- Trigger input
- Trigger output
- Digital signal input/output
- Digital signal input
- Start of Test (SOT) input (for component handlers)
- Busy status output (for component handlers)
- End of Test (EOT) output (for component handlers)
- Interlock control
- High voltage status output (shared with the digital signal input/output DIO 14)

The pin assignment of the Digital I/O connector is shown in Table 3-1. Pins DIO 1 to DIO 14 can be assigned to one of the above functions, except for interlock control. To set the DIO functions, press the More function key, then the I/O > DIO > Config softkeys. For details, see “DIO Configuration dialog box” on page 4-46.

Figure 3-15 shows the input/output circuits internally connected to each pin of the Digital I/O connector.

Figure 3-15 Digital I/O Internal Circuit

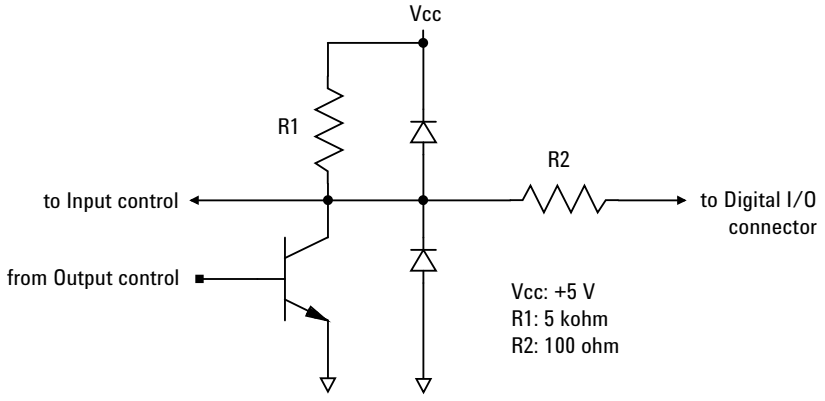


Table 3-1 **Digital I/O Pin Assignment**

Description	Pin Number		Description
+5 V [a]	25	13	DIO 13 (bit 13)
Interlock control [b]	24	12	DIO 12 (bit 12)
+5 V [a]	23	11	DIO 11 (bit 11)
+5 V [a]	22	10	DIO 10 (bit 10)
GND	21	9	DIO 9 (bit 9)
GND	20	8	DIO 8 (bit 8)
GND	19	7	DIO 7 (bit 7)
GND	18	6	DIO 6 (bit 6)
GND	17	5	DIO 5 (bit 5)
Interlock control [c]	16	4	DIO 4 (bit 4)
GND	15	3	DIO 3 (bit 3)
DIO 14 (bit 14) or High voltage status	14	2	DIO 2 (bit 2)
		1	DIO 1 (bit 1)

a. Current limit: 600 mA (total current to the pins 22, 23, and 25)
b. Used for the positive logic. Connected to the pin 25 for the negative logic.
c. Used for the negative logic. Connected to the pin 17 for the positive logic.

4 Front Panel Reference

This chapter provides the reference information of the Agilent B2900 front panel keys and display.

- “Hard Keys and Rotary Knob”
- “Display and Assist Keys”
- “Function Keys”
- “Config key group”
- “Function key group”
- “Trigger key group”
- “Result key group”
- “File key group”
- “Program key group”
- “I/O key group”
- “Display key group”
- “System key group”

NOTE

If measurement is not performed properly, check the trigger setting. The trigger type must be set to AUTO, or the trigger count (Count) must be set properly. See “Trigger parameters” on page 4-15.

Hard Keys and Rotary Knob

Line switch

Turns the instrument on or off.

Trigger

Starts a single (one shot) measurement or initiates trigger system. If a repeat (continuous) measurement is in progress, stops the repeat measurement.

The single measurement is performed with the DC bias output, staircase sweep output, pulsed bias output, or pulsed sweep output set to the channel. One single measurement can contain the maximum of 100000 measurement points.

Once a single measurement starts, the data buffer (maximum 100000 data) is cleared, and the last single measurement result is stored in the buffer. The measurement result is displayed on the Single view, Dual view, Graph view, or Roll view. Also the last single measurement result can be listed and displayed on the Measure Result dialog box.

Auto

Starts a repeat measurement. If a repeat measurement is in progress, stops the repeat measurement. The repeat measurement is performed with the DC bias output of the Source value. And the measurement result is displayed on the Single view, Dual view, or Roll view. The repeat measurement result is not stored in the buffer.

The repeat measurement is performed with the following trigger setup. Settings of "Trigger parameters" are ignored.

- Acquire trigger (measurement trigger): Initiate
- ARM acquire count: Infinite
- ARM acquire source: AUTO (automatic internal)
- TRIGger acquire count (Measure Count) 100
- TRIGger acquire source (Measure Trigger): AUTO (automatic internal)
- TRIGger acquire timer period (Measure Period): 10 ms (this is automatically extended if the measurement is not completed.)
- Trigger delay (Source Delay=Measure Delay): 0 s
- Trigger output: Disable
- Measurement range: Compliance range if the fixed mode is selected

View

Changes the display mode. See "Display and Assist Keys" on page 4-5.

Cancel / Local

Cancels the setup operation if the instrument is in the local status. Returns the instrument to the local status if it is in the remote status.

On/Off

Used to enable or disable the SMU channel. Turns the channel off if it is in the output status even if it is in the remote status. One switch on 1-channel models, and two switches on 2-channel models.

The switch turns green if the channel is enabled.

The switch turns red if the channel is in the high voltage state.

Numeric/alpha keys

Used to enter the value for setup parameters such as the source output value, limit (compliance) value, and message, specified by the field pointer. The value can be changed if the field pointer is in the EDIT (green) status.

Rotary knob

If the field pointer is in the MOVE (blue) status, turning the knob moves the pointer. Pressing the knob fixes the pointer position and changes the pointer status to EDIT (green).

If the field pointer is in the EDIT (green) status, turning the knob changes the value of the setup parameter specified by the pointer. Pressing the knob fixes the value and changes the pointer status to MOVE (blue).

If the field pointer is in the EDIT (green) status on a setup field other than the Source field and the Limit (Compliance) field, turning the knob changes the setting value. The value is applied by pressing the knob.

If the field pointer is in the EDIT (green) status on the Source or Limit (Compliance) field, turning the knob changes the setting value of the source channel in real time.

If the digit pointer is on a digit of a numeric value entry field, turning the knob changes the value of the digit. Note that changing the value from 9 to 0 or from 0 to 9 changes the value of the next digit.

If the digit pointer is on the decimal point of a numeric value entry field, turning the knob moves the decimal point.

Left and right keys

If the field pointer is in the MOVE (blue) status, pressing the key moves the pointer.

If the field pointer is in the EDIT (green) status, pressing the key changes the value of the setup parameter specified by the pointer.

If the field pointer is in the EDIT (green) status on a numeric value entry field, pressing the key changes the pointer to the digit pointer.

If the digit pointer is on a digit of a numeric value entry field, pressing the key moves the pointer on the digits.

Display and Assist Keys

Agilent B2900 provides several display modes which depend on the model as shown below. The display mode is changed by the View key. Pressing the key changes the mode as shown below.

On B2901A Single → Graph → (return to Single)

On B2902A Dual → Single for channel 1 → Single for channel 2 → Graph → (return to Dual)

On B2911A Single → Graph → Roll → (return to Single)

On B2912A Dual → Single for channel 1 → Single for channel 2 → Graph → Roll → (return to Dual)

For each display mode, five assist keys are available on the right side of the display. They are assigned to several softkeys such as Mode, Source, Limit, Measure, and More. The softkey assignment depends on the display mode.

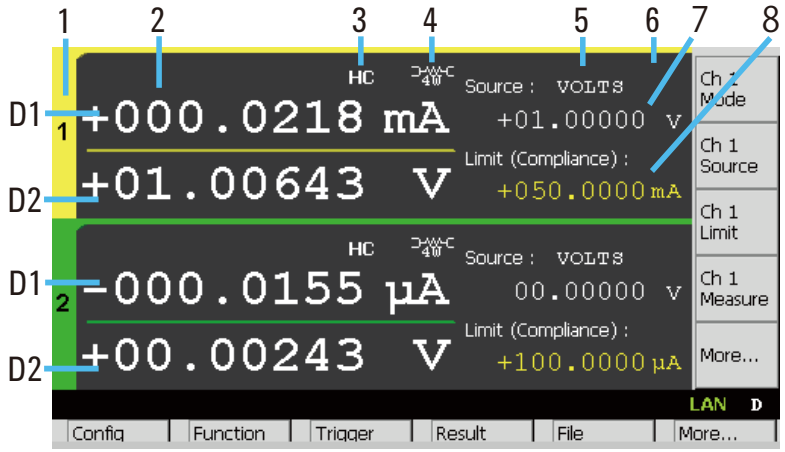
For details of each display mode and assist keys, see the following sections.

- "Dual View"
- "Single View"
- "Graph View"
- "Roll View"
- "Status Information"

The status information is common for all display modes. It is displayed above the bottom softkeys associated with the function keys. This display area is also used to display system messages and error messages.

Dual View

Available on B2902A and B2912A. The upper half is for channel 1. The lower half is for channel 2. Each area displays the measurement results, source and measurement settings, and channel status. Most setup parameters can be edited on this display.



Display area

1. Channel number. 1 or 2.
2. Latest measurement data
3. High capacitance (HC) mode indicator
4. Remote sensing (4-wire connection) status indicator
5. Source function. VOLTS or AMPS.
6. Source shape indicator. DC, pulse, sweep, or pulsed sweep. DC does not show the indicator.
7. Source output value, 5½ digit resolution on B2902A, and 6½ digit resolution on B2912A
8. Limit (Compliance) value

D1. Primary measurement data

D2. Secondary measurement data or limit test result Pass or Fail

Assist keys

In the following descriptions, *Ch n* indicates *Ch 1* or *Ch 2*.

_Ch n_ Mode Changes the assist keys to VOLTS (V) and AMPS (I) used to select the source function.

VOLTS (V) sets the voltage source.

AMPS (I) sets the current source.

_Ch n_ Source Changes the assist keys to the unit keys shown below.

mV and V for the voltage source

nA, μA, mA, and A for the current source

First, enter or set the output value by using the numeric/alpha keys, rotary knob, and arrow keys. Then press one of the unit keys to apply the value.

_Ch n_ Limit Changes the assist keys to the unit keys shown below.

nA, μA, mA, and A for the current compliance

mV and V for the voltage compliance

First, enter or set the limit value by using the numeric/alpha keys, rotary knob, and arrow keys. Then press one of the unit keys to apply the value.

_Ch n_ Measure Changes the assist keys to AMPS (I), VOLTS (V), OHMS (R), and WATTS (P) used to select the measurement function.

AMPS (I) sets the current measurement.

VOLTS (V) sets the voltage measurement.

OHMS (R) sets the resistance measurement.

WATTS (P) sets the power measurement.

Resistance data is given by Resistance=Vmeas/Imeas.

Power data is given by Power=Vmeas×Imeas.

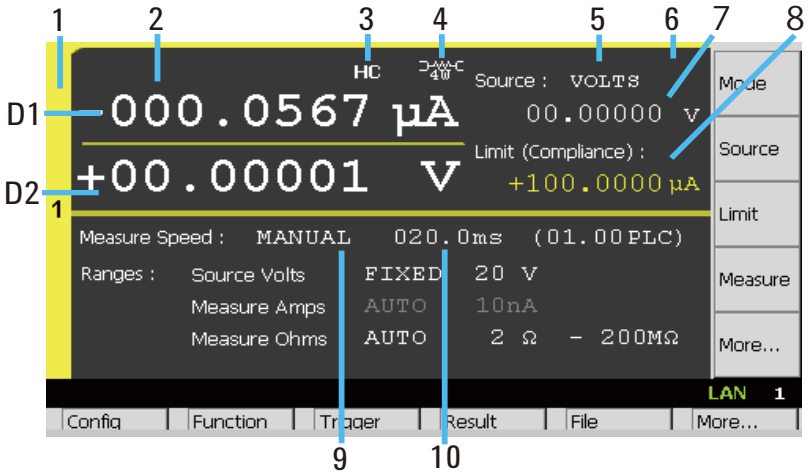
In the above formula, Vmeas is the voltage measurement data, and Imeas is the current measurement data.

For details on using resistance compensation, see “Resistance Compensation” on page 6-16.

More... Changes the assist keys to *Ch 1* assist keys or *Ch 2* assist keys. *Ch 1* assist keys are effective for channel 1. *Ch 2* assist keys are effective for channel 2.

Single View

Displays the measurement results, source and measurement settings, and channel status. Most setup parameters can be edited on this display. The lower half displays the setup parameters selected by Assist keys 2.



Display area

1. Channel number. 1 or 2.
2. Latest measurement data
3. High capacitance (HC) mode indicator
4. Remote sensing (4-wire connection) status indicator
5. Source function. VOLTS or AMPS.
6. Source shape indicator. DC, pulse, sweep, or pulsed sweep. DC does not show the indicator.
7. Source output value, 5½ digit resolution on B2901A/B2902A, and 6½ digit resolution on B2911A/B2912A
8. Limit (Compliance) value
9. Measurement speed. AUTO, SHORT, MEDIUM, NORMAL, LONG, or MANUAL.
10. Aperture time in seconds or PLC (power line cycle, number of power line cycles per a measurement). Only for the MANUAL speed.

D1. Primary measurement data

D2. Secondary measurement data or limit test result Pass or Fail

Assist keys 1

Mode

Changes the assist keys to VOLTS (V) and AMPS (I) used to select the source function.

VOLTS (V) sets the voltage source.

AMPS (I) sets the current source.

Source

Changes the assist keys to the unit keys shown below.

mV and V for the voltage source

nA, μA, mA, and A for the current source

First, enter or set the output value by using the numeric/alpha keys, rotary knob, and arrow keys. Then press one of the unit keys to apply the value.

Limit

Changes the assist keys to the unit keys shown below.

nA, μA, mA, and A for the current compliance

mV and V for the voltage compliance

First, enter or set the limit value by using the numeric/alpha keys, rotary knob, and arrow keys. Then press one of the unit keys to apply the value.

Measure

Changes the assist keys to AMPS (I), VOLTS (V), OHMS (R), and WATTS (P) used to select the measurement function.

AMPS (I) sets the current measurement.

VOLTS (V) sets the voltage measurement.

OHMS (R) sets the resistance measurement.

WATTS (P) sets the power measurement.

Resistance data is given by Resistance=Vmeas/Imeas.

Power data is given by Power=Vmeas×Imeas.

In the above formula, Vmeas is the voltage measurement data, and Imeas is the current measurement data.

For details on using resistance compensation, see “Resistance Compensation” on page 6-16.

More...

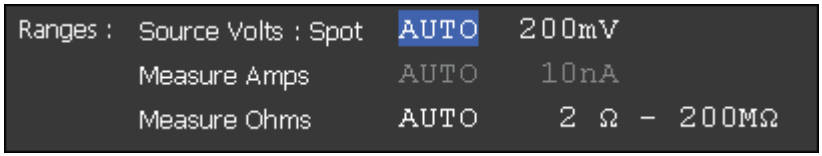
Changes the assist keys to Assist keys 2.

Assist keys 2

Speed	Changes the assist keys to AUTO (1 PLC for 10 nA and 100 nA ranges, 0.01 PLC for other ranges), SHORT (0.01 PLC), MEDIUM (0.1 PLC), NORMAL (1 PLC), LONG (10 PLC), or MANUAL used to select the measurement speed. The aperture time is automatically set to the above values in parentheses. For the aperture time, see "Measurement Time" on page 6-5. For the MANUAL speed, the aperture time must be set to the right field in seconds or PLC (power line cycle, number of power line cycles per measurement). Move the field pointer to the one by using the arrow keys or rotary knob and press the knob to set the pointer to the EDIT mode. Enter or set the value by using the numeric/alpha keys, knob, or arrow keys, then press the knob or one of the unit keys to apply the value. For setting the seconds value, the following unit keys are available as assist keys. µs, ms, and s
Show Sweep	Displays the sweep setup parameters shown in "Sweep parameters" on page 4-12, and changes the softkey label to *Hide Sweep*.
Hide Sweep	Displays the range setup parameters shown in "Range parameters" on page 4-11, and changes the softkey label to *Show Sweep*.
Show Pulse	Displays the pulse setup parameters shown in "Pulse parameters" on page 4-14, and changes the softkey label to *Hide Pulse*.
Hide Pulse	Displays the range setup parameters shown in "Range parameters" on page 4-11, and changes the softkey label to *Show Pulse*.
Show Trigger	Displays the trigger setup parameters shown in "Trigger parameters" on page 4-15, and changes the softkey label to *Hide Trigger*.
Hide Trigger	Displays the range setup parameters shown in "Range parameters" on page 4-11, and changes the softkey label to *Show Trigger*.
More...	Changes the assist keys to Assist keys 1.

Softkey labels *Show XXXX* and *Hide XXXX* are switched by pressing the key.

Range parameters



The following setup parameters are available. *Source* or *Measure XXXX* is decided by the source setting.

Source Volts: Spot For the voltage source. Selects the range operation AUTO or FIXED for the constant voltage output and the source side voltage measurement.

Measure Amps For the voltage source. Selects the range operation AUTO or FIXED for the current measurement.

Source Amps: Spot For the current source. Selects the range operation AUTO or FIXED for the constant current output and the source side current measurement.

Measure Volts For the current source. Selects the range operation AUTO or FIXED for the voltage measurement.

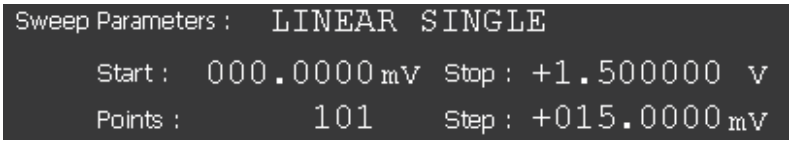
The right field is used to set the range value for the FIXED range operation, or the minimum range value for the AUTO range operation. For the available range values, see “Output and Measurement Ranges” on page 2-11.

Measure Ohms Selects the resistance measurement operation AUTO, FIXED, or V/I. For AUTO and FIXED, the channel performs resistance measurement by using the current source and voltage measure condition automatically set by the resistance measurement range setting. For V/I, the channel performs measurement by using the present source/measure condition, and the resistance value is given by V/I calculation.

The right field is used to set the resistance measurement range value for the FIXED operation, or the minimum and maximum ranges for the AUTO operation. For the available range values, see Table 2-7 on page 2-15. This setup field is not available for the V/I operation.

In the AUTO range operation, the channel automatically sets the range which provides the best resolution for the source output value or the measured value.

Sweep parameters



B2900 can be used as a sweep source, and supports the following sweep operations. The operation can be selected by using the assist keys displayed when the field pointer is in the EDIT (green) status on the Sweep Parameters field.

- LINEAR SINGLE: Sweep from start to stop in a linear incremental step
- LINEAR DOUBLE: Sweep from start to stop to start in a linear incremental step
- LOG SINGLE: Sweep from start to stop in a logarithmic incremental step
- LOG DOUBLE: Sweep from start to stop to start in a log incremental step
- LIST: Sweep of values defined in the List sweep setup list. See “List sweep setup”.

The following setup parameters are available.

Start	Sets the sweep start value.
Stop	Sets the sweep stop value.
Points	Sets the number of sweep steps.
Step	Sets the sweep step value (incremental step value). Not available for the LOG and LIST sweep operations.

When the field pointer is in the EDIT (green) status on an entry field, the assist keys are changed to the unit keys as shown below.

nA, μA, mA, and A for current sweep

mV and V for voltage sweep

For the range operation of the sweep source, see “Sweep dialog box” on page 4-27. The range parameters *Source Volt: Spot* and *Source Amps: Spot* are not effective for the AUTO and BEST range operations of the sweep source. They are effective for the constant source and FIXED range operation of the sweep source.

List sweep setup

When the field pointer is in the EDIT (green) status on the LIST sweep Start/Stop/Points field, the following assist keys are available for setting the list sweep source.

Edit Opens the List Sweep dialog box used to set the list sweep source.

Load Opens the Load List Sweep Data dialog box used to load a list sweep data from a USB memory connected to the front panel USB-A connector.

- List Sweep dialog box

  This dialog box provides the following GUI for setting the list sweep source. Data resolution is 6 digits on B2901A/B2902A, and 7 digits on B2911A/B2912A.

  (data graph) Displays the shape of the list sweep output

  Type Data type V (voltage) or I (current)

  CH Channel number 1 or 2, only on 2-channel models

  (data list) Lists the data index and the output value

  Points Number of data points

  Max Maximum value

  Min Minimum value

- Load List Sweep Data dialog box

  This dialog box provides the following GUI for loading a list sweep data from a file stored on a USB memory.

  (data graph) Displays the shape of the list sweep data selected by the file list

  Path Folder into which the list sweep data file is saved

  (file list) List of the list sweep data file

  Points Number of data points

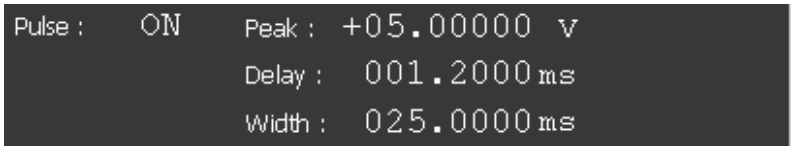
  Max Maximum value

  Min Minimum value

The following data can be loaded as the list sweep data.

- Comma separated value format, file extension csv
- Carriage return or line feed separated value format, file extension txt
- Space separated value format in a line, file extension prn

Pulse parameters



B2900 can be used as a pulse source, and supports pulsed output and measurement. Pulse ON or OFF can be selected by using the assist keys displayed when the field pointer is in the EDIT (green) status on the Pulse field.

The following setup parameters are available.

Peak Sets the pulse peak value. Not available for the sweep source which sets the sweep output value to the pulse peak.

The pulse base value is set by the Source field in the upper half of the display area. See “Single View” on page 4-8.

Delay Sets the pulse delay time. The pulse source changes the output level from the base value to the peak value when the delay time elapsed after trigger delay.

Width Sets the pulse width.

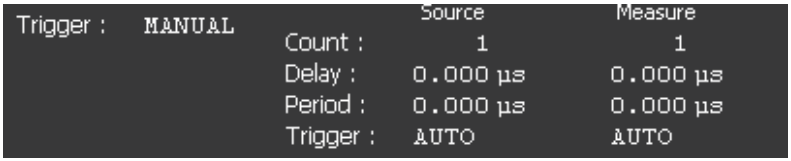
When the field pointer is in the EDIT (green) status on an entry field, the assist keys are changed to the unit keys as shown below.

nA, μA, mA, and A for the peak current

mV and V for the peak voltage

μs, ms, and s for the delay and width

Trigger parameters



The B2900 supports the following trigger types for triggering source output and measurement. They are effective for setting triggers easily.

The trigger type can be selected by using the assist keys displayed when the field pointer is in the EDIT (green) status on the Trigger field. See Table 4-1 for the trigger types and the setup parameters.

AUTO Automatic trigger type

SYNC Synchronize trigger type

TIMER Timer trigger type

MANUAL Manual trigger type

The following setup parameters are available for setting the source output trigger (transient action) by using the Source column, and the measurement trigger (acquire action) by using the Measure column.

Count Trigger count (number of triggers). This value is automatically set for the AUTO trigger type. For the other trigger type, set the number of triggers required for each source output and measurement properly. For example, set Source Count = Measure Count = 10 for the sweep measurement with 10 steps.

Delay Sets the trigger delay time.

Period Sets the trigger period.

Trigger Selects the trigger source by using the assist key AUTO, BUS, TIMER, INT*m* (only for 2-channel model), LAN, or EXT*n*, where *m* is the integer 1 or 2, and *n* is an integer from between 1 and 14. See Table 4-1 for the trigger sources.

When the field pointer is in the EDIT (green) status on the Delay or Period field, the assist keys are changed to the unit keys as shown below.

µs, ms, and s

Table 4-1 **Trigger Types and Setup Parameters**

Type	Count	Delay	Period	Trigger
AUTO	set automatically	0 second	N.A.	AUTO
SYNC	entered value	entered value	N.A.	AUTO
TIMER	entered value	entered value	entered value	TIMER
MANUAL	entered value	entered value	entered value	selected value

Trigger=AUTO automatically selects the trigger source best suited for the present operating mode by using internal algorithms.

Trigger=BUS selects the remote interface trigger command such as the group execute trigger (GET) and the *TRG command.

Trigger=TIMER selects a signal internally generated every interval set by the *Period* parameter.

Trigger=INT1 or INT2 selects a signal from the internal bus 1 or 2, respectively.

Trigger=LAN selects the LXI trigger.

Trigger=EXT*n* selects a signal from the DIO pin *n* which is an output port of the Digital I/O D-sub connector on the rear panel. *n*=1 to 14.

NOTE

Setting trigger parameters in detail

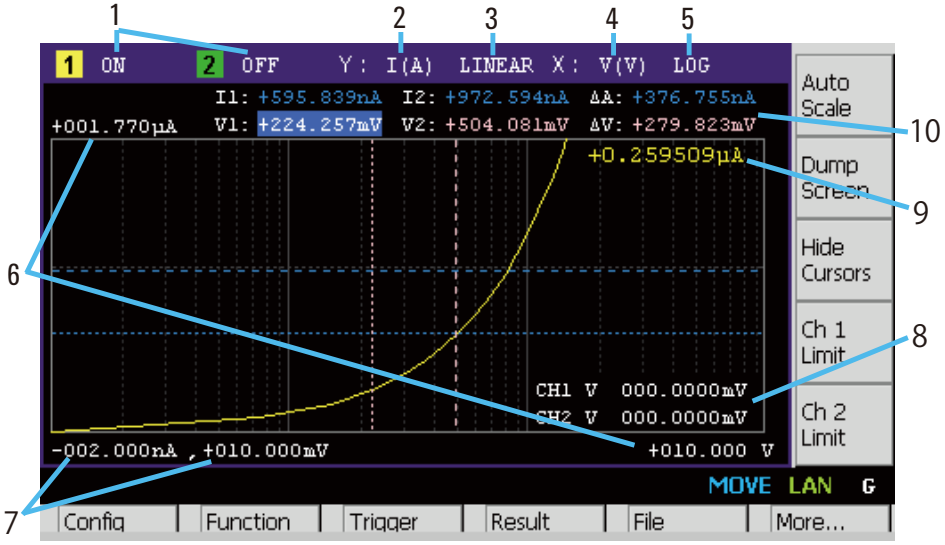
For details of the trigger system, see Figure 6-8 on page 6-28.

The Single view provides the trigger types and parameters effective for setting triggers easily. If you want to set the trigger parameters in detail, select the MANUAL trigger type and use the Trigger Configuration dialog box opened by pressing the Trigger > Config function keys. See “Trigger key group” on page 4-35.

The Single view does not contain the setup parameters for the arm layer, but contains the setup parameters for the trigger layer. The Single view setup is given priority over the trigger layer setup on the Trigger Configuration dialog box. Hence, the overlapped parameter values on the dialog box are ignored.

Graph View

Displays the graph for plotting the channel 1 and/or 2 measurement or math result. The Graph view can plot up to 5000 data.



Display area

1. Graph display status ON or OFF. Only on 2-channel models. [*n*] is for channel *n*.
2. Y-axis data type I (A), V (V), R (Ω), P (W), or MATH (see Table 4-2)
3. Y-axis scale LINEAR or LOG
4. X-axis data type I (A), V (V), R (Ω), P (W), MATH, t (s), V1, or V2 (see Table 4-2)
5. X-axis scale LINEAR or LOG
6. Graph maximum value
7. Graph minimum value
8. Channel 1 and/or 2 source output value, limit value, or none (controlled by the Ch *n* Source, Ch *n* Limit, or Hide Ch *n* assist key)
9. Channel 1 and/or 2 Y-axis data at the active X-cursor position. ----.---- is displayed for the *no-data* position.
10. Cursor data (controlled by the Show Cursors or Hide Cursors assist key)

    First line Positions and distance (e.g. I1, I2, ΔA) of Y-cursors 1 and 2

Second line Positions and distance (e.g. t1, t2, Δt) of X-cursors 1 and 2

Table 4-2 **X and Y Axes Data Types for Graph View**

Data type	Assist key	Description
I (A)	AMPS (I)	Current data
V (V)	VOLTS (V)	Voltage data
R (Ω)	OHMS (R)	Resistance data
P (W)	WATTS (P)	Power data
MATH	MATH	Math result data
t (s)	TIME (t)	Time data. Only for the X-axis data.
V1	Ch 1 V (V1)	Only on 2-channel models. Voltage data of channel 1 or 2. Only for the X-axis data.
V2	Ch 2 V (V2)	

Assist keys

Auto Scale Changes graph scale to fit the trace in the graph automatically.

Dump Screen Opens the File Selection (Dump Screen) dialog box which is used to save the screen dump as a JPEG file.

The file can be saved onto a USB memory connected to the front panel USB-A connector. The file is saved with the specified name. If the file extension is not specified, ".jpg" is added automatically.

Show Cursors Displays the cursors (Y-cursors 1 and 2, X-cursors 1 and 2, and cursor data) and changes the softkey label to *Hide Cursors*.

Hide Cursors Hides the cursors and changes the softkey label to *Show Cursors*.

Ch *n* Source Displays the channel *n* source output value and changes the softkey label to *Ch n Limit*.

Ch *n* Limit Hides the channel *n* source output value and displays the limit value. Also changes the softkey label to *Hide Ch n*.

Hide Ch *n* Hides the channel *n* limit value and changes the softkey label to *Ch n Source*.

In the above descriptions, *Ch n* indicates *Ch 1* or *Ch 2*.

NOTE

If the number of data exceeds 5000

If the number of measurement data exceeds 5000, the Graph view and the Roll view plot the following data. where, *n* is integer, 1 to 5000.

Number of data is 5001 to 10000: [2*(*n*−1)+1]th data

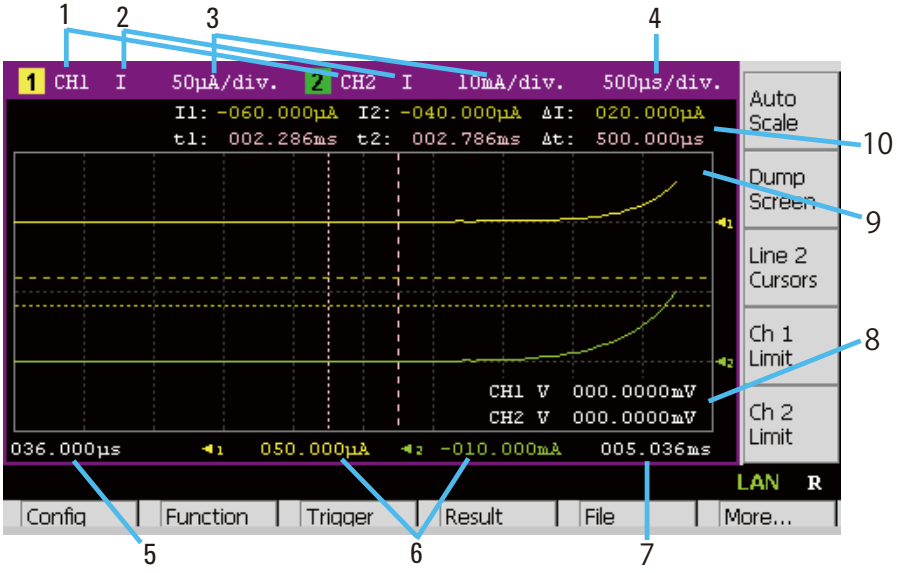
Number of data is 10001 to 25000: [5*(*n*−1)+1]th data

Number of data is 25001 to 50000: [10*(*n*−1)+1]th data

Number of data is 50001 to 100000: [20*(*n*−1)+1]th data

Roll View

Available on B2911A and B2912A. Displays the time domain graph for plotting the channel 1 and/or 2 measurement data. See Table 4-3 for the Y-axis data types. The Roll view can plot up to 5000 data.



Display area

1. Displays status ON or OFF, on B2911A

   Displays status Ch 1, Ch 2, or OFF, on B2912A

   Two lines can be displayed on the graph. [1] indicates the graph setup for line 1. [2] indicates the graph setup for line 2.

2. Y-axis data type I, V, R, or P.

3. Y-axis scale per division A/div., V/div., Ω/div., or W/div.
4. X-axis scale per division s/div.
5. X-axis minimum value (minimum timestamp)
6. Y-axis offset values for line 1 and 2
7. X-axis maximum value (maximum timestamp)
8. Channel 1 and/or 2 source output value, limit value, or none (controlled by the Ch *n* Source, Ch *n* Limit, or Hide Ch *n* assist key)
9. Channel 1 and/or 2 Y-axis data at the active X-cursor position. ----.---- is displayed for the *no-data* position.
10. Cursor data (controlled by the Line 1 Cursors, Line 2 Cursors, or Hide Cursors assist key)

    First line Positions and distance (e.g. I1, I2, ΔA) of Y-cursors 1 and 2

    Second line Positions and distance (e.g. t1, t2, Δt) of X-cursors 1 and 2

Assist keys

Auto Scale Changes graph scale to fit the trace in the graph automatically.

Dump Screen Opens the File Selection (Dump Screen) dialog box which is used to save the screen dump as a JPEG file.

The file can be saved onto a USB memory connected to the front panel USB-A connector. The file is saved with the specified name. If the file extension is not specified, ".jpg" is added automatically.

Line 1 Cursors Displays the cursors (Y-cursors 1 and 2, X-cursors 1 and 2, and cursor data) for line 1, and changes the softkey label to *Line 2 Cursors*.

Line 2 Cursors Displays the cursors (Y-cursors 1 and 2, X-cursors 1 and 2, and cursor data) for line 2, and changes the softkey label to *Hide Cursors*.

Hide Cursors Hides the cursors and changes the softkey label to *Line 1 Cursors*.

Ch *n* Source Displays the channel *n* source output value and changes the softkey label to *Ch n Limit*.

Ch *n* Limit Hides the channel *n* source output value and displays the limit value. Also changes the softkey label to *Hide Ch n*.

Hide Ch *n* Hides the channel *n* limit value and changes the softkey label to *Ch n Source*.

In the above descriptions, *Ch n* indicates *Ch 1* or *Ch 2*.

Table 4-3 Y-Axis Data Types for Roll View

Data type	Assist key	Description
I	AMPS (I)	Current data
V	VOLTS (V)	Voltage data
R	OHMS (Ω)	Resistance data
P	WATTS (P)	Power data

Status Information

The status information is common for all display modes. It is displayed above the bottom softkeys associated with the function keys.

Table 4-4 **Status Indicator**

Label	Color	Description
AUTO	white	Trigger auto. Automatic trigger is enabled now.
ARM	white	Trigger active. Trigger system is active now.
HV	yellow	High voltage. Output voltage setting is over ±42 V.
		Channel 1 floating status. Channel 1 is not grounded.
		Channel 2 floating status. Channel 2 is not grounded.
REM	white	Remote. Instrument is in the remote state.
		Local lockout. Instrument is in the local lockout (LLO) status.
ERR	white	Error. At least one error is detected.
EDIT	green	Edit mode. The field specified by the pointer can be edited. Not in the move mode.
MOVE	blue	Move mode. The field pointer can be moved. Not in the edit mode.
LAN	green or red	LXI LAN status indicator. Green indicates normal LAN status. Red indicates abnormal condition. Blinking indicates the LAN identification status.
D	white	Display mode: Dual view
1	white	Display mode: Single view for channel 1
2	white	Display mode: Single view for channel 2
G	white	Display mode: Graph view
R	white	Display mode: Roll view

Function Keys

Agilent B2900 has six function keys below the front panel display, and provides the following nine softkeys.

Function keys 1	**Config**	SMU configuration setup. Displays the softkeys for setting several functions of the SMU. See “Config key group” on page 4-24.
	Function	Math, limit test, and trace function setup. Displays the softkeys for setting these functions. See “Function key group” on page 4-30.
	Trigger	Trigger configuration and control. Displays the softkeys for setting and controlling the trigger system. See “Trigger key group” on page 4-35.
	Result	Measurement, limit test, and trace result display. Displays the softkeys for displaying these results. See “Result key group” on page 4-38.
	File	File operation. Displays the softkeys for saving and loading a file. See “File key group” on page 4-41.
	More...	Changes the function keys to Function keys 2.
Function keys 2	**Program**	Program configuration and control. Displays the softkeys for setting and controlling the program memory. See “Program key group” on page 4-42.
	I/O	I/O setup. Displays the softkeys for setting the I/O interfaces. See “I/O key group” on page 4-43.
	Display	Display setup. Displays the softkeys for setting the display functions. See “Display key group” on page 4-48.
	System	System setup. Displays the softkeys used for several system setups. See “System key group” on page 4-49.
	More...	Changes the function keys to Function keys 1.

Config key group

Pressing the Config key displays the following three softkeys for setting several functions of the SMU.

Source

Displays the following three softkeys for setting the SMU source operation.

Connection Channel operation and connection setup. See "Output Connection dialog box" on page 4-25.

Filter Output filter setup. See "Output Filter dialog box" on page 4-26.

Sweep Sweep source detail setup. See "Sweep dialog box" on page 4-27.

Measure

Displays the following two softkeys for setting the SMU measurement operation.

R Compen Resistance compensation ON or OFF. See "Resistance Compensation" on page 6-16.

On a 1-channel model, pressing this key displays the ON and OFF keys used to set the resistance compensation on or off.

On a 2-channel model, pressing this key displays the ALL, Ch 1, and Ch 2 keys. They are used to specify the channel for setting the resistance compensation on or off.

ALL specifies channels 1 and 2.

Ch 1 specifies channel 1 only.

Ch 2 specifies channel 2 only.

Ranging Measurement range detail setup. See "Ranging dialog box" on page 4-28.

Common

Displays the following two softkeys for setting the SMU's miscellaneous function.

Wait Source and measurement wait time setup. See "Wait Control dialog box" on page 4-29.

Group Only on 2-channel models. Channel grouping ON or OFF. If this function is ON, the channels perform synchronous channel operation. The present setting is indicated by an asterisk on the softkey label.

Output Connection dialog box

This dialog box provides the following parameters for setting the channel operation and connection.

Ch	Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2) This field specifies the channel set by this dialog box.
Sensing Type	Sensing type, 2-wire connection (2-WIRE) or 4-wire connection (4-WIRE). Set 4-WIRE for remote sensing.
Low Terminal State	Low sense terminal connection, grounded (GROUND) or floating (FLOAT)
High Capacitance Mode	High capacitance mode, ON or OFF Set the mode to ON to perform high capacitive load measurements. See “High Capacitance Mode” on page 6-15.
Over Voltage/Current Protection	Over voltage or current protection, ON or OFF Set the function ON to turn off the channel output automatically and immediately when it reaches its compliance.
Output-Off State	Output-off state, high impedance (HIGH Z), normal (NORMAL), or zero volt (ZERO) This is the source setup condition after output off. See Table 6-1 on page 6-13.
Auto Output-On	Automatic output on function, ON or OFF Set the function ON to turn on the channel output automatically just before the trigger system is initiated by the SCPI command (not by front panel operation).
Auto Output-Off	Automatic output off function, ON or OFF Set the function ON to turn off the channel output automatically and immediately when all trigger system changes the status from busy to idle.

Output Filter dialog box

This dialog box provides the following parameters for setting the output filter.

Ch	Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2) This field specifies the channel set by this dialog box.
Filter State	Output filter, ON or OFF Set the filter ON to obtain clean source output without spikes and overshooting. Note, however, that using a filter may increase the SMU settling time.
Automatic Filter	Automatic filter, ON or OFF Set the function ON to automatically set the output filter which provides the best filter characteristics and cutoff frequency.
Time Constant	Filter time constant, 5 μs to 500 μs

Sweep dialog box

This dialog box provides the following parameters for setting details of the sweep source operation.

Ch — Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2)

This field specifies the channel set by this dialog box.

Sweep Ranging — Sweep source range operation, BEST, AUTO, or FIXED. See Table 4-5 on page 4-27.

Sweep Direction — Sweep direction, UP (start to stop direction) or DOWN (stop to start direction)

Output after Sweep — The value the source channel applies after it completes the sweep output

START VALUE (START): The value applied when the source channel starts the sweep

END VALUE (END): The value applied when the source channel completes the sweep

Table 4-5 Sweep Source Range Operation

	Description
BEST	In the linear sweep mode, the sweep source channel automatically uses the minimum range which covers the whole sweep output. In the log sweep mode, the sweep source channel automatically uses the range which provides the best resolution for each sweep step output.
AUTO	The sweep source channel automatically changes and sets the range which provides the best resolution to apply the source output for each sweep step.
FIXED	The sweep source channel sets the range specified by the range parameter *Source Volts: Spot* or *Source Amps: Spot*. See “Range parameters” on page 4-11.

Ranging dialog box

This dialog box provides the following parameters for setting details of the auto ranging operation for measurements.

Ch — Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2)

This field specifies the channel set by this dialog box.

Current Auto Ranging — Current measurement auto range operation, NORMAL, SPEED, or RESOLUTION (RESOLN). See Table 4-6.

Voltage Auto Ranging — Voltage measurement auto range operation, NORMAL, SPEED, or RESOLUTION (RESOLN). See Table 4-6.

Threshold — Sets the *rate* value of the formula shown below.

Table 4-6 Measurement Auto Range Operation

	Description
NORMAL	Supports basic operation and downward changing operation described below
SPEED	Supports basic operation and upward and downward changing operations described below
RESOLN	Supports basic operation and upward changing operation described below

- Basic operation

  The channel automatically sets the range which provides the best resolution in performing the measurement.

- Upward changing operation

  If measured data ≥ *value1*, the range changes up after the measurement.

  value1 = measurement range × *rate* / 100

- Downward changing operation

  If measured data ≤ *value2*, the range changes down immediately.

  value2 = measurement range × *rate* / 1000

Wait Control dialog box

This dialog box provides the following parameters for setting the source and measurement wait time.

The source wait time is defined as the time the source channel cannot change the output after the start of a DC output or the trailing edge of a pulse.

The measurement wait time is defined as the time the measurement channel cannot start measurement after the start of a DC output or the trailing edge of a pulse.

Ch	Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2) This field specifies the channel set by this dialog box.
State	Wait time, ON or OFF
Automatic	Automatic wait time, ON or OFF
Gain and Offset	Parameters for calculating the wait time. See the following formula.

- If State=ON and Automatic=ON:

  wait time = *Gain* × initial wait time + *Offset*

- If State=ON and Automatic=OFF:

  wait time = *Offset*

- If State=OFF:

  wait time=0

The initial wait time is automatically set by the instrument, and cannot be changed.

Function key group

Pressing the Function key displays the following three softkeys for setting the math, limit test, and trace functions.

Math Math function setup. See “Math Expression dialog box” on page 4-30.

Limit Test Displays the following two softkeys for setting the limit test function.

- **Composite** Composite limit test setup. See “Composite Limit Test Setup dialog box” on page 4-31.
- **Limits** Limit test setup. See “Limit Test Setup dialog box” on page 4-32.

Trace Trace function setup. See “Trace Buffer Setup dialog box” on page 4-34.

Math Expression dialog box

This dialog box provides the following parameters for setting the math function. If the math function is ON, the measurement data can be calculated by using the specified math expression.

- **Ch** Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2)

  This field specifies the channel set by this dialog box.
- **Status** Math function, ON or OFF
- **Unit String** Unit for the calculation result of the math expression

The available math expressions are listed in the area below the Unit String field. This area can be used to select the math expression for data calculation. To select a math expression, highlight the name in this area.

The data calculation is effective for data measured after the math function is set by this dialog box. The calculation result can be displayed on the dialog box opened by using the Result key group. See “Result key group” on page 4-38.

Math expressions can be defined by using the SCPI commands while the B2900 is in the remote mode.

For the predefined math expressions, see “Predefined Math Expressions” on page 6-17.

Composite Limit Test Setup dialog box

This dialog box provides the following parameters for setting the limit test.

Ch	Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2) This field specifies the channel set by this dialog box.
Limit Test	Composite limit test, ON or OFF
Mode	Operation mode, GRADING (GRADE) or SORTING (SORT) GRADING: Grading mode. See Figure 6-5 for the operation. SORTING: Sorting mode. See Figure 6-6 for the operation.
Auto Clear	Automatic clear of the composite limit test result, ON or OFF If this parameter is ON, the composite limit test results and the DIO lines are automatically cleared.
Update	Only for the GRADING mode. IMMEDIATE (IMM.) or END See “Immediate?” shown in Figure 6-5. IMMEDIATE: Outputs result immediately. (Immediate? Yes) END: Outputs result at the end. (Immediate? No)
Offset Cancel	Offset cancel of the limit test, ON or OFF If this parameter is ON, the limit test data will be as follows. Limit test data = raw data − offset value
Offset	Offset value used for the offset cancel, −9.999999E+20 to +9.999999E+20
Pass Pattern	Bit pattern for the limit test *pass* state. For the GRADING mode.
Fail Pattern	Bit pattern for the limit test *fail* state. For the SORTING mode.
GPIO Pins	DIO pins assigned to the bit pattern output
/BUSY	DIO pin assigned to the BUSY (busy) signal output
/SOT	DIO pin assigned to the SOT (start of test) signal input
/EOT	DIO pin assigned to the EOT (end of test) signal output

For the DIO pin assignment, see “Using Digital I/O” on page 3-29.

DIO pins assigned to the GPIO Pins, /BUSY, /SOT, or /EOT must be set to the DIGITAL I/O function by using the DIO Configuration dialog box.

NOTE

Values of GPIO Pins, /BUSY, /SOT, and /EOT

0 to 14 (integer). Numbers 1 to 14 indicate the DIO pins 1 to 14, respectively. 0 indicates that it is not used.

For GPIO Pins, multiple continuous pins are assigned. For example, “1, 2, 3, 4” indicates that the DIO pins 1 to 4 are assigned. Then LSB is DIO pin 1.

Limit Test Setup dialog box

This dialog box provides the following parameters for setting the limit test, which is a part of the composite limit test.

Ch — Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2)

This field specifies the channel set by this dialog box.

Feed Data — Type of data used for the pass/fail judgement of the limit test, MATH, VOLTS, AMPS, or OHMS.

MATH: Calculation result data of math expression

VOLTS: Voltage measurement data

AMPS: Current measurement data

OHMS: Resistance data given by Resistance=Vmeas/Imeas

Where, Vmeas is the voltage measurement data, and Imeas is the current measurement data.

For details on using resistance compensation, see “Resistance Compensation” on page 6-16.

Test Index — Index of limit test, No. 1 to 12.

Index numbers 1 to 12 are also used for bin numbers 1 to 12. See “Limit Test Result dialog box” on page 4-39.

Limit Test — Limit test, ON or OFF

Function — Test mode, COMPLIANCE (COMP.) or LIMIT

COMPLIANCE: Compliance check

LIMIT: Limit test

Pass Pattern — Bit pattern for the limit test *pass* state. For the SORTING mode.

Fail on — Only for compliance check. OUT or IN.

	Fail on=IN judges limit test failure if the channel goes into the compliance state. Fail on=OUT judges limit test failure if the channel comes out of the compliance state.
Fail Pattern	Only for compliance check. Bit pattern for the limit test *fail* state.
Up Pattern	Not available for compliance check. Bit pattern for the *failed-by-exceeding-upper-limit* state. Used for the GRADING mode.
Up Limit	Not available for compliance check. Upper limit for the pass/fail judgement. Used for the GRADING mode.
Low Pattern	Only for limit test. Bit pattern for the *failed-by-exceeding-lower-limit* state. Used for the GRADING mode.
Low Limit	Only for limit test. Lower limit for the pass/fail judgement. Used for the GRADING mode.

Bit pattern is sent to the DIO pins specified by the GPIO Pins field on the Composite Limit Test Setup dialog box.

Trace Buffer Setup dialog box

This dialog box provides the following parameters for setting the trace function. The data specified by the Feed Data parameter can be stored in the trace buffer if the Buffer Control parameter is NEXT. The maximum data size is specified by the Buffer Size parameter. See Figure 6-7 on page 6-24 for the trace buffer.

Ch

Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2)

This field specifies the channel set by this dialog box.

Feed Data

Type of data placed in the trace buffer, SENSE, MATH, or LIMIT

SENSE: Measurement result data

MATH: Calculation result data of math expression

LIMIT: Limit test data

The data contains the voltage measurement data, current measurement data, resistance measurement data, source output setting data, calculation result data, limit test data, time data, or status data selected by using the Format keys of the I/O key group. See "I/O key group" on page 4-43.

Buffer Control

Trace buffer control mode, NEVER or NEXT

NEVER: Disables the write operation to the trace buffer.

NEXT: Enables the write operation until buffer full.

Buffer full will change the mode to NEVER.

Buffer Size

Size of the trace buffer, 1 to 100000 data

Trigger key group

Pressing the Trigger key displays the following four softkeys for setting the trigger parameters in detail and controlling the trigger system. See Figure 6-8 on page 6-28.

Config Opens a dialog box. See "Trigger Configuration dialog box" on page 4-36.

Initiate Displays the softkeys for selecting the device action to initiate (to go to the arm layer of the trigger system). See Table 4-7.

Abort Displays the softkeys for selecting the device action to abort (to return to the idle state of the trigger system). See Table 4-7.

Immediate Displays the following two softkeys for selecting the arm layer or trigger layer for sending the immediate trigger.

Trigger Selects the trigger layer.

Arm Selects the arm layer.

Selecting the layer displays the softkeys for selecting the device action to send the immediate trigger. See Table 4-7.

Table 4-7 Softkeys to Select Device Action and Channel

Softkey label	Description
ALL	Selects the transient and acquire device actions.
Trans.	Selects the transient (source output) device action only.
Acq.	Selects the acquire (measurement) device action only.
On a 1-channel model, selecting the device action executes Initiate, Abort, or Immediate for the specified device action.	
On a 2-channel model, selecting the device action displays the following three softkeys for selecting the channel.	
ALL	Selects channels 1 and 2.
Ch 1	Selects channel 1 only.
Ch 2	Selects channel 2 only.
Selecting the channel executes Initiate, Abort, or Immediate for the specified device action of the specified channel.	

Trigger Configuration dialog box

This dialog box is used to set the trigger parameters in detail. Note that the overlapped parameter values are ignored and replaced with the settings made on the Single view. See “Trigger parameters” on page 4-15.

Ch

Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2)

This field specifies the channel set by this dialog box.

Layer

Specifies the layer or device action set by this dialog box.

ARM: Arm layer

TRIGGER: Trigger layer

ACTION: Device action

For ACTION, the available parameters are Ch, Layer, Action, and Trigger Output.

Action

Specifies the device action type set by this dialog box.

TRANS.: Transient (source output) device action

ACQ.: Acquire (measurement) device action

Count

Count, 0 to 100000, for the action specified by the Ch, Layer, and Action parameters

Infinity (INF.) is available only for the arm count.

Bypass

Bypass, ON or OFF

Bypass=ON enables the bypass only for the first passage to the event detector for the action specified by the Ch, Layer, and Action parameters.

Bypass=OFF disables the bypass.

Trigger Source

Event for the action specified by the Ch, Layer, and Action parameters. AUTO, BUS, TIMER, INT1, INT2, LAN, EXT1, EXT2, EXT3, EXT4, EXT5, EXT6, EXT7, EXT8, EXT9, EXT10, EXT11, EXT12, EXT13, or EXT14. See Table 4-8.

Period

Only for the TIMER event.

Interval of the TIMER event for the action specified by the Ch, Layer, and Action parameters, 10 µs to 100000 s

Trigger Delay

Delay time for the action specified by the Ch, Layer, and Action parameters, 0 to 100 s

Trigger Output Trigger output, ON or OFF

If this parameter is ON, B2900 sends an output trigger when it changes the trigger state for the action specified by the Ch, Layer, and Action parameters. See Figure 6-8 on page 6-28. Also see "DIO Configuration dialog box" on page 4-46 for details on setting the trigger output timing.

The right field of the Trigger Output entry field shows the present setting of the trigger output terminal. In the default setting, it is the EXT1 terminal. It can be changed by the following commands.

- Between initial state and arm layer

  :ARM[:ACQ|:TRAN]:TOUT:SIGN

- Between arm layer and trigger layer

  :TRIG[:ACQ|:TRAN]:TOUT:SIGN

- Between trigger layer and transient action

  :SOUR:TOUT:SIGN

- Between trigger layer and acquire action

  :SENS:TOUT:SIGN

Table 4-8 Trigger Source

Trigger Source	Description
AUTO	Signal internally generated and optimized for the present operating mode
BUS	Remote interface trigger command such as the group execute trigger (GET) and the *TRG command
TIMER	Signal internally generated every interval set by the Period field
INT1 or INT2	Signal from the internal bus 1 or 2
LAN	LXI trigger specified by the :ARM[:ACQ|:TRAN]:SOUR:LAN and :TRIG[:ACQ|:TRAN]:SOUR:LAN commands
EXT*n*	Signal from the DIO pin *n*, which is an I/O port of the Digital I/O D-sub connector on the rear panel. *n*=1 to 14

Result key group

Pressing the Result key displays the following three softkeys for displaying the measurement, limit test, and trace results.

Measure Displays the measurement result. See “Measure Result dialog box” on page 4-38.

Limit Test Displays the limit test result. See “Limit Test Result dialog box” on page 4-39.

Trace Displays the trace result. See “Trace Statistical Result dialog box” on page 4-40.

Measure Result dialog box

This dialog box is used to display the last single (one shot) measurement result (maximum 100000 data) stored in the data buffer.

This dialog box provides the following GUI for displaying the measurement result. The result data is shown in the index and data table below the Type field. Also, the data is plotted in the graph area above the Points fields.

Ch Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2)

This field specifies the channel of the data to display.

Type Type of data to display, AMPS, VOLTS, OHMS, WATTS, MATH, or TIME

AMPS: Current measurement data

VOLTS: Voltage measurement data

OHMS: Resistance data given by Resistance=Vmeas/Imeas

WATTS: Power data given by Power=Vmeas×Imeas

MATH: Calculation result data of math expression

TIME: Time data

In the above formula, Vmeas is the voltage measurement data, and Imeas is the current measurement data.

For details on using resistance compensation, see “Resistance Compensation” on page 6-16.

Points Number of data points.

Max. Y-axis maximum value of the graph.

Min. Y-axis minimum value of the graph.

Limit Test Result dialog box

This dialog box provides the following GUI for displaying the limit test result. The result data is shown in the data list area below the Length field.

Ch Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2)

This field specifies the channel of the data to display.

Length Data length

The limit test data contains the following information.

`(aaaaa) BIN: bb  DATA: +c.cccccE+dd`

(aaaaa) Data index `aaaaa`

BIN: Bin number `bb` (`01` to `12`) See “Limit Test Setup dialog box” on page 4-32.

If the limit test data is out of the bins, `00` is set for the GRADING mode and `15` is set for the SORTING mode.

DATA: Limit test data `+c.cccccE+dd`

Trace Statistical Result dialog box

This dialog box provides the following GUI for displaying the trace statistical result. The result data is displayed in the Mean, Std. Dev., Min., and Max. fields.

Ch — Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2)

This field specifies the channel of the data to display.

Feed — Always SENSE

Element — Type of data to display, AMPS, VOLTS, or OHMS

AMPS: Current measurement data

VOLTS: Voltage measurement data

OHMS: Resistance data given by Resistance=Vmeas/Imeas

In the above formula, Vmeas is the voltage measurement data, and Imeas is the current measurement data.

For details on using resistance compensation, see “Resistance Compensation” on page 6-16.

Length — Data length

Mean — Mean value

Std. Dev. — Standard deviation

Min. — Minimum value

Max. — Maximum value

File key group

Pressing the File key displays the following two softkeys for saving a file on and loading a file from a USB memory connected to the front panel USB-A connector.

Save

Displays the following five softkeys for saving a file. Pressing a softkey displays the File Selection dialog box. See “File Selection dialog box” on page 4-41.

Measure Saves a measurement data file.

Math Saves a math result data file.

Limit Test Saves a limit test result data file.

Trace Saves a trace buffer data file.

Config Saves a system setting data file.

Load

Displays the following softkey for loading a file. Pressing the softkey displays the File Selection dialog box. See “File Selection dialog box” on page 4-41.

Config Loads a system setting data file.

File Selection dialog box

This dialog box provides the following GUI for saving or loading a file.

Path Folder name for saving or loading a file.

File Name File name to save or load.

The files and folders saved in the specified folder are listed in the area between the Path field and the File Name field. This area can be used for selecting a file to save or overwrite. To select a file, highlight its name in this area.

For saving a system setting file, if the file extension is not specified, “.sta” is added automatically. For saving the other data file, “.csv” is added automatically.

Program key group

Pressing the Program key displays the following four softkeys for setting and controlling the program memory.

The program memory can be defined by using the SCPI commands while the B2900 is in the remote mode.

Catalog Displays the Program Catalog dialog box which lists the programs saved in the program memory. This dialog box is also used to specify the memory program to use. To select a memory program, highlight its name in this list.

View Displays the Program View dialog box which shows the program code of the specified program.

Variable Displays the Variable dialog box which lists the variables used in the memory programs. Available index is 1 to 100.

Control Displays the following five softkeys for controlling the operation of the program memory.

Run	Starts the specified memory program.
Pause	Pauses the execution of the memory program.
Step	Starts the step execution of the specified memory program.
Stop	Stops the execution of the memory program.
Continue	Continues the execution of the memory program presently paused.

I/O key group

Pressing the I/O key displays the following five softkeys for setting the I/O interfaces.

Format Displays the five softkeys for setting the data output format. See “Data Output Format” on page 4-44.

LAN Displays the following four softkeys for managing the LAN interface.

- **Config** Displays the LAN Configuration dialog box used to set the configuration of the LAN interface. See “LAN Configuration dialog box” on page 4-46.
- **Status** Displays the LAN Status dialog box which displays the status of the LAN interface.
- **Reset** Resets all of the LAN connections.
- **Defaults** Sets the LAN settings to the factory default settings.

Pressing the Reset softkey or the Defaults softkey displays a confirmation dialog box. Press the OK softkey to confirm the specified action, or press the Cancel/Local key to cancel the action.

USB Displays the USB Status dialog box which displays the VISA USB connect string.

Example: `USB0::2391::36376::MY12345678::0::INSTR`

GPIB Displays the GPIB Configuration dialog box used to set the GPIB address of the B2900. This dialog also displays the VISA GPIB connect string.

Example: `GPIB0::23::INSTR`

DIO Displays the following two softkeys for managing the Digital I/O interface.

- **Config** Displays the DIO Configuration dialog box used to set the configuration of the Digital I/O interface. See “DIO Configuration dialog box” on page 4-46.
- **R/W** Displays the DIO Read/Write dialog box used to read or write a value set to the Digital I/O interface. See “DIO Read/Write dialog box” on page 4-47.

Data Output Format

Pressing the Format softkey displays the following five softkeys for setting the format and elements of the output data.

Measure Displays the Format (Measure) dialog box used to set the elements of the measurement data output. See “Format (Measure) dialog box” on page 4-44.

Math/Limit Displays the Format (Math/Limit) dialog box used to set the elements of the math result data output and the limit test result data output. See “Format (Math/Limit) dialog box” on page 4-45.

Trace Displays the Format (Trace) dialog box used to set the elements of the trace data output. See “Format (Trace) dialog box” on page 4-45.

Data Type Displays the following three softkeys for specifying the data output format. The present setting is indicated by an asterisk on the softkey label.

- **ASCII** ASCII format
- **REAL32** IEEE-754 single precision format, 4-byte
- **REAL64** IEEE-754 double precision format, 8-byte

Byte Swap Displays the following two softkeys for enabling or disabling the byte swap for the IEEE-754 precision format data output. The present setting is indicated by an asterisk on the softkey label.

- **OFF** Disables the byte swap. Normal byte order.
- **ON** Enables the byte swap. Reverse byte order.

If Byte Swap=ON, the byte order is reversed. Byte 1 to byte 4 are sent in the order of byte 4 to byte 1 for the IEEE-754 single precision format, and byte 1 to byte 8 are sent in the order of byte 8 to byte 1 for the IEEE-754 double precision format.

Format (Measure) dialog box

This dialog box provides the following parameters for setting the elements of the measurement data output.

Voltage Voltage data output, ON or OFF

Current Current data output, ON or OFF

Resistance	Resistance data output, ON or OFF
Source	Source data output, ON or OFF
Time	Time data output, ON or OFF
Status	Status data output, ON or OFF

Format (Math/Limit) dialog box

This dialog box provides the following parameters for setting the elements of the math result data output and the limit test result data output.

Data	Result data output, ON or OFF
Time	Time data output, ON or OFF
Status	Status data output, ON or OFF

Format (Trace) dialog box

This dialog box provides the following parameters for setting the elements of the trace statistical data output.

Ch Only on 2-channel models. Channel 1 (Ch 1) or 2 (Ch 2)

This field specifies the channel set by this dialog box.

Data Trace data. Selects one from the following data elements.

MEAN	Mean value
STD.DEV.	Standard deviation
MIN.	Minimum value
MAX.	Maximum value
PK-PK	Peak to peak value

Timestamp Timestamp data format. Selects one from the following selections.

ABSOLUTE	Absolute value (ABS.). Returns the incremental value for the first timestamp data.
DELTA	Delta value (DELTA). Returns the incremental value for the previous timestamp data.

LAN Configuration dialog box

This dialog box provides the following parameters for setting the configuration of the LAN interface.

mDNS	mDNS (multicast DNS) status, ON or OFF
IP Address Config.	IP address configuration, AUTO or MANUAL
	AUTO configuration uses the DHCP server.
IP Address	IP address of this instrument, used for the MANUAL IP address configuration
Subnet	Subnet mask, used for the MANUAL IP address configuration
Gateway	IP address of gateway, used for the MANUAL IP address configuration
DNS Server Config.	DNS server configuration, AUTO or MANUAL
DNS Server	IP address of DNS server, primary and secondary, used for the MANUAL DNS server configuration
Hostname	Host name of this instrument
WINS Server	IP address of WINS server, primary and secondary

DIO Configuration dialog box

This dialog box provides the following parameters for setting the configuration of the Digital I/O interface.

Pin #	Digital I/O pin number, 1 to 14
	This field specifies the pin set by this dialog box.
Function	Function of the specified pin of the Digital I/O interface, digital signal input/output (DIGITAL I/O), digital signal input (DIGITAL IN), trigger output (TRIGGER OUT), trigger input (TRIGGER IN), or high voltage state (HIGH VOLTAGE LAMP, HI-VOLT LAMP, only for pin 14)
	If Function is set to HIGH VOLTAGE LAMP, other setup parameters on this dialog box is ignored.
Polarity	Polarity of the input/output function, positive (POSITIVE, POS.) or negative (NEGATIVE, NEG.)

Output Trigger Type	Type of output trigger, edge (EDGE) or level (LEVEL)
Output Trigger Timing	Timing of the output trigger, after action (arm, trigger, and device action) (AFTER), before action (BEFORE), or both (BOTH)
Output Pulse Width	Pulse width of the output trigger, 10 µs to 10 ms

For more information about the trigger function, see “Trigger key group” on page 4-35.

DIO Read/Write dialog box

This dialog box provides the following parameters for reading or writing a value set to the Digital I/O interface.

Format	Format of the value set to the Mask Value field and the Value field, binary (BIN), decimal (DEC), or hexadecimal (HEX)
Mask Value	Mask value which indicates the pattern of the un-used bits of the Digital I/O interface The READ assist key is used to read the mask value presently set to the Digital I/O interface. The WRITE assist key is used to set the specified mask value to the Digital I/O interface.
Value	Value set to the Digital I/O interface The READ assist key is used to read the value presently set to the Digital I/O interface. The WRITE assist key is used to write the specified value to the Digital I/O interface.

Display key group

Pressing the Display key displays the following four softkeys for setting the display functions. The present setting is indicated by an asterisk on the softkey label.

Remote

Displays the following two softkeys for enabling or disabling the front panel display when the B2900 is in the remote mode.

OFF Disables the front panel display. Effective for fast operation.

ON Enables the front panel display.

Color

Displays the following two softkeys for specifying the display color set.

Set 1 Sets the color set 1.

Set 2 Sets the color set 2.

Zoom

Displays the following two softkeys for enabling or disabling the display zoom.

OFF Disables the zoom. Normal display.

ON Enables the zoom. Only the measured data is displayed.

Zoom-in can be cancelled by pressing the Zoom Out assist key.

In the zoom-in state, setup information is not displayed, and the measurement result is zoomed. Then,

- the Dual view displays the primary measurement data with a large font, and the secondary measurement data for each channel with a small font.
- the Single view displays the primary and secondary measurement data with a large font.

Digits

Displays the following four softkeys for specifying the data display resolution.

4 Sets 3½ digit resolution.

5 Sets 4½ digit resolution.

6 Sets 5½ digit resolution.

7 Sets 6½ digit resolution.

System key group

Pressing the System key displays the following nine softkeys used for several system setups.

Error Displays the following two softkeys to view or clear errors.

- **Log** Displays the Error Log dialog box which displays the SCPI errors.
- **Clear** Clears the error buffer immediately.

Reset Initializes the B2900.

Pressing the Reset softkey displays a confirmation dialog box. Press the OK softkey to start initialization, or the Cancel/Local key to cancel.

Cal/Test Displays the following two softkeys for performing self-calibration or self-test.

- **Self-Cal** Performs self-calibration.
- **Self-Test** Performs self-test.

Pressing the softkey displays a confirmation dialog box. Press the OK softkey to start self-calibration or self-test, or the Cancel/Local key to cancel.

PLC Displays the following two softkeys to specify the power line frequency. The present setting is indicated by an asterisk on the softkey label.

- **50 Hz** Specifies the power line frequency 50 Hz.
- **60 Hz** Specifies the power line frequency 60 Hz.

Timestamp Displays the following two softkeys to clear timestamp.

- **Clear** Clears the timestamp. Pressing this softkey displays the confirmation dialog box. Press the OK softkey to clear the timestamp, or the Cancel/Local key to cancel.
- **Auto CLR** Displays the following two softkeys for setting the automatic clear of the timestamp. The present setting is indicated by an asterisk on the softkey label.
  - **OFF** Disables the automatic clear of the timestamp.
  - **ON** Enables the automatic clear of the timestamp.

Start-up

Displays the System Start-up dialog box which provides the following setup parameters.

Power-on State Power-on state, RST, RCL0, RCL1, RCL2, RCL3, or RCL4

The power-on state can be selected from the factory default reset condition (RST) and user conditions RCL0, RCL1, RCL2, RCL3, and RCL4 which can be defined by using the *SAV 0, *SAV 1, *SAV 2, *SAV 3, and *SAV 4 commands, respectively, while the B2900 is in the remote mode.

Power-on Program Power-on program execution ON or OFF

If this parameter is ON, the power-on program is automatically executed when the B2900 is turned on.

The power-on program can be defined by using the :PROG:PON:COPY command while the B2900 is in the remote mode.

Sound

Displays the following two softkeys to enable or disable the beep and sound. The present setting is indicated by an asterisk on the softkey label.

OFF Disables the beep and sound.

ON Enables the beep and sound.

SCPI

Displays the following two softkeys for specifying the B2900 remote control command set. The present setting is indicated by an asterisk on the softkey label.

Default Specifies the default command set which supports all B2900 functions.

2400 Specifies the conventional command set designed for using the existing programs which you created to control existing instruments, such as Series 2400 by Keithley Instruments, Inc.

Info.

Displays the following four softkeys.

Revision Displays the Revision dialog box which displays the model number, serial number, and firmware revision of the B2900.

Date/Time Displays the Date and Time dialog box which is used to view or set the date and time.

Update Used for firmware update.

Demo. Starts demonstration.

5 Front Panel Operations

This chapter explains how to use the Agilent B2900.

- “Basic Operations”
- “Configuring Various Settings”
- “Controlling the Source Output”
- “Controlling the Measurement Function”
- “Using the Math Function”
- “Performing the Limit Test”
- “Using the Trace Buffer”
- “Using Program Memory”

NOTE

Turning the instrument on or off

Press the line switch. When the power is on, the LED below the switch is turned green.

NOTE

Setting the instrument to local mode

Press the Cancel/Local key.

The front panel keys are available when the instrument is in local mode.

NOTE

Enabling or disabling the channel

Press the On/Off switch.

The channel status is indicated by the lighting status of the switch as follows.

Off: The channel is disabled.

Green: The channel is enabled.

Red: The channel is in the high voltage state.

NOTE

Starting measurement

Press the Trigger key. According to the setting conditions, the single (one shot) measurement is performed with the DC bias output, staircase sweep output, pulsed bias output, or pulsed sweep output.

Press the Auto key. The repeat (continuous) measurement is performed with the DC bias output (of the Source value).

Basic Operations

Use the field pointer to specify a setup field in the setup screen. The field pointer can take the following states. Change the status as needed during the setup of B2900.

MOVE status Highlighted in blue. You can move the pointer from field to field.

EDIT status Highlighted in green. You can change the value of the current field.

Changing the Setting in a Field

1. If the field pointer is in the EDIT status, press the rotary knob. The pointer status is changed to MOVE.
2. Turn the rotary knob or press the arrow keys to move the field pointer.
3. Move the field pointer to the item to be changed and press the rotary knob. The pointer status is changed to EDIT.
4. Enter a value or character by pressing the numeric/alpha keys, turning the rotary knob, or pressing the arrow keys. Press the rotary knob to fix the setting value. The pointer status is changed to MOVE.

   Or press the assist key corresponding to the setting value to fix the setting value. The pointer status is changed to MOVE.

NOTE

Digit pointer

In numeric value entry fields such as the Source and Limit (Compliance) fields, you can specify only one digit to change its value.

When the field pointer is in the EDIT status (i.e., all digits in the entry field are highlighted in green), pressing the arrow keys changes the pointer to the digit pointer, which points only one digit in the entry field. In this status, the following operations are allowed.

The arrow keys are used to move the pointer.

The numeric/alpha keys and rotary knob are used to change the value of the digit indicated by the pointer.

When the pointer is on the decimal point, turning the knob moves the decimal point.

Changing the Settings on a Dialog Box

1. Set the items on the dialog box in the same way as described in “Changing the Setting in a Field” on page 5-3.
2. To apply the settings, press Apply.

   To apply all settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key instead of pressing Apply.

Configuring Various Settings

This section describes how to configure various settings apart from the source output and measurement functions.

- "Setting the Power Frequency"
- "Resetting to the Initial Settings"
- "Setting the Beeper"
- "Setting the Date and Time"
- "Performing the Self-Test"
- "Performing the Self-Calibration"
- "Setting the Operations at Power On"
- "Displaying the Error Message"
- "Clearing the Error Buffer"
- "Clearing Timestamp"
- "Setting the Automatic Clear of Timestamp"
- "Displaying the Firmware Revision"
- "Setting the GPIB Address"
- "Setting the Remote Control Command Set"
- "Setting the Remote Display Mode"

Setting the Power Frequency

1. Press the More > System > PLC function keys.
2. Press 50 Hz or 60 Hz. To cancel the setting change, press the Cancel/Local key.

Resetting to the Initial Settings

1. Press the More > System > Reset function keys.

   The Confirmation dialog box is displayed.
2. Press OK to reset. To cancel the operation, press the Cancel/Local key.

Setting the Beeper

1. Press the More > System > More > Sound function keys.
2. To enable the beeper, press ON. To disable it, press OFF. To cancel the setting change, press the Cancel/Local key.

Setting the Date and Time

1. Press the More > System > More > Info. function keys.
2. Press Date/Time.

   The Date and Time dialog box is displayed.
3. Set the date and time.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Performing the Self-Test

1. Press the On/Off switch and confirm that the switch is turned off.
2. Disconnect test leads and cables from the channel terminals.
3. Press the More > System > Cal/Test > Self-Test function keys.

   The Confirmation dialog box is displayed.
4. Press OK to perform the self-test. To cancel the operation, press the Cancel/Local key.

Performing the Self-Calibration

The self-calibration must be performed after warming-up of 60 minutes.

1. Press the On/Off switch and confirm that the switch is turned off.
2. Disconnect test leads and cables from the channel terminals.
3. Press the More > System > Cal/Test > Self-Cal function keys.

   The Confirmation dialog box is displayed.

4. Press OK to perform the self-calibration. To cancel the operation, press the Cancel/Local key.

Setting the Operations at Power On

1. Press the More > System > More > Start-up function keys.

   The System Start-up dialog box is displayed.

2. See “Start-up” on page 4-50 to set each parameter.

Displaying the Error Message

1. Press the More > System > Error function keys.
2. Press Log.

   The error message is displayed in the Error Log dialog box.

3. Press OK to close the dialog box.

Clearing the Error Buffer

1. Press the More > System > Error function keys.
2. To clear the error buffer, press Clear. To cancel the operation, press the Cancel/Local key.

Clearing Timestamp

1. Press the More > System > Timestamp function keys.
2. Press Clear. The Confirmation dialog box is displayed.
3. To perform the operation, press OK. To cancel the operation, press the Cancel/Local key.

Setting the Automatic Clear of Timestamp

1. Press the More > System > Timestamp function keys.
2. Press Auto CLR.
3. To enable the automatic clear, press ON. To disable it, press OFF. To cancel the setting change, press the Cancel/Local key.

Displaying the Firmware Revision

1. Press the More > System > More > Info. function keys.
2. Press Revision.

   The revision information is displayed in the Revision dialog box.
3. Press OK to close the dialog box.

Setting the GPIB Address

1. Press the More > I/O function keys.
2. Press GPIB.

   The GPIB Configuration dialog box is displayed.
3. Set the GPIB address.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Setting the Remote Control Command Set

1. Press the More > System > More > SCPI function keys.
2. To use the default command set, press Default. To use the conventional command set, press 2400.
3. If the command set is changed, the Confirmation dialog box is displayed. To perform the operation, press OK. To cancel the operation, press the Cancel/Local key.

Setting the Remote Display Mode

1. Press the More > Display function keys.
2. Press Remote.
3. To enable the screen display in remote mode, press ON. To disable it, press OFF. To cancel the setting change, press the Cancel/Local key.

Controlling the Source Output

This section describes how to control the source output of Agilent B2900.

- “Setting the Source Output Mode”
- “Applying the DC Voltage/Current”
- “Stopping the Source Output”
- “Setting the Limit/Compliance Value”
- “Setting the Output Range”
- “Setting the Pulse Output”
- “Setting the Sweep Output”
- “Setting the List Sweep Output”
- “Setting the Source Output Trigger Parameters”
- “Setting the Source Wait Time”
- “Setting the Output Filter”
- “Setting the Connection Type”
- “Setting the Low Terminal State”
- “Enabling or Disabling the High Capacitance Mode”
- “Enabling or Disabling the Over Voltage/Current Protection”
- “Specifying the Output-Off Status”
- “Enabling or Disabling the Automatic Output-On Function”
- “Enabling or Disabling the Automatic Output-Off Function”
- “Setting the Ranging Mode of the Sweep Source”
- “Setting the Sweep Direction”
- “Setting the Source Output Value after Sweep”

Setting the Source Output Mode

1. For the Single view, press the Mode assist key. For the Dual view, press the Ch1 Mode or Ch2 Mode assist key.

The field pointer moves to the Source mode setup field.

2. To set the source mode to voltage source mode, press the VOLTS (V) assist key. To set it to current source mode, press the AMPS (I) assist key.

Applying the DC Voltage/Current

1. For the Single view, press the Source assist key. For the Dual view, press the Ch1 Source or Ch2 Source assist key.

   The field pointer moves to the Source value setup field.

2. Enter the output value by using the numeric/alpha keys, rotary knob, and arrow keys.
3. Press the rotary knob or assist key to fix the setting value.
4. Press the On/Off switch for channel 1 or 2 (Ch 1 or Ch 2).

   The output of the specified voltage/current starts. While the switch is turned green, the output continues and changes in setting values are immediately reflected in the output.

Stopping the Source Output

1. Press the On/Off switch for channel 1 or 2 (Ch 1 or Ch 2).

   The output and measurement are stopped and the switch turns off.

Setting the Limit/Compliance Value

For details on this function, see “Limit/Compliance” on page 6-3.

1. For the Single view, press the Limit assist key. For the Dual view, press the Ch1 Limit or Ch2 Limit assist key.

   The field pointer moves to the Limit (Compliance) field.

2. Enter the limit/compliance value by using the numeric/alpha keys, rotary knob, and arrow keys.
3. Press the rotary knob or assist key to fix the setting value.

Setting the Output Range

For details on this function, see “Ranging Mode” on page 6-4 and “Range parameters” on page 4-11.

1. Press the View key to display the Single view. If the Range parameters are not displayed, press the Hide XXXX assist key.
2. Move the field pointer to the Source Volts: Spot (voltage source range) or Source Amps: Spot (current source range) field.
3. Press the rotary knob to change the pointer status to EDIT.
4. To set the range operation mode to the auto range operation, press the AUTO assist key. To set it to the fixed range operation, press the FIXED assist key. The pointer status is changed to MOVE.
5. Move the field pointer to the range value setup field (on the right side of the Source Volts: Spot or Source Amps: Spot field).
6. Press the rotary knob to change the pointer status to EDIT.
7. Press the assist key to set the output range.

   For the auto range operation, set the minimum range of the range operation.

   For the fixed range operation, set the range to be used.

Setting the Pulse Output

For details on this function, see “Pulse Output” on page 6-7.

1. Press the View key to display the Single view.
2. Press the Show Pulse assist key to display the Pulse parameters. For details on the parameters, see “Pulse parameters” on page 4-14.
3. Move the field pointer to the Pulse field.
4. Press the rotary knob to change the pointer status to EDIT.
5. Press the ON assist key. The pointer status is changed to MOVE.
6. Move the field pointer to the pulse parameter setup field (Peak, Delay, or Width).
7. Press the rotary knob to change the pointer status to EDIT.
8. Enter the pulse peak value (Peak), delay time (Delay), or pulse width (Width).
9. Press the rotary knob or assist key to fix the setting value.
10. Repeat steps 6 to 9 for all parameters.

NOTE Outputting the pulse voltage/current

Press the On/Off switch to start outputting the Source value. The Source value is used as the pulse base value.

Press the Trigger key to perform the specified pulse output and measurement.

Setting the Sweep Output

For details on this function, see “Sweep Output” on page 6-9.

The following procedure sets the staircase sweep output.

Before performing the pulsed sweep output, it is necessary to set the staircase sweep output and pulse output. For details on setting the pulse output, see “Setting the Pulse Output” on page 5-11.

1. Press the View key to display the Single view.
2. Press the Show Sweep assist key to display the Sweep parameters. For details on the parameters, see “Sweep parameters” on page 4-12.
3. Move the field pointer to the Sweep Parameters field.
4. Press the rotary knob to change the pointer status to EDIT.
5. Press the LINEAR SINGLE, LINEAR DOUBLE, LOG SINGLE, or LOG DOUBLE assist key to select the relevant sweep operation. The pointer status is changed to MOVE.
6. Move the field pointer to the sweep parameter setup field (Start, Stop, Points, or Step).
7. Press the rotary knob to change the pointer status to EDIT.
8. Enter the sweep start value (Start), sweep stop value (Stop), number of sweep steps (Points), or sweep step value (Step).
9. Press the rotary knob or assist key to fix the setting value.
10. Repeat steps 6 to 9 for all parameters.

NOTE

Outputting the sweep voltage/current

Press the On/Off switch to start outputting the Source value.

Press the Trigger key to perform the specified sweep output and measurement.

Setting the List Sweep Output

For details on this function, see “List Sweep” on page 6-10.

1. Press the View key to display the Single view.
2. Press the Show Sweep assist key to display the Sweep parameters.
3. Move the field pointer to the Sweep Parameters field.
4. Press the rotary knob to change the pointer status to EDIT.
5. Press the LIST assist key. The pointer status is changed to MOVE.
6. Move the field pointer to the sweep parameter setup field (Start, Stop, or Points).
7. Press the rotary knob to change the pointer status to EDIT.
8. Press the Edit assist key. The List Sweep dialog box is displayed.
9. Set the list sweep source using the List Sweep dialog box. For details, see “List sweep setup” on page 4-12.
10. To apply the settings, press Apply.

    To apply the settings and close the dialog box, press OK.

    To cancel the setting change, press the Cancel/Local key.

NOTE Load assist key

If you press the Load assist key instead of the Edit assist key in step 8, the Load List Sweep Data dialog box is displayed to allow you to load list sweep data from a USB memory.

For details, see “List sweep setup” on page 4-12.

NOTE Outputting the list sweep voltage/current

Press the On/Off switch to start outputting the Source value.

Press the Trigger key to perform the specified list sweep output and measurement.

Setting the Source Output Trigger Parameters

For details on this function, see “Trigger System” on page 6-27.

1. Press the View key to display the Single view.

2. Press the Show Trigger assist key to display the Trigger parameters. For details on the parameters, see “Trigger parameters” on page 4-15.
3. Move the field pointer to the Trigger field.
4. Press the rotary knob to change the pointer status to EDIT.
5. Press the AUTO, SYNC, TIMER, or MANUAL assist key to set the trigger type. The pointer status is changed to MOVE.
6. Move the field pointer to the trigger parameter setup field (Count, Delay, Period, or Trigger in the Source column).
7. Press the rotary knob to change the pointer status to EDIT.
8. Enter the trigger count (Count), trigger delay time (Delay), trigger period (Period), or trigger source (Trigger).
9. Press the rotary knob or assist key to fix the setting value.
10. Repeat steps 6 to 9 for all parameters.

NOTE

If you want to set the trigger parameters in detail, select the MANUAL trigger type and use the Trigger Configuration dialog box opened by pressing the Trigger > Config function keys. See “Trigger key group” on page 4-35.

Setting the Source Wait Time

For details on this function, see “Measurement Time” on page 6-5.

1. Press the Config > Common > Wait function keys.

   The Wait Control dialog box is displayed.
2. Set each parameter in the Source column. For details on the parameters, see “Wait Control dialog box” on page 4-29.
3. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Setting the Output Filter

For details on this function, see “Output Filter” on page 6-11.

1. Press the Config > Source > Filter function keys.

The Output Filter dialog box is displayed.

2. Set each parameter. For details on the parameters, see “Output Filter dialog box” on page 4-26.
3. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Setting the Connection Type

For details on this function, see “2-Wire Connections or 4-Wire Connections” on page 3-11.

1. Press the Config > Source > Connection function keys.

   The Output Connection dialog box is displayed.
2. In the Ch field, set the channel to which the setting change is applied.
3. Set 2-WIRE or 4-WIRE in the Sensing Type field.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Setting the Low Terminal State

For details on this function, see “Floating” on page 3-12.

1. Press the Config > Source > Connection function keys.

   The Output Connection dialog box is displayed.
2. In the Ch field, set the channel to which the setting change is applied.
3. Set GROUNDED or FLOATING in the Low Terminal State field.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Enabling or Disabling the High Capacitance Mode

For details on this function, see “High Capacitance Mode” on page 6-15.

1. Press the Config > Source > Connection function keys.

   The Output Connection dialog box is displayed.
2. In the Ch field, set the channel to which the setting change is applied.
3. Set ON (enable) or OFF (disable) in the High Capacitance Mode field.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Enabling or Disabling the Over Voltage/Current Protection

For details on this function, see “Over Voltage/Current Protection” on page 6-12.

1. Press the Config > Source > Connection function keys.

   The Output Connection dialog box is displayed.
2. In the Ch field, set the channel to which the setting change is applied.
3. Set ON (enable) or OFF (disable) in the Over Voltage/Current Protection field.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Specifying the Output-Off Status

For details on this function, see “Output-Off Status” on page 6-13.

1. Press the Config > Source > Connection function keys.

   The Output Connection dialog box is displayed.
2. In the Ch field, set the channel to which the setting change is applied.
3. Set HIGH Z (high impedance), NORMAL (normal), or ZERO (zero volt) in the Output-Off State field.
4. To apply the settings, press Apply.

To apply the settings and close the dialog box, press OK.

To cancel the setting change, press the Cancel/Local key.

Enabling or Disabling the Automatic Output-On Function

For details on this function, see “Automatic Output-ON/OFF Function” on page 6-14.

1. Press the Config > Source > Connection function keys.

   The Output Connection dialog box is displayed.

2. In the Ch field, set the channel to which the setting change is applied.
3. Set ON (enable) or OFF (disable) in the Auto Output-On field.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Enabling or Disabling the Automatic Output-Off Function

For details on this function, see “Automatic Output-ON/OFF Function” on page 6-14.

1. Press the Config > Source > Connection function keys.

   The Output Connection dialog box is displayed.

2. In the Ch field, set the channel to which the setting change is applied.
3. Set ON (enable) or OFF (disable) in the Auto Output-Off field.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Setting the Ranging Mode of the Sweep Source

For details on this function, see “Ranging Mode” on page 6-4.

1. Press the Config > Source > Sweep function keys.

The Sweep dialog box is displayed.

2. In the Ch field, set the channel to which the setting change is applied.
3. Set BEST, AUTO, or FIXED in the Sweep Ranging field. For details, see “Sweep dialog box” on page 4-27.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Setting the Sweep Direction

1. Press the Config > Source > Sweep function keys.

   The Sweep dialog box is displayed.

2. In the Ch field, set the channel to which the setting change is applied.
3. Set UP or DOWN in the Sweep Direction field. For details, see “Sweep dialog box” on page 4-27.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Setting the Source Output Value after Sweep

1. Press the Config > Source > Sweep function keys.

   The Sweep dialog box is displayed.

2. In the Ch field, set the channel to which the setting change is applied.
3. Set START VALUE or END VALUE in the Output after Sweep field. For details, see “Sweep dialog box” on page 4-27.
4. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Controlling the Measurement Function

This section describes how to control the measurement function of Agilent B2900.

- “Enabling the Resistance Measurement”
- “Setting the Measurement Mode”
- “Performing Spot Measurement”
- “Stopping Measurement”
- “Setting the Measurement Speed”
- “Setting the Measurement Range”
- “Performing Sweep Measurement”
- “Setting the Measurement Trigger Parameters”
- “Setting the Measurement Wait Time”
- “Setting the Measurement Auto Range Operation”
- “Enabling or Disabling the Resistance Compensation”

Enabling the Resistance Measurement

1. Press the View key to display the Single view. If the Range parameters are not displayed, press the Hide XXXX assist key.
2. Move the field pointer to the Measure Ohms (resistance measurement range) field. If this field is set to OFF, the resistance measurement is disabled.
3. Press the rotary knob to change the pointer status to EDIT.
4. Press the AUTO, FIXED, or V/I assist key to set the resistance measurement operation. The pointer status is changed to MOVE.

   For details on the resistance measurement operation, see “Range parameters” on page 4-11.

   To set the measurement range continuously, see “Setting the Measurement Range” on page 5-21.

Setting the Measurement Mode

1. For the Single view, press the Measure assist key. For the Dual view, press the Ch1 Measure or Ch2 Measure assist key.
2. To set the measurement mode to the current measurement, press the AMPS (I) assist key. To set it to the voltage measurement, press the VOLTS (V) assist key. To set it to the resistance measurement, press the OHMS (R) assist key. To set it to the power measurement, press the WATTS (P) assist key.

Performing Spot Measurement

1. Set the measurement mode. For details, see “Setting the Measurement Mode” on page 5-20.
2. Set the output voltage or current. For details, see “Applying the DC Voltage/Current” on page 5-10.
3. Press the On/Off switch for channel 1 or 2 (Ch1 or Ch2).

   The output of the specified voltage/current starts. While the switch is turned green, the output continues and changes in setting values are immediately reflected in the output.
4. Press the Trigger key.

   The spot measurement is performed.

NOTE

For details on how to change the Limit/Compliance value, see “Setting the Limit/Compliance Value” on page 5-10.

Stopping Measurement

1. Press the On/Off switch for channel 1 or 2 (Ch1 or Ch2).

   The output and measurement are stopped and the switch turns off.

Setting the Measurement Speed

For details on this function, see “Measurement Time” on page 6-5.

1. Press the View key to display the Single view.
2. Press the Speed assist key.

3. Press the AUTO, SHORT, MEDIUM, NORMAL, LONG, or MANUAL assist key to set the measurement speed. For details, see “Speed” on page 4-10.
4. When MANUAL is specified, the aperture time setup field and PLC setup field are displayed. Enter and fix a value in either of the fields to set the measurement speed.

Setting the Measurement Range

For details on this function, see “Ranging Mode” on page 6-4 and “Range parameters” on page 4-11.

1. Press the View key to display the Single view. If the Range parameters are not displayed, press the Hide XXXX assist key.
2. Move the field pointer to the Measure Volts (voltage measurement range), Measure Amps (current measurement range), or Measure Ohms (resistance measurement range) field.
3. Press the rotary knob to change the pointer status to EDIT.
4. To set the range operation mode to the auto range operation, press the AUTO assist key. To set it to the fixed range operation, press the FIXED assist key. The pointer status is changed to MOVE.
5. Move the field pointer to the range value setup field (on the right side of the Measure Volts, Measure Amps, or Measure Ohms field).
6. Press the rotary knob to change the pointer status to EDIT.
7. Press the assist key to set the measurement range.

   For the auto range operation, set the minimum range of the range operation.

   For the fixed range operation, set the range to be used.

Performing Sweep Measurement

For details on this function, see “Sweep Output” on page 6-9.

1. Press the View key to display the Single view.
2. Set the source function. For details, see “Setting the Source Output Mode” on page 5-9.
3. Set the Source value and Limit (Compliance) value. For details, see “Applying the DC Voltage/Current” on page 5-10 and “Setting the Limit/Compliance Value” on page 5-10.

4. Set the measurement mode. For details, see “Setting the Measurement Mode” on page 5-20.
5. Set the sweep source. For details, see “Setting the Sweep Output” on page 5-12.
6. Press the View key to display the Graph view.
7. Press the On/Off switch for channel 1 or 2 (Ch1 or Ch2).

   The output of the Source value starts. While the switch is turned green, the output continues and changes in setting values are immediately reflected in the output.
8. Press the Trigger key.

   The sweep measurement is performed and the measurement result is displayed in a graph.

Setting the Measurement Trigger Parameters

For details on this function, see “Trigger System” on page 6-27.

1. Press the View key to display the Single view.
2. Press the Show Trigger assist key to display the Trigger parameters. For details on the parameters, see “Trigger parameters” on page 4-15.
3. Move the field pointer to the Trigger field.
4. Press the rotary knob to change the pointer status to EDIT.
5. Press the AUTO, SYNC, TIMER, or MANUAL assist key to set the trigger type. The pointer status is changed to MOVE.
6. Move the field pointer to the trigger parameter setup field (Count, Delay, Period, or Trigger in the Measure column).
7. Press the rotary knob to change the pointer status to EDIT.
8. Enter the trigger count (Count), trigger delay time (Delay), trigger period (Period), or trigger source (Trigger).
9. Press the rotary knob or assist key to fix the setting value.
10. Repeat steps 6 to 9 for all parameters.

NOTE

If you want to set the trigger parameters in detail, select the MANUAL trigger type and use the Trigger Configuration dialog box opened by pressing the Trigger > Config function keys. See “Trigger key group” on page 4-35.

Setting the Measurement Wait Time

For details on this function, see “Measurement Time” on page 6-5.

1. Press the Config > Common > Wait function keys.

   The Wait Control dialog box is displayed.

2. Set each parameter in the Measure column. For details on the parameters, see “Wait Control dialog box” on page 4-29.

3. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Setting the Measurement Auto Range Operation

For details on this function, see “Ranging dialog box” on page 4-28.

1. Press the Config > Measure > Ranging function keys.

   The Ranging dialog box is displayed.

2. In the Ch field, set the channel to which the setting change is applied.

3. Set the current measurement auto range operation (NORMAL, SPEED, or RESOLN) in the Current Auto Ranging field.

   Also, set the threshold of the auto range operation in the Threshold field.

4. Set the voltage measurement auto range operation (NORMAL, SPEED, or RESOLN) in the Voltage Auto Ranging field.

   Also, set the threshold of the auto range operation in the Threshold field.

5. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Enabling or Disabling the Resistance Compensation

1. Press the Config > Measure > R Compen function keys.
2. Specify the channel to which the setting change is applied.

   ALL: Channels 1 and 2 (Ch 1 and Ch 2)

   Ch 1: Channel 1 (Ch 1) only

   Ch 2: Channel 2 (Ch 2) only
3. To enable the resistance compensation, press ON. To disable it, press OFF. To cancel the setting change, press the Cancel/Local key.

Using the Math Function

This section describes how to use the math function. For details on this function, see “Math Expression” on page 6-17. Also, for details on the setup parameters, see “Math Expression dialog box” on page 4-30.

1. Press the Function > Math function keys.

   The Math Expression dialog box is displayed.

2. In the Ch field, set the channel to which the setting change is applied.
3. In the Status field, set ON (enable) or OFF (disable) for the math function.
4. In the Unit String field, enter the unit for the calculation result data.

   To enter alphabets, press the ABC assist key and then use the numeric/alpha keys.

   To enter numbers, press the 123 assist key and then use the numeric/alpha keys.

   To delete a character, highlight the character to be deleted and then press the Delete function key.

   To insert a character, highlight the character at the position where to insert the character and then press the Insert function key.

5. Select a math expression to use.

   To select a math expression, highlight the name of the math expression in the list area below the Unit String field.

6. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

Performing the Limit Test

This section describes how to set the limit test and how to display the result of the limit test. For details on this function, see “Limit Test” on page 6-20.

To perform the limit test, set the composite limit test, individual limit tests, and source output and measurement conditions, and then press the Trigger key.

- “Setting the Composite Limit Test”
- “Setting Individual Limit Tests”
- “Displaying the Limit Test Result”

Setting the Composite Limit Test

For details on the setup parameters, see “Composite Limit Test Setup dialog box” on page 4-31.

1. Press the Function > Limit Test > Composite function keys.

   The Composite Limit Test dialog box is displayed.

2. In the Ch field, set the channel to which the setting change is applied.
3. In the Limit Test field, set ON (enable) or OFF (disable) for the composite limit test.
4. In the Mode field, set GRADING (grading mode) or SORTING (sorting mode) for the operation mode.
5. In the Auto Clear field, set ON (enable) or OFF (disable) for the automatic clear of the composite limit test result.
6. When the operation mode is GRADING, set IMMEDIATE (for outputting results immediately) or END (for outputting results at the end) for the test result output timing in the Update field.
7. In the Offset Cancel field, set ON (enable) or OFF (disable) for the offset cancel.
8. In the Offset field, set the offset value used for the offset cancel.
9. When the operation mode is GRADING, set a bit pattern that represents the limit test pass state (Pass) in the Pass Pattern field.
10. When the operation mode is SORTING, set a bit pattern that represents the limit test fail state (Fail) in the Fail Pattern field.

11. In the /BUSY field, set the DIO pin number used for outputting the BUSY signal.
12. In the /SOT field, set the DIO pin number used for outputting the start-of-test (SOT) signal.
13. In the /EOT field, set the DIO pin number used for outputting the end-of-test (EOT) signal.
14. To apply the settings, press Apply.

    To apply the settings and close the dialog box, press OK.

    To cancel the setting change, press the Cancel/Local key.

Setting Individual Limit Tests

For details on the setup parameters, see “Limit Test Setup dialog box” on page 4-32.

1. Press the Function > Limit Test > Limits function keys.

   The Limit Test Setup dialog box is displayed.
2. In the Ch field, set the channel to which the setting change is applied.
3. In the Feed Data field, set the type of data used for the pass/fail judgement of the limit test.

   MATH: Calculation result data of math expression

   VOLTS: Voltage measurement data

   AMPS: Current measurement data

   OHMS: Resistance data given by Resistance=Vmeas/Imeas

   (Vmeas: Voltage measurement data, Imeas: Current measurement data)
4. In the Test Index field, set the index of the limit test between numbers 1 and 12.

   Index numbers 1 to 12 are also used for bin numbers 1 to 12. For details, see “Displaying the Limit Test Result” on page 5-29.
5. In the Limit Test field, set ON (enable) or OFF (disable) for the limit test identified by Test Index.
6. In the Function field, set COMPLIANCE (compliance check) or LIMIT (limit test) for the test mode.
7. When the operation mode is SORTING, set a bit pattern that represents the limit test pass state (Pass) in the Pass Pattern field.

8. When the test mode is COMPLIANCE, configure the following settings:
   - In the Fail on field, set IN or OUT for the fail judgement method.

     IN: Failure if the channel goes into the compliance state.

     OUT: Failure if the channel comes out of the compliance state.
   - In the Fail Pattern field, set a bit pattern that represents the limit test fail state (Fail).
9. When the test mode is LIMIT and the operation mode is GRADING, configure the following settings:
   - In the Up Pattern field, set a bit pattern that represents the failed-by-exceeding-upper-limit state.
   - In the Low Pattern field, set a bit pattern that represents the failed-by-exceeding-lower-limit state.
   - In the Up Limit field, set the upper limit for the pass/fail judgement.
   - In the Low Limit field, set the lower limit for the pass/fail judgement.
10. To apply the settings, press Apply.

    To apply the settings and close the dialog box, press OK.

    To cancel the setting change, press the Cancel/Local key.

NOTE

For using MATH in the pass/fail judgement of the limit test, see “Using the Math Function” on page 5-25.

For using the resistance compensation, see “Enabling or Disabling the Resistance Compensation” on page 5-24.

Displaying the Limit Test Result

For details on the setup parameters, see “Limit Test Result dialog box” on page 4-39.

1. Press the Result > Limit Test function keys.

   The Limit Test Result dialog box is displayed.

2. In the Ch field, set the channel for the data to be displayed.

   The limit test result is displayed in the area below the Length field.

3. Press OK to close the dialog box.

The Length field displays the number of data.

In the area below the Length field, the limit test result is displayed in the following format:

```
(aaaaa) BIN: bb  DATA: +c.cccccE+ddd
```

(aaaaa) Data index `aaaaa`

BIN: Bin number `bb` (`01` to `12`). For details, see “Setting Individual Limit Tests” on page 5-27.

If the limit test data is out of the bins, `00` is set for the GRADING mode and `15` is set for the SORTING mode.

DATA: Limit test data `+c.cccccE+ddd`

Using the Trace Buffer

This section describes how to set the trace buffer and how to display the statistical data. For details on this function, see “Trace Buffer” on page 6-23.

To use the trace buffer, set the trace buffer and source output and measurement conditions, and then press the Trigger key.

- “Setting the Trace Buffer”
- “Displaying the Statistical Data”

Setting the Trace Buffer

For details on the setup parameters, see “Trace Buffer Setup dialog box” on page 4-34.

1. Press the Function > Trace function keys.

   The Trace Buffer Setup dialog box is displayed.

2. In the Ch field, set the channel to which the setting change is applied.
3. In the Feed Data field, set SENSE (for collecting the measurement result data), MATH (for collecting the calculation result data), or LIMIT (for collecting the limit test result data).
4. In the Buffer Control field, set NEXT (for enabling the write operation to the trace buffer) or NEVER (for disabling it).
5. In the Buffer Size field, set the size of the trace buffer (1 to 100000).
6. To apply the settings, press Apply.

   To apply the settings and close the dialog box, press OK.

   To cancel the setting change, press the Cancel/Local key.

NOTE

To specify the measurement result data (SENSE) to be collected, use “Format (Measure) dialog box” on page 4-44.

To specify the calculation result data (MATH) or limit test result data (LIMIT) to be collected, use “Format (Math/Limit) dialog box” on page 4-45.

To change the statistical data to be saved in the trace buffer, use “Format (Trace) dialog box” on page 4-45.

Displaying the Statistical Data

For details on the setup parameters, see “Trace Statistical Result dialog box” on page 4-40.

1. Press the Result > Trace function keys.

   The Trace Statistical Result dialog box is displayed.

2. In the Ch field, set the channel for the data to be displayed.

3. In the Element field, set SOURCE (source output data), VOLTS (voltage measurement data), AMPS (current measurement data), OHMS (resistance measurement data) for the data type of the statistical calculation.

   The statistical data for the data specified here is displayed in the area below the Length field.

4. Press OK to close the dialog box.

The Length field displays the number of data.

The statistical data is displayed in the following fields:

Mean: Mean value

Std. Dev.: Standard deviation

Min.: Minimum value

Max.: Maximum value

Using Program Memory

This section describes how to select and run a memory program. For details on this function, see “Program Memory” on page 6-25.

See also “Program key group” on page 4-42.

- “Selecting a Program”
- “Controlling the Program Operation”

Selecting a Program

1. Press the More > Program > Catalog function keys.

   The Program Catalog dialog box is displayed.

2. Highlight the name of the memory program to be run.
3. Press OK.

NOTE To set a value for a variable used in the memory program, use the Variable dialog box. For details, see “Program key group” on page 4-42.

Controlling the Program Operation

1. Press the More > Program > Control function keys.
2. Use the following keys to control the operation of a memory program.

Run	Starts the specified memory program.
Pause	Pauses the execution of the memory program.
Step	Starts the step execution of the specified memory program.
Stop	Stops the execution of the memory program.
Continue	Continues the execution of the memory program presently paused.

6 Function Details

This chapter describes the following functions of the Agilent B2900.

- “Limit/Compliance”
- “Ranging Mode”
- “Measurement Time”
- “Pulse Output”
- “Sweep Output”
- “List Sweep”
- “Output Filter”
- “Over Voltage/Current Protection”
- “Output-Off Status”
- “Automatic Output-ON/OFF Function”
- “High Capacitance Mode”
- “Resistance Measurement”
- “Math Expression”
- “Limit Test”
- “Trace Buffer”
- “Program Memory”
- “Channel Grouping”
- “Trigger System”
- “Interlock Function”
- “Over Temperature Protection”
- “Initial Settings”

Limit/Compliance

Limit/Compliance is the output limiter for preventing damage to the test device from overcurrent or overvoltage. Voltage compliance is for current output channels, and current compliance is for voltage output channels.

When a channel reaches compliance, the channel acts as a constant voltage source or a constant current source. The channel keeps the output value once compliance has been reached.

Compliance can be set with the same resolution and accuracy as output current or output voltage.

To Set Compliance

The following points must be noted when setting the compliance.

- The minimum compliance value is limited as follows.
  - Current compliance

    1 % of the range (at 100 nA Range)

    1 nA (at 10 nA Range)
  - Voltage compliance

    20 mV (at 0.2 V range)
- If the current compliance value is too low, the SMU will require a long settling time.

Ranging Mode

The following ranging modes are available for performing source output or measurement.

- FIXED (fixed range)

  The channel uses the specified range only.

- AUTO (auto range)

  The channel automatically uses the range which provides the best resolution for the source output value or the measurement value. It is possible to specify the minimum range effective for the auto range operation.

- BEST (best, only for the sweep source channel)

  In the linear sweep mode, the channel automatically uses the minimum range which covers the whole sweep output.

  In the log sweep mode, the channel automatically uses the range which provides the best resolution for each sweep step output.

Setting the Ranging Mode

The following points must be noted when setting the ranging mode.

- The measurement channel does not use ranges higher than the minimum range which covers the compliance value.
- The pulsed source channel always uses the fixed range for measurement.
- For the source side measurement, the channel uses the present source range.
- To set the ranging mode of the DC (constant) source or measurement channel, see “Range parameters” on page 4-11.
- To set the ranging mode of the sweep source channel, see “Sweep dialog box” on page 4-27.
- To set the detail of the auto ranging operation for measurements, see “Ranging dialog box” on page 4-28.

Measurement Time

Measurement time depends on aperture time, measurement range, and other measurement conditions, and can be expressed by the following formula:

Measurement time = Aperture time + Overhead time

Aperture time is the time required for measurement, and does not include such factors as range change or data compensation, which would be the overhead time.

Aperture Time

Aperture time is the time required to acquire the measurement data. For accurate and reliable measurement, the aperture time should be increased.

The aperture time is set by using the Measure Speed parameter on the Single view. See “Speed” on page 4-10.

Overhead Time

Overhead time is the time required for range change, etc. This time depends on the measurement condition, and cannot be specified. Major elements of the overhead time are:

- Range change time during measurement (when measurement ranging mode is set to AUTO)
- Range change time at the start of a measurement (when the measurement range is less than the compliance value)

To Control Source/Measure Timing

The source output and measurement timing can be controlled by the following parameters. See Figure 6-1. This figure shows an example of sweep output. For a bias output, focus the shape of a sweep step only.

1. Source delay

   The source delay time is defined as the time from trigger to start of a source output.

2. Measure delay

   The measurement delay time is defined as the time from trigger to start of a measurement.

3. Source wait

   The source wait time is defined as the time the source channel cannot change the output value after starting an output.

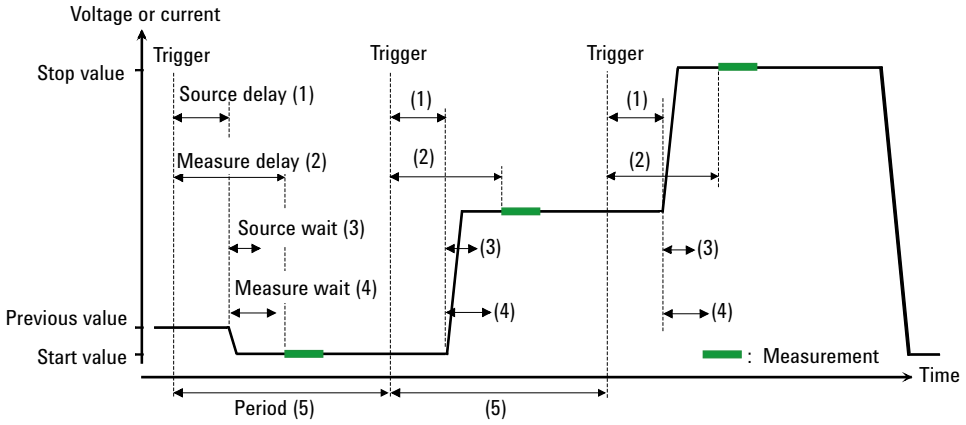
4. Measure wait

   The measurement wait time is defined as the time the measurement channel cannot start measurement after starting an output.

5. Period

   The period is the trigger interval. It can be defined for the TIMER or MANUAL trigger type (trigger source) and for the source output and measurement actions individually.

Figure 6-1 **Source Output and Measurement Timing, Sweep Output Example**



To set the delay time and the period, see “Trigger parameters” on page 4-15.

To set the wait time, see “Wait Control dialog box” on page 4-29.

For more information about the trigger setup, see “Trigger key group” on page 4-35.

Pulse Output

The source/measure unit SMU can apply the pulsed voltage or current. Figure 6-2 shows a pulsed sweep output example. For a pulsed bias output, focus the shape of a pulse only.

To Control Pulse Output/Measure Timing

The pulse output and measurement timing can be controlled by the following parameters. See Figure 6-2.

1. Source delay

   The source delay time is defined as the time from trigger to start of a source output.

2. Measure delay

   The measurement delay time is defined as the time from trigger to start of a measurement.

3. Pulse delay

   The pulse delay time is defined as the time from the start of a source output to the start of a pulse (peak) output.

4. Source wait

   The source wait time is defined as the time the source channel cannot change the output value after the trailing edge of a pulse.

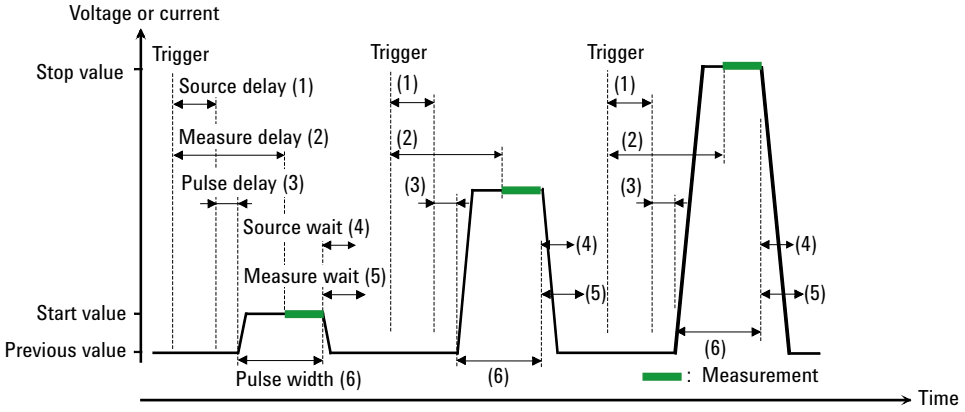
5. Measure wait

   The measurement wait time is defined as the time the measurement channel cannot start measurement after the trailing edge of a pulse.

6. Pulse width

   The pulse width is the time from the start of a pulse output to the end of a pulse (peak) output. However, it is strictly defined as the time from 10 % of peak level at the leading edge to 90 % of peak level at the trailing edge. The available values are 50 μs to 100000 s.

Figure 6-2 **Pulse Output and Measurement Timing, Sweep Output Example**



To set the delay time, see “Trigger parameters” on page 4-15.

To set the pulse delay time and the pulse width, see “Pulse parameters” on page 4-14.

To set the wait time, see “Wait Control dialog box” on page 4-29.

For more information about the trigger setup, see “Trigger key group” on page 4-35.

To Set Pulse Output

The following points must be noted when setting the pulse output.

- Pulse base value is set by the Source value on the Single or Dual view.
- Pulse peak value is set by the Single view.

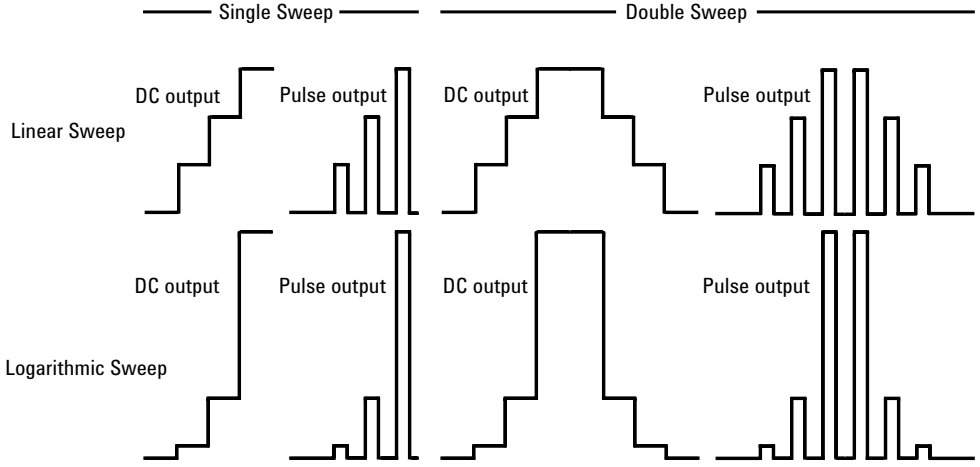
  Set the Peak value of “Pulse parameters” on page 4-14 for the pulsed bias output.

  Or set the Start, Stop, and Points values of “Sweep parameters” on page 4-12 for the pulsed sweep output.

Sweep Output

The source/measure unit SMU can apply a sweep voltage or current. It supports several shapes of sweep output, as shown in Figure 6-3. The SMU not only performs the sweep output but performs the measurement for each sweep step as shown in Figures 6-1 and 6-2.

Figure 6-3 **Variety of Sweep Outputs**



To Set Sweep Output

The following points must be noted when setting the sweep output.

- To set the staircase sweep source, see “Sweep parameters” on page 4-12.
- To set the ranging mode of the sweep source, see “Sweep dialog box” on page 4-27.
- To set the sweep direction, see “Sweep dialog box” on page 4-27.
- To set the output condition after sweep, see “Sweep dialog box” on page 4-27.
- To set the pulse delay time and the pulse width, see “Pulse parameters” on page 4-14.
- To set the list sweep source, see “List sweep setup” on page 4-12.

List Sweep

The list sweep function is effective for performing an arbitrary waveform output. The source/measure unit (SMU) can apply the waveform as shown in Figure 6-4, and measure voltage or current at each output value. The source output and the measurement can be performed in the following minimum interval.

- B2901A/B2902A: 20 µs
- B2911A/B2912A: 10 µs

The source output and measurement timing is controlled by the trigger system. And the interval can be set to a constant value if the trigger type is set to TIMER.

To set these trigger parameters, see “Trigger parameters” on page 4-15. The interval can be set by the Period parameter. The number of output values can be set by the Count parameter.

To set the source output values, use the List Sweep dialog box. See “List sweep setup” on page 4-12.

Figure 6-4 shows an example setup of the List Sweep dialog box with an image of the output waveform.

Figure 6-4 List Sweep Dialog Box

Output Filter

The filter is mounted on the source/measure unit (SMU). It assures clean source output with no spikes or overshooting. However, using a filter may increase the SMU settling time.

To set the filter, see “Output Filter dialog box” on page 4-26.

Over Voltage/Current Protection

The over voltage/current protection is effective for preventing damage to the test device from overcurrent or overvoltage. If this function is enabled, the source/measure unit (SMU) sets the output to 0 V and sets the output switch to off automatically and immediately when it reaches the compliance status.

To set the over voltage/current protection, see “Output Connection dialog box” on page 4-25.

Output-Off Status

The output-off status is the condition which is set on the source/measure unit (SMU) automatically, immediately after its output is turned off. The status must be specified before enabling the source output. The available conditions are shown in Table 6-1

To set the output-off status, see “Output Connection dialog box” on page 4-25.

Table 6-1 **Output-Off State**

Name	Conditions after output-off
HIGH Z, high impedance	• Output relay: off (open or break) • Voltage source setup is not changed if the source applies 40 V or less. • Current source setup is not changed if the source uses the 100 mA range or lower.
NORMAL	• Source function: Voltage source • Output voltage: 0 V • Current compliance: 100 µA at the 100 µA range • Output relay: off (open or break)
ZERO	• Source function: Voltage source • Output voltage: 0 V • Current compliance: 100 µA at the 100 µA range

NOTE

This setting is not applied to the output-off process triggered by the emergency condition such as the over voltage/current protection, interlock open, and over temperature protection. Then the output voltage is immediately set to 0 V and the output switch is set to off.

Automatic Output-ON/OFF Function

The automatic output-ON/OFF function defines the source channel's output ON/OFF operation when the trigger system changes the status.

- Automatic-ON function

  If this function is enabled, the source/measure unit (SMU) automatically turns the channel output ON just before the trigger system is initiated by an SCPI command, not by a front panel operation.

- Automatic-OFF function

  If this function is enabled, the SMU automatically turns the channel output OFF immediately when all trigger system changes the status from busy to idle.

To set the automatic output ON/OFF function, see "Output Connection dialog box" on page 4-25.

High Capacitance Mode

High capacitance mode is effective for the measurement of a capacitive load greater than 0.01 μF.

If the measurement result data is not stable, set this function ON. The measurement data may come stable. This function is effective for measurements of capacitive devices up to 50 μF.

High capacitance mode is available for the following source/measure condition.

- Operation mode: voltage source and current measurement
- Measurement ranging mode: Fixed
- Measurement range value: 1 μA to 10 A

To set the high capacitance mode, see “Output Connection dialog box” on page 4-25.

Resistance Measurement

B2900 supports resistance measurement. If the measurement parameter is set to resistance OHMS (R), the source/measure unit (SMU) automatically sets the current source and voltage measurement operation to perform resistance measurement.

For performing accurate measurement, B2900 provides the compensation function.

NOTE

To Enable Resistance Measurement

The resistance measurement operation must be specified. See “Range parameters” on page 4-11 and “Enabling the Resistance Measurement” on page 5-19.

In the initial setting, the resistance measurement operation is set to OFF.

Resistance Compensation

Resistance compensation (R Compen) is effective for performing low resistance measurements accurately. If R Compen is set to ON, the channel performs measurement twice and returns the compensated measurement result given by the following formula. This technique is effective for reducing the thermal EMF.

$R_{compen}=(V_2-V_1)/(I_2-I_1)$

where, V_1 is the measurement results at the 0 A source condition, and I_1 is the measurement results at the 0 V source condition.

To enable resistance compensation, press the Config > Measure > R Compen > ON function key on a 1-channel model, or the Config > Measure > R Compen > ALL or Ch 1 or Ch2 > ON function key on a 2-channel model.

To disable resistance compensation, press the Config > Measure > R Compen > OFF function key on a 1-channel model, or the Config > Measure > R Compen > ALL or Ch 1 or Ch2 > OFF function key on a 2-channel model.

Math Expression

B2900 provides a math function for performing calculations using the measurement result data. The calculation result can be displayed and used for the limit test and trace statistics.

For the predefined math expressions, see “Predefined Math Expressions”.

To define a math expression, see the Agilent B2900 *SCPI Command Reference*. Math expressions can be defined by using the :CALC:MATH commands. For resources effective for the expression, see “Resources Used in the Expressions”.

To use the math function, see “Math Expression dialog box” on page 4-30.

To display the calculation result, see “Graph View” on page 4-17 and “Measure Result dialog box” on page 4-38.

Predefined Math Expressions

The following math expressions have already been defined in B2900. The predefined math expressions are not cleared by the power off and on operations.

- Power (POWER)
- Offset Compensated Ohms (OFFCOMPOHM)
- Varistor Alpha (VARALPHA)
- Voltage Coefficient (VOLTCOEF)

In the following formula, [*c*] specifies the channel (1 or 2) used for the measurement.

POWER

Calculates power using the following formula.

POWER = VOLT[*c*] * CURR[*c*]

OFFCOMPOHM

Calculates offset compensated ohms (resistance) using the following formula.

OFFCOMPOHM = (VOLT[*c*][1]−VOLT[*c*][0]) / (CURR[*c*][1]−CURR[*c*][0])

where, VOLT[*c*][0] and CURR[*c*][0] are the data measured with a current output level, and VOLT[*c*][1] and CURR[*c*][1] are the data measured with a different current output level or zero output.

This function is effective for reducing measurement errors in low resistance measurements.

VARALPHA

Calculates varistor alpha using the following formula.

VARALPHA = log(CURR[*c*][1] / CURR[*c*][0]) / log(VOLT[*c*][1] / VOLT[*c*][0])

where, CURR[*c*][0] and VOLT[*c*][0] are the measurement data at a point on a varistor's non-linear I-V characteristics curve, and CURR[*c*][1] and VOLT[*c*][1] are the data at the another point.

VOLTCOEF

Calculates voltage coefficient using the following formula.

VOLTCOEF = (RES[*c*][1]−RES[*c*][0]) / (RES[*c*][1] * (VOLT[*c*][1]−VOLT[*c*][0])) * 100 %

where, RES[*c*][0] and RES[*c*][1] are the resistance measurement data at the first and second measurement points, respectively, and VOLT[*c*][0] and VOLT[*c*][1] are the voltage measurement data at the first and second measurement points, respectively.

The voltage coefficient is known as the ratio of the fractional change for a resistor whose resistance varies with voltage.

Resources Used in the Expressions

The following resources can be used in user-defined math expressions.

- Reserved variables

  The variables listed in Table 6-2 are reserved for reading the channel output or measurement data.

  Scalar variable is used for spot measurement data.

  Vector (array) variable is used for sweep measurement data.

- Math operators

  The following operators are available.

  - Arithmetic operators: +, −, *, /, ^, see Table 6-3
  - Elementary functions: ln, log, sin, cos, tan, exp

  The functions log and ln perform the operation after calculating the absolute value. So if a negative value is specified, they do not cause an error but calculate as a positive value. For example, log(−10) results in log(10)=1.

Table 6-2 **Reserved Variables**

Reserved variable [a]		Description
Scalar	**Vector**	
SOUR[*c*]	SOUR[*c*][]	Source output setting data
VOLT[*c*]	VOLT[*c*][]	Voltage measurement data
CURR[*c*]	CURR[*c*][]	Current measurement data
RES[*c*]	RES[*c*][]	Resistance measurement data
TIME[*c*]	TIME[*c*][]	Time (timestamp) data

a. The numeric suffix [*c*] is effective for specifying the channel. For example, use CURR2 to read the current spot measurement data of the channel 2.

Table 6-3 **Arithmetic and Unary Operators**

Priority of task	Operator	Description
High : : : : : Low	( )	Parentheses
	+ and −	Unary plus operator and unary minus operator
	^	Exponentiation operator
	* and /	Multiplication operator and division operator
	+ and −	Additive operator and subtraction operator

Limit Test

Limit test is a pass/fail judgement performed for a measurement data or math result data obtained by a channel. It can be performed if both limit test and composite limit test are set to ON. Maximum of twelve limit tests can be defined and used for the bins of composite limit test.

B2900 supports the following two operation modes of composite limit test.

- Grading mode

  Performs limit test for up to 12 test limits (bins) until a failure is detected. See Figure 6-5 for an example flowchart.

- Sorting mode

  Performs limit test for up to 12 test limits (bins) until a pass is detected. See Figure 6-6 for an example flowchart.

In the figures, SOT is the start-of-test strobe pulse sent by the component handler connected to B2900 via the Digital I/O connector.

To set the composite limit test, see “Composite Limit Test Setup dialog box” on page 4-31.

To set the limit test, see “Limit Test Setup dialog box” on page 4-32.

The composite limit test result Pass or Fail is displayed with the measurement result data on the Single or Dual view. To display the limit test result log, see “Limit Test Result dialog box” on page 4-39.

NOTE

Limit test for the math result

If the math expression refers to a measurement result data by multiple channels, the acquire trigger count for the channels must be the same.

If the math expression contains a vector operation, the acquire trigger count must be equal to or greater than the maximum number of the vector.

Figure 6-5 **Composite Limit Test Flowchart Example for Grading Mode**

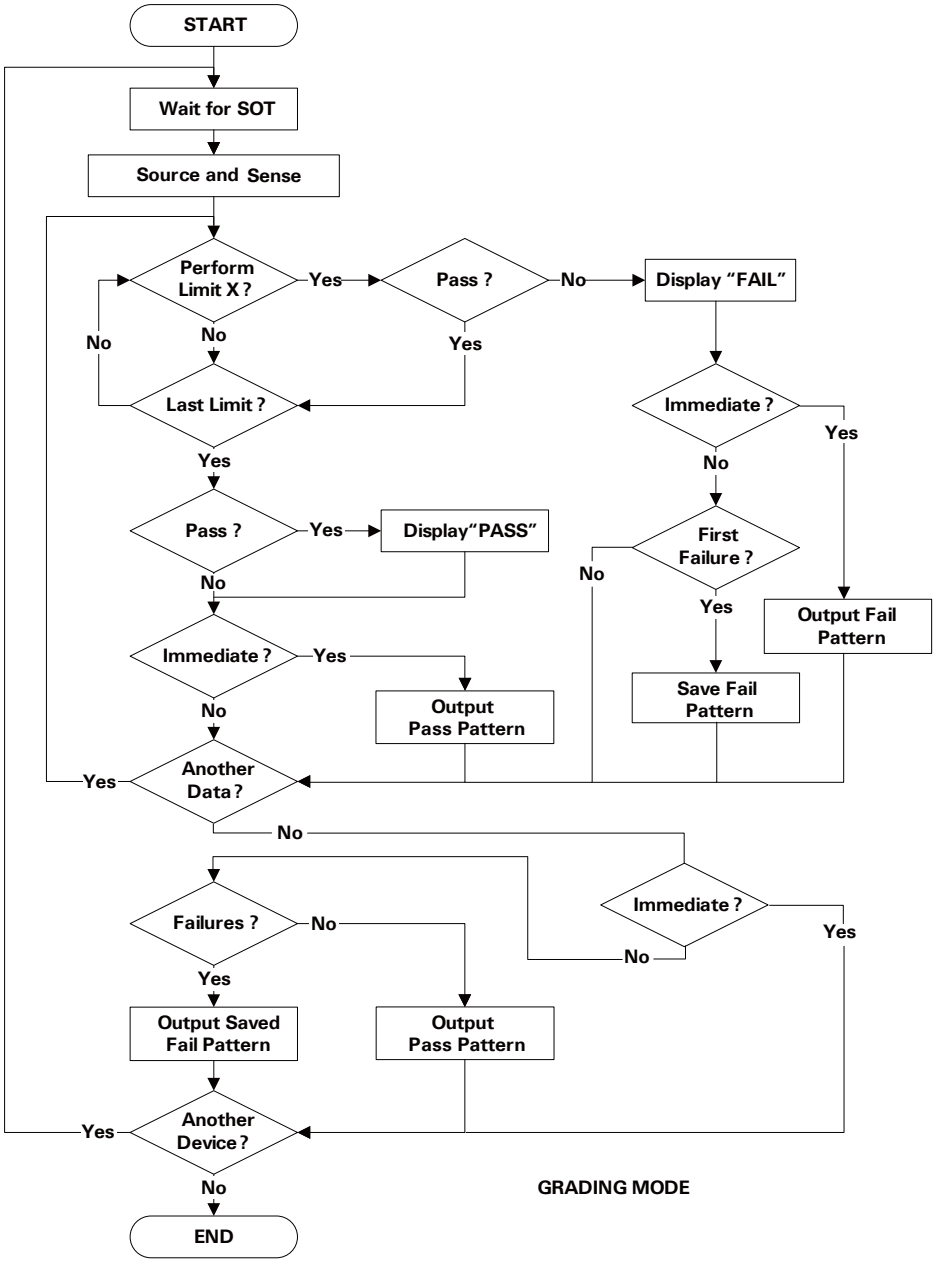
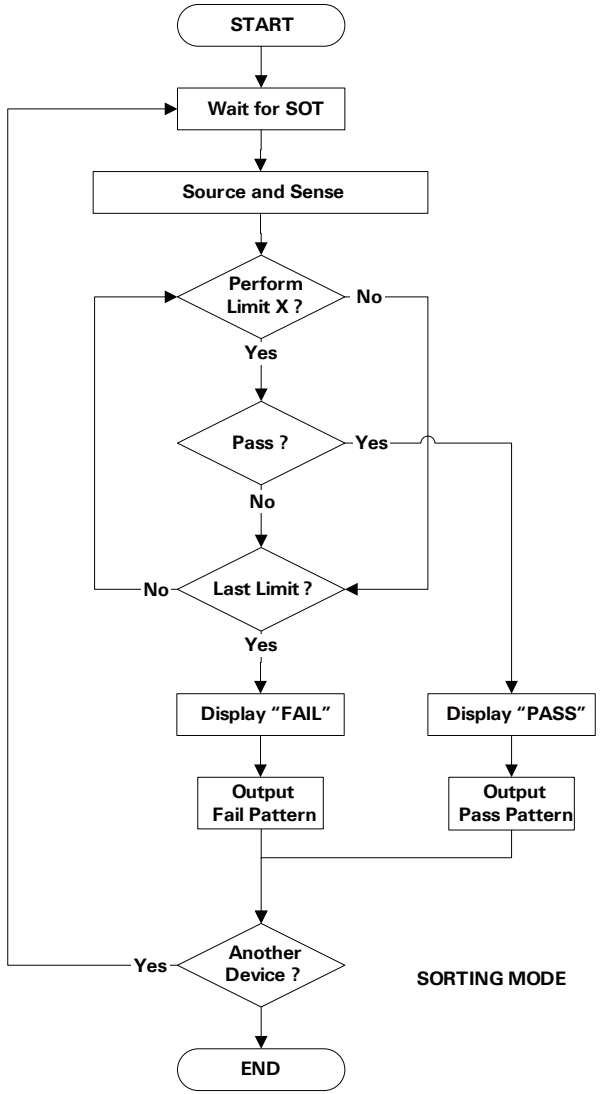


Figure 6-6 **Composite Limit Test Flowchart Example for Sorting Mode**



Trace Buffer

The trace buffer collects the test result data until a buffer full is detected. The maximum data size is 100,000 blocks for each channel. The data flow is shown in Figure 6-7. One data block may contain multiple data, such as voltage measurement data, current measurement data, resistance measurement data, source output data, calculation result data, limit test data, time data, and status data. They are selected by using the Format keys of the I/O key group. See “I/O key group” on page 4-43.

For setting the trace buffer, see “Trace Buffer Setup dialog box” on page 4-34.

In Figure 6-7, the variables indicate the following data.

- VOLT: Voltage measurement data
- CURR: Current measurement data
- RES: Resistance measurement data
- TIME: Time data (timestamp of the measurement start trigger)
- STAT: Status data or limit test status
- SOUR: Source output data
- CALC: Math (calculation) result data or limit test data (= raw data − offset data)

If data is stored in the trace buffer, its statistical data can be calculated. Calculable statistical data is as follows.

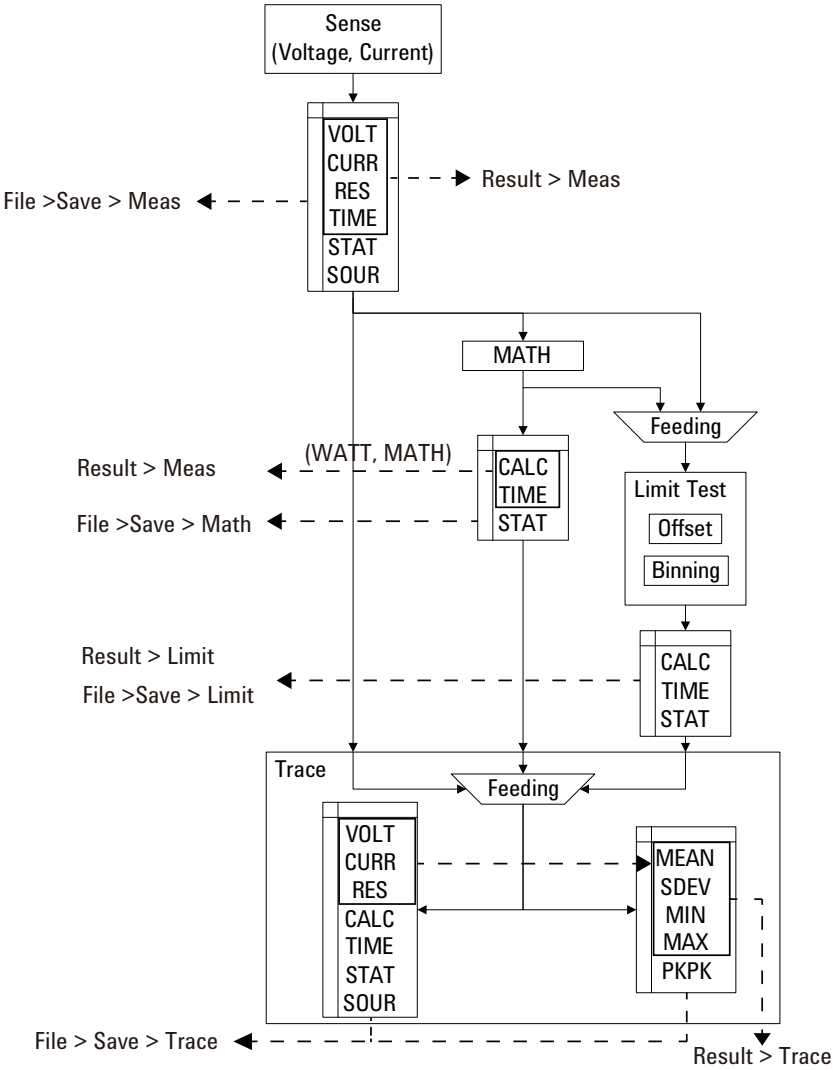
- MEAN: Mean value
- SDEV: Standard deviation
- MIN: Minimum value
- MAX: Maximum value
- PKPK: Peak to peak value

The statistical data (except for PKPK) of VOLT, CURR, or RES data can be displayed on the Trace Statistical Result dialog box. See “Trace Statistical Result dialog box” on page 4-40 for displaying the data.

Use an external computer to display the data which cannot be displayed on the B2900 screen. The data can be saved in an USB memory connected to the front panel USB-A connector or can be read by using SCPI commands.

NOTE Do not forget to save or read the data before turning the B2900 off. The trace buffer is cleared by turning the instrument off.

Figure 6-7 **Data Flow to Trace Buffer for Each Channel**



Program Memory

The program memory stores command strings temporarily. The stored program can be executed by using the front panel keys, or automatically when B2900 is turned on. See “Program key group” on page 4-42 and “Start-up” on page 4-50. The keys used for controlling the program memory are shown in Table 6-4. This table also shows the status changed by pressing the program control keys.

The program memory can eliminate several processes in the program execution, such as transferring commands, checking command syntax, and converting commands to the internal codes. Thus, using the program memory speeds up program execution. If frequently used command strings are stored in the program memory, interface/computer activity is minimized.

The program memory can be defined by using SCPI commands while B2900 is in the remote mode. See Agilent B2900 series *SCPI Command Reference*.

- Number of programs saved in the memory: 100
- Number of programs used for start-up automatic execution: 1
- Total memory size: 100 KB
- Maximum length for a line: 256 bytes
- Maximum number of characters of program name: 32 with alphabets, numbers, hyphens, and underscores

Table 6-4 Program Control Keys (Function Keys) and Status Changes

Control key	Present execution status		
	Running	**Paused**	**Stopped**
Run	Error	to Running	to Running
Pause	to Paused	Paused	Stopped
Step	Error	to Running to Paused	to Running to Paused
Stop	to Stopped	to Stopped	Stopped
Continue	Error	to Running	Error

Channel Grouping

This section applies only to 2-channel models. This function is used to control the channel output timing automatically so that the channel keeps the output while the other channel performs measurement.

The grouped channels start the source output in the order of channel number, then start the measurement at the same time, and keep the output until the measurement is completed. If delay time and wait time are set, this is adjusted by these values.

If the grouping is released, the channels work independently regardless of the condition of the other channel.

To enable the channel grouping, press the Config > Common > Group > ON function keys.

To disable the channel grouping, press the Config > Common > Group > OFF function keys.

NOTE

About Wait Time

If wait time is set, channels cannot start measurement or source output change until the wait time elapses. See “Wait Control dialog box” on page 4-29 for setting the wait time.

For the grouped channels, the wait time starts at the timing of the last output change (DC output change or pulse level transition from peak to base) by the last source output channel.

Trigger System

B2900 supports the ARM-TRIGger model described in *1999 SCPI Command Reference*. The ARM-TRIGger model shows independent event detection for the ARM and TRIGger layers. This layered model is similar to the for-loop statement of programming languages. When the trigger system is initiated, the ARM layer waits for the specified ARM source signal. After the ARM condition is satisfied, the control is passed to the TRIGger layer. The TRIGger layer waits for the specified TRIGger source signal, and launches the device action(s) when the TRIGger condition is satisfied. Both layers have repeat count.

B2900 has both source and measure functions, and has the independent ARM-TRIGger model's operation for each function and channel. See Figure 6-8. ARM-TRIGger operations can be controlled independently or simultaneously.

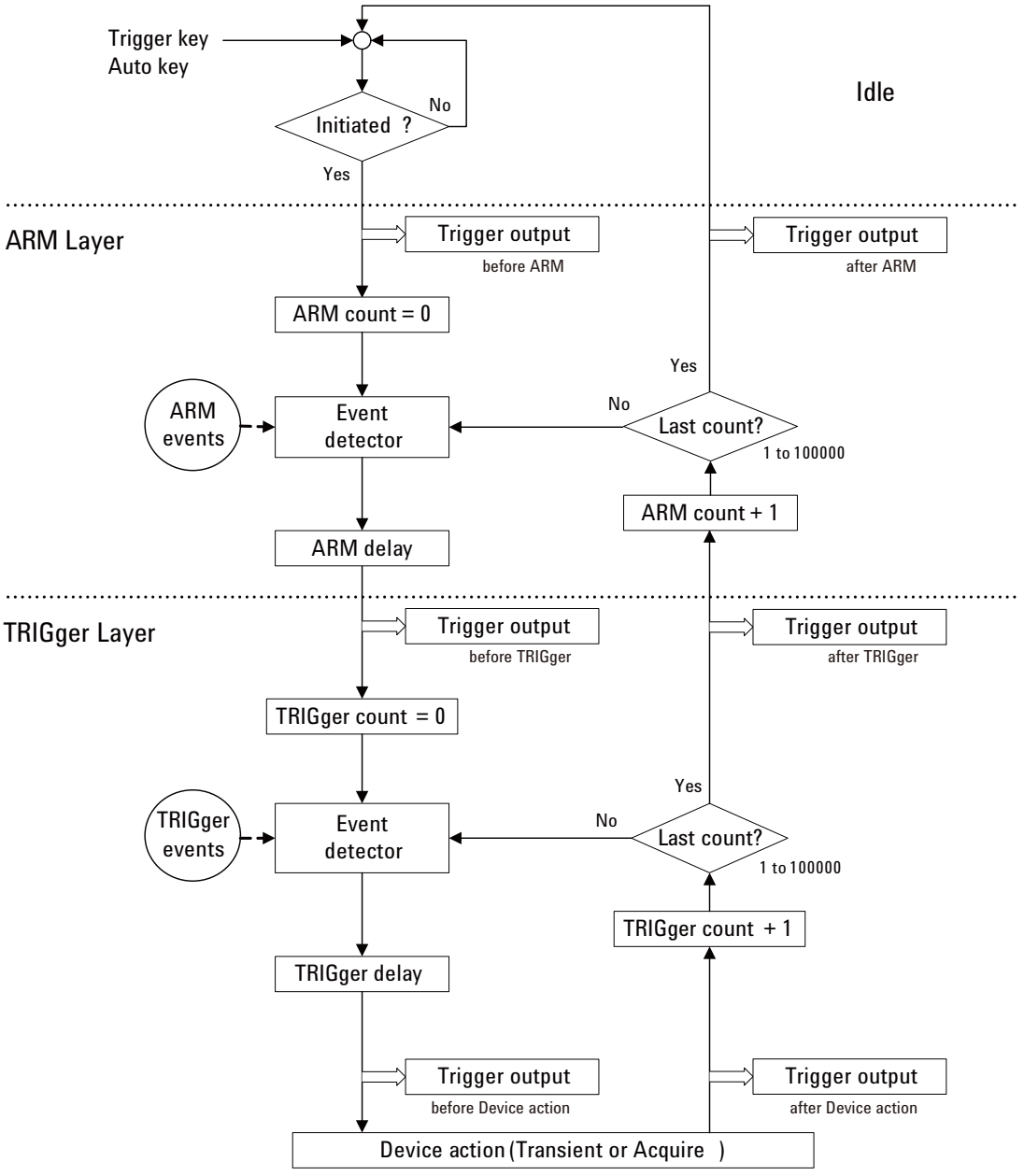
Trigger Source

B2900 supports the following trigger sources.

- AUTO (automatic internal, AINT): Automatically selects the trigger source best suited for the present operating mode by using internal algorithms.
- BUS: Trigger source will be the remote interface trigger command such as the group execute trigger (GET) and the *TRG command.
- TIMER (timer, TIMer): Trigger source will be a signal internally generated every interval set by the *Period* parameter.
- INT1 or INT2 (internal): Trigger source will be a signal from the internal bus 1 or 2, respectively.
- EXT1, EXT2, EXT3, EXT4, EXT5, EXT6, EXT7, EXT8, EXT9, EXT10, EXT11, EXT12, EXT13, or EXT14 (external): Trigger source will be a signal from the DIO pin *n* which is an output port of the Digital I/O D-sub connector on the rear panel. *n*=1 to 14.
- LAN: Trigger source will be the LXI trigger.

The trigger setup parameters can be set by the "Trigger parameters" on page 4-15 of the Single view, or the "Trigger Configuration dialog box" on page 4-36.

Figure 6-8 **B2900 Trigger System**



Device Actions

B2900 supports the following device actions.

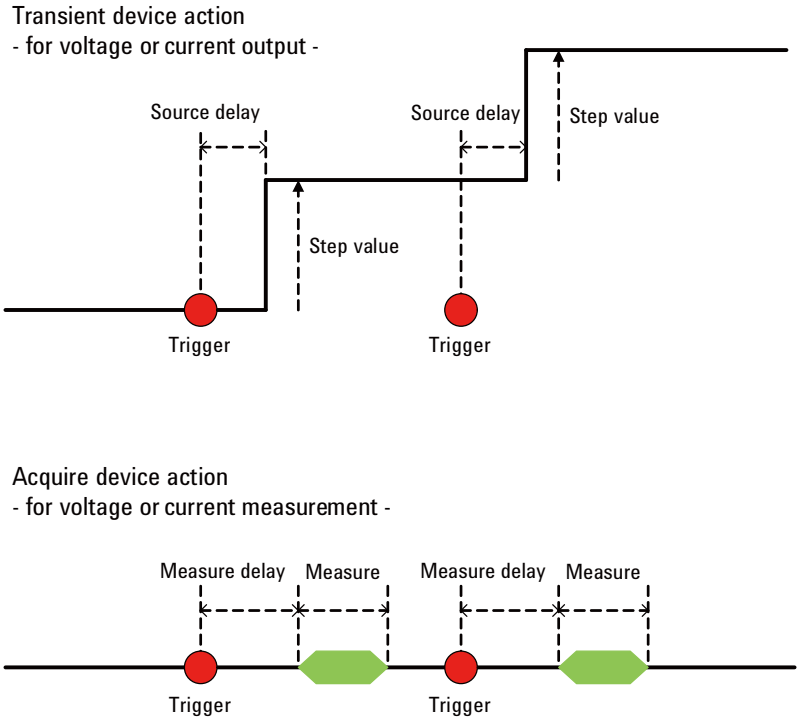
- Triggered transient (source) action

  After the transient trigger condition is satisfied, the channel applies a new voltage or current value after the source delay time (Source delay) elapses.

- Triggered acquire (measurement) action

  After the acquire trigger condition is satisfied, the channel performs current and/or voltage measurement after the measurement delay time (Measure delay) elapses.

Figure 6-9 **Transient and Acquire Device Actions**



Trigger Output

B2900 provides the trigger output function by using the Digital I/O connector on the rear panel. For more information about the connector, see “Using Digital I/O” on page 3-29.

- Trigger output terminal

  Specifies Digital I/O pins. Pin assignment can be specified by the “DIO Configuration dialog box” on page 4-46.

- Trigger output timing

  The output trigger can be generated at the timing shown in Table 6-5. The trigger output timing can be specified by the Layer, Action, and Trigger Output parameters of the “Trigger Configuration dialog box” on page 4-36 and the Output Trigger Timing parameter of the “DIO Configuration dialog box” on page 4-46.

Table 6-5 Trigger Output Timing and Setup Parameters

Trigger output timing	Layer	Action	Trigger Output	Output Trigger Timing
Starting arm loop	ARM	TRANS. for transient action or ACQ. for acquire action	ON	BEFORE
Ending arm loop	ARM		ON	AFTER
Starting trigger loop	TRIGGER		ON	BEFORE
Ending trigger loop	TRIGGER		ON	AFTER
Starting transient (source) action	ACTION	TRANS.	ON	BEFORE
Ending transient (source) action	ACTION	TRANS.	ON	AFTER
Starting acquire (measure) action	ACTION	ACQ.	ON	BEFORE
Ending acquire (measure) action	ACTION	ACQ.	ON	AFTER

The output trigger polarity, type, and pulse width can be set by the “DIO Configuration dialog box” on page 4-46.

Synchronous Device Actions

This section applies only to when performing synchronous channel operation on a 2-channel model.

If channels are set as shown below, the device actions start simultaneously.

- To synchronize transient actions (source output)
  - Trigger source is set to the same mode.
  - Delay time is set to the same value.
  - Source output ranging mode is set to the fixed mode.
  - Source wait time control is set to OFF.
  - Measurement wait time control is set to OFF.
  - Measurement ranging mode is set to the fixed mode.
- To synchronize acquire actions (measurement)
  - Trigger source is set to the same mode.
  - Delay time is set to the same value.
  - Measurement wait time control is set to OFF.
  - Measurement ranging mode is set to the fixed mode.

Interlock Function

The interlock function is designed to prevent electrical shock when a user touches the measurement terminals. If the interlock terminal is open, maximum output is limited to ±42 V.

To perform high voltage measurement greater than ±42 V, connect the interlock terminal to an interlock circuit of a test fixture or a shielding box. The interlock circuit must have one LED and two mechanical switches that are connected together and placed near the shielding box opening doors. For details on installing the interlock circuit, see “Installing the Interlock Circuit” on page 3-19.

The interlock function works as shown below.

- When the interlock terminal is open, maximum output is limited to ±42 V.
- When the interlock terminal is shorted, source channel can apply its maximum output value.
- When the interlock terminal is opened in a high voltage condition greater than ±42 V, the output voltage is immediately set to 0 V and the output switch is set to off.

WARNING **Open the interlock terminal so that the SMU cannot apply dangerous voltage when the source/measure terminal is touchable or opened.**

Over Temperature Protection

The over temperature protection is effective for preventing damage to a channel from over temperature. If B2900 is used in an environment over 30 °C, channel outputs are limited to the value less than the maximum value. If a channel output reaches the limit, all channels automatically and immediately set the output to 0 V and set the output switch to off. And the causal channel is locked automatically.

To unlock the channel, the self-test must be performed. If the self-test does not report any problem, you can use the channel soon. For performing the self-test, see "Self-test" on page 3-8.

The maximum output for the condition over 30 °C is less than the maximum output for the specification condition of 23 °C ± 5 °C. The channel output limit is given by the following formula.

$$DC_{MAX} \leq ([(P_{CS} + 30 - T_{AMB}) - |V_{OAB} \times I_B|] / |V_{OAP} \times I_P|)^2 \times 100$$

The parameters are described below.

- DC_{MAX}: Allowable maximum duty ratio in %, or 0 for DC bias output
- P_{CS}: Maximum power, 64 W
- T_{AMB}: Ambient temperature, in °C
- V_{OAB} = 250 V, for $|I_B| \leq 105$ mA

  V_{OAB} = 39 V, for $|I_B| > 105$ mA and $|V_B| > 6$V

  V_{OAB} = 21 V, for $|I_B| > 105$ mA and $|V_B| \leq 6$V

  V_B: Pulse base voltage setting value or DC bias voltage setting value, in V
- I_B: Current at pulse base or DC current, in A
- V_{OAP} = 250 V, for $|I_P| \leq 105$ mA

  V_{OAP} = 39 V, for $|I_P| > 105$ mA and $|V_P| > 6$V

  V_{OAP} = 21 V, for $|I_P| > 105$ mA and $|V_P| \leq 6$V

  V_P: Pulse peak voltage setting value, in V
- I_P: Current at pulse peak, in A

Initial Settings

The B2900 is initialized by turning the B2900 on, the *RST command, or the device clear. Initial settings of the B2900 are shown in this section.

Table 6-6 **System Initial Settings**

Setup item	Power on	Reset
GPIO function	Digital In	→
GPIO function (D14)	High Voltage	→
GPIO polarity	Negative	→
GPIO output trigger type	Edge	→
GPIO output trigger timing	Both	→
GPIO output trigger pulse width	100 µs	→
Display digits	7	→
Zoomed display	OFF	Not changed
Display image format	JPG	→
User message enable	Disabled	→
User message	“”	→
Byte order (measurement data)	Normal	→
Data format (measurement data)	ASCII	→
Data format (GPIO data)	ASCII	→
Data format (status register)	ASCII	→
Data elements (measurement data)	All (V/I/R/S/T/Stat)	→
Data elements (calculate)	CALC	→
Automatic timestamp reset	ON	→

Setup item	Power on	Reset
Mass storage directory	(Root)	→
Program variables	None	Not changed
Program selection	None	→
Program status	Idle	→

Table 6-7 SMU Initial Settings

Setup item	Power on	Reset
Low terminal state	Grounded	Not changed
Output state	OFF	→
Output auto filter enable	ON	→
Output filter enable	ON	→
Output filter time constant	5 µs	→
Output filter frequency	31.8309886 kHz	→
Output OFF state	Normal	→
Output protection	OFF	→
Source mode	Voltage	→
Source shape	DC	→
Automatic output-on	ON	→
Automatic output-off	OFF	→
Voltage source	0 V	→
Voltage protection level	2 V	→
Voltage source auto ranging	ON	→
Voltage source range	2 V	→
Voltage source range lower limit	0.2 V	→

Setup item	Power on	Reset
Voltage source mode	Fixed	→
Voltage sweep points	1	→
Voltage sweep start	0 V	→
Voltage sweep stop	0 V	Not changed
Voltage list points	1	→
Voltage list values	0 V	→
Current source	100 µA	→
Current protection level	100 µA	→
Current source auto ranging	ON	→
Current source range	100 µA	→
Current source range lower limit	10 nA for B291*x* 100 nA for B290*x*	→
Current source mode	Fixed	→
Current sweep points	1	→
Current sweep start	0 A	→
Current sweep stop	0 A	Not changed
Current list points	1	→
Current list values	0 A	→
Sweep direction	UP	→
Double sweep	OFF	→
Sweep ranging	BEST	→
Continuous triggered source	ON	→
Pulse delay	0 s	→
Pulse width	50 µs	→

Setup item	Power on	Reset
Auto settling time	ON	→
Settling time	0 s	→
Measure function	Current	→
Auto aperture	ON	→
Aperture time	0.1 PLC	→
Voltage measure range mode	AUTO	→
Voltage measure range limit	0.2 V	→
Voltage measure range	2 V	→
Current measure mode	AUTO	→
Current measure range limit	1 μA	→
Current measure range	100 μA	→
Resistance measure mode	OFF	→
Res. meas. range	2 Ω	→
Res. meas. range limit (Low)	2 Ω	→
Res. meas. range limit (High)	200 MΩ	→
Res. meas. compensation	OFF	→
Remote sensing	OFF	→
Measurement auto range operation	NORMAL	→
Measurement auto range threshold	90	→

Table 6-8 **Trigger System Initial Settings**

Setup item	Power on	Reset
ARM count	1	→
ARM source	AINT	→
ARM timer	100 µs	→
ARM delay time	0 s	→
ARM bypass	OFF	→
Trigger count	1	→
Trigger source	AINT	→
Trigger timer	10 µs for B291*x* 20 µs for B290*x*	→
Trigger delay time	0 s	→
Trigger bypass	OFF	→
External trigger output	EXT1	→
External trigger output (LAN)	LAN0-7 (all)	→
External trigger output enable	OFF	→

Table 6-9 **LXI Trigger Events Initial Settings**

Setup item	Power on	Reset
Event domain	0	→
LAN event	“WaitingForAcquireArm1”, “WaitingForTransitionArm1”, “WaitingForAcquireTrigger1”, “WaitingForTransitionTrigger1”, “Measuring1”, “Settling1” “WaitingForAcquireArm2”, “WaitingForTransitionArm2”, “WaitingForAcquireTrigger2”, “WaitingForTransitionTrigger2”, “Measuring2”, “Settling2”	→
Delay time	0	→
Input/output filter string	“ALL:5044”	→
Input/output status	OFF	→
Input detection	RISE	→
Output drive	OFF	→
Output slope	Positive	→
Output source	“”	→
Output timestamp delta	0	→
Event logging	ON	→
Circular event logging	ON	→
Event log size	100	→

Table 6-10 **Calculate Functions Initial Settings**

Setup item	Power on	Reset
Composite limit test result transfer timing	IMM	→
Composite limit test result automatic clearance	ON	→
Composite limit test fail bit pattern	All 0	→
Composite limit test pass bit pattern	All 0	→
Composite limit test mode	GRADing	→
GPIO bit assignment (pass/fail bit pattern)	None	→
GPIO bit assignment (/BUSY)	None	→
GPIO bit assignment (/EOT)	None	→
GPIO bit assignment (/SOT)	None	→
Limit test feed source	VOLTage	→
Compliance check fail bit pattern	All 0	→
Compliance check fail condition	IN	→
Limit test function	LIM	→
Upper limit	+1	→
Lower limit	−1	→
Upper bit pattern	All 0	→
Pass bit pattern	All 0	→
Lower bit pattern	All 0	→
Limit test enable	OFF	→
Math function enable	OFF	→
Math function expression	(VOLT*CURR)	→

Setup item	Power on	Reset
Math function expression name	“POWER”	→
Math function catalog	“POWER”, “OFFCOMPOHM”, “VOLTCOEF”, “VARALPHA”	→
Math function unit name	“W”	→
Offset value for test	0	→
Offset value enable	OFF	→
Trace feed source	SENSe	→
Trace control	NEVer	→
Trace points	100000	→
Trace statistics format	MEAN	→
Trace timestamp format	ABS	→

Table 6-11 **Non-volatile Communication Settings**

Setup item	Factory default setting
DHCP	Enabled
IP address	169.254.5.2
Subnet mask	255.255.0.0
Default gateway	0.0.0.0
Obtain DNS server from DHCP	Enabled
DNS server	0.0.0.0
WINS server	0.0.0.0
Hostname	A-B29*xx*A-*nnnnn* B29*xx*A: model number *nnnnn*: suffix of serial number.
Desired hostname	
Desired service name	
mDNS	Enabled
Use DNS naming service	Enabled
Use NetBIOS naming service	Enabled
Domain name	Not set
GPIB address	23
LXI identify	Disabled
GPIB command interface	Enabled
USB command interface	Enabled
VXI-11 command interface	Enabled
SCPI telnet command interface	Enabled
SCPI socket command interface	Enabled
SCPI HiSLIP command interface	Enabled

Setup item	Factory default setting
Web interface	Enabled
Command prompt for a Telnet session	B2900A>
Welcome message for a Telnet session	Welcome to Agilent B2900A Series

Table 6-12 Other Non-volatile Settings

Setup item	Factory default setting
Channel grouping	“1” for 1-ch models “1-2” for 2-ch models
Remote display	Enabled
Display color set	1
Beeper	Enabled
Graphical web interface (web server)	Enabled
SCPI language mode	Default
Power-on program	Not set
Line frequency	50 Hz
Fan control mode	Normal