GS820
Multi Channel Source Measure Unit
USER'S MANUAL

YOKOGAWA
Yokogawa Meters & Instruments Corporation

IM 765601-01E
2nd Edition

Thank you for purchasing the GS820 Multi Channel Source Measure Unit.
This user's manual contains useful information about the instrument's functions and operating procedures and lists the handling precautions of the GS820. To ensure correct use, please read this manual thoroughly before beginning operation. Keep this manual in a safe place for quick reference in the event a question arises.

Manual Title	Manual No.	Description
GS820 Multi Channel Source Measure Unit User's Manual	IM 765601-01E	This manual. Explains all the functions of the GS820 and their operating procedures.

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
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Revisions

- 1st Edition: August 2007
- 2nd Edition: July 2012

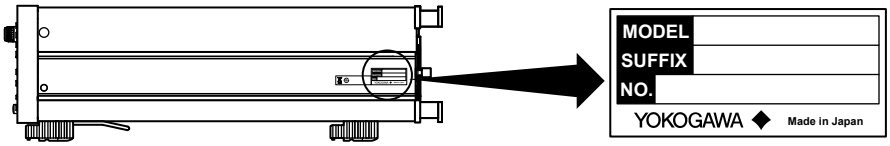
2nd Edition : July 2012 (YMI)

Checking the Contents of the Package

Unpack the box and check the contents before operating the instrument. If some of the contents are not correct or missing or if there is physical damage, contact the dealer from which you purchased them.

GS820

Check that the model name and suffix code given on the name plate on the side panel of the instrument match those on your order.



MODEL and SUFFIX Codes

Model	Suffix Code	Description
765601		Standard model (external I/O connector: 15 pins)
765602		Digital I/O model (external I/O connector: 50 pins)
Power cord	-D	UL/CSA Standard Power Cord (Part No.: A1006WD) [Maximum rated voltage: 125 V; Maximum rated current: 7A]
	-F	VDE Standard Power Cord (Part No.: A1009WD) [Maximum rated voltage: 250 V; Maximum rated current: 10 A]
	-Q	BS Standard Power Cord (Part No.: A1054WD) [Maximum rated voltage: 250 V; Maximum rated current: 10 A]
	-R	AS Standard Power Cord (Part No.: A1024WD) [Maximum rated voltage: 250 V; Maximum rated current: 10 A]
	-H	GB Standard Power Cord (Part No.: A1064WD) [Maximum rated voltage: 250 V; Maximum rated current: 10 A]

NO. (Instrument Number)

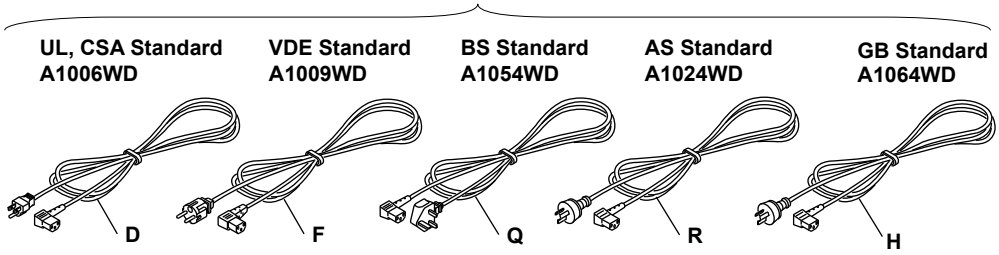
When contacting the dealer from which you purchased the instrument, please give them this number.

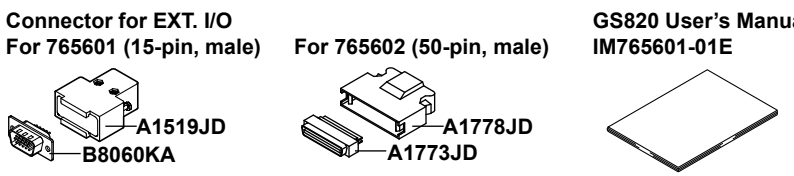
Standard Accessories

The standard accessories below are supplied with the instrument.

Name	Part Number	Qty.	Notes
Power cord	A1006WD	1	UL/CSA Standard Power Cord Maximum rated voltage: 125 V; Maximum rated current: 7A
	A1009WD	1	VDE Standard Power Cord Maximum rated voltage: 250 V; Maximum rated current: 10 A
	A1054WD	1	BS Standard Power Cord Maximum rated voltage: 250 V; Maximum rated current: 10 A
	A1024WD	1	AS Standard Power Cord Maximum rated voltage: 250 V; Maximum rated current: 10 A
	A1064WD	1	GB Standard Power Cord Maximum rated voltage: 250 V; Maximum rated current: 10 A
Rubber feet	A9088ZM	2	Two rubber feet in one set.
Measurement lead	758933	2 sets	Safety terminal cable. Red and black, 2 pcs. each
Alligator clip adapter	758922	2 sets	Safety terminal-to-alligator clip adapter. Red and black, 2 pcs. each
External I/O connector	B8060KA/A1519JD	1 set	15-pin connector for the 765601 and connector cover, 1 pc. each
	A1773JD/A1778JD	1 set	50-pin connector for the 765602 and connector cover, 1 pc. each
User's Manual	IM765601-01E	1	This manual

One of these power cords is supplied according to the suffix code.





Optional Accessories (Sold Separately)

The optional accessories below are available for purchase separately.

Name	Part Number	Minimum Q'ty	Notes
Measurement lead	758933	1	Safety terminal cable. Length: 1 m. Red and black, 1 pc. each
Measurement lead	758917	1	Safety terminal cable. Length: 0.75 m.Red and black, 1 pc. each
Banana plug set	758919	1 set	ϕ4-mm plug/ϕ4-mm socket adapter. Red and black, 1 pc. each
Small alligator clip adapter	758922	1 set	Safety terminal-to-alligator clip adapter. Red and black, 1 pc. each
Large alligator clip adapter	758929	1 set	Safety terminal-to-alligator clip adapter. Red and black, 1 pc. each
Fork terminal adapter	758921	1 set	Safety terminal-to-fork terminal adapter. Red and black, 1 pc. each
Conversion adapter	758924	1	BNC-to-safety terminal adapter
BNC cable	366924	1	BNC-BNC, length: 1 m
BNC cable	366925	1	BNC-BNC, length: 2 m
Safety terminal adapter	758923	1 set	Spring clamp type. Red and black, 1 pc. each
Safety terminal adapter	758931	1 set	Screw-in type. Red and black, 1 pc. each
Synchronous operation cable	758960	1	RJ-11 cable, 6 pins, length: 1 m

Safety Precautions

This instrument is an IEC safety class I instrument (provided with a terminal for protective earth grounding).
The general safety precautions described herein must be observed during all phases of operation. If the instrument is used in a manner not specified in this manual, the protection provided by the instrument may be impaired. Yokogawa Electric Corporation assumes no liability for the customer's failure to comply with these requirements.

The following symbols are used on this instrument.

Warning: handle with care. Refer to the user's manual or service manual.
This symbol appears on dangerous locations on the instrument which require special instructions for proper handling or use. The same symbol appears in the corresponding place in the manual to identify those instructions.

Alternating current

ON (power)

OFF (power)

ON (power) state

OFF (power) state

Be sure to comply with the precautions below. Not complying might result in injury or death.

WARNING

- Use the Correct Power Supply
  Before connecting the power cord, ensure that the source voltage matches the rated supply voltage of the instrument and that it is within the maximum rated voltage of the provided power cord.
- Use the Correct Power Cord and Plug
  To prevent the possibility of electric shock or fire, be sure to use the power cord supplied by YOKOGAWA. The main power plug must be plugged into an outlet with a protective earth terminal. Do not disable this protection by using an extension cord without protective earth grounding.
- Connect the Protective Grounding Terminal
  Be sure to connect the protective earth to prevent electric shock before turning ON the power. The power cord that comes with the instrument is a three-prong type power cord. Connect the power cord to a properly grounded three-prong outlet.
- Do Not Impair the Protective Grounding
  Never cut off the internal or external protective earth wire or disconnect the wiring of the protective earth terminal. Doing so poses a potential shock hazard.
- Do Not Operate with Defective Protective Grounding or Fuse
  Do not operate the instrument if the protective earth or fuse might be defective. Also, make sure to check them before operation.
- Do Not Operate in Explosive Atmosphere
  Do not operate the instrument in the presence of flammable liquids or vapors. Operation in such an environment constitutes a safety hazard.
- Do Not Remove Covers
  The cover should be removed by YOKOGAWA's qualified personnel only. Opening the cover is dangerous, because some areas inside the instrument have high voltages.
- Ground the Instrument before Making External Connections
  Securely connect the protective grounding before connecting to the item under measurement or to an external control unit.
  If you are going to touch the circuit, make sure to turn OFF the circuit and check that no voltage is present.

Be sure to comply with the precautions below. There are limitations to the operating environment.

CAUTION

This product is a Class A (for industrial environment) product. Operation of this product in a residential area may cause radio interference in which case the user is required to correct the interference.

Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE), Directive 2002/96/EC
(This directive is valid only in the EU.)
This product complies with the WEEE Directive (2002/96/EC) marking requirement. This marking 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. When disposing products in the EU, contact your local Yokogawa Europe B. V. office.

New EU Battery Directive

New EU Battery Directive, DIRECTIVE 2006/66/EC
(This directive is valid only in the EU.)
Batteries are included in this product. This marking indicates they shall be sorted out and collected as ordained in ANNEX II in DIRECTIVE 2006/66/EC.

Battery type
Lithium battery

You cannot replace batteries by yourself. When you need to replace batteries, contact your local Yokogawa Europe B.V.office.

Conventions Used in This Manual

Markings

The following markings are used in this manual.

Improper handling or use can lead to injury to the user or damage to the instrument. This symbol appears on the instrument to indicate that the user must refer to the users manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."

WARNING Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

CAUTION Calls attentions to actions or conditions that could cause light injury to the user or damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

Note Calls attention to information that is important for proper operation of the instrument.

Subheadings

On pages that describe the operating procedures in chapters 3 through 17 and the appendix, the following symbols are used to distinguish the procedures from their explanations.

Procedure Carry out the procedure according to the step numbers. All procedures are written with inexperienced users in mind; experienced users may not need to carry out all the steps.

Explanation This section describes the setup items and the limitations regarding the procedures. It may not give a detailed explanation of the function. For a detailed explanation of the function, see chapter 2.

<<Corresponding Command Mnemonic>>
Indicates a communication command that corresponds to the function described on the procedural explanation page.

Displayed Characters and Terminology Used in the Procedural Explanations

Keys and Rotary Knob

Bold characters used in the procedural explanations indicate characters that are marked on the panel key or the rotary knob.

SHIFT+Key

SHIFT+key means you will press the SHIFT key to turn ON the SHIFT key and then press the panel key. In this state, the item marked in purple characters below the key is controlled.

Contents

1.1 Front Panel

Remote indicator
Illuminates when the GS820 is in remote mode (controlled via communications). → Sections 14.2 and 15.1

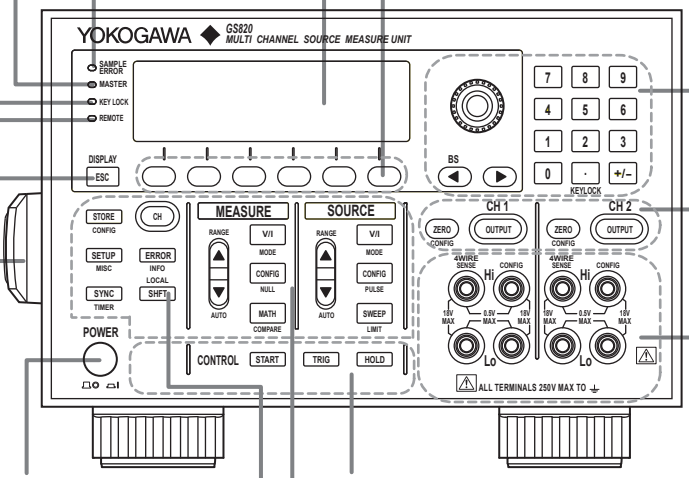
KEY LOCK indicator
Illuminates when key lock is ON. → Section 11.8

Master indicator
Illuminates when set as a master unit in synchronized operation. → Section 10.4

Sampling error indicator
Illuminates when a sampling error occurs in sweep start, source trigger, or measurement trigger.
→ Sections 5.7, 6.5, and 7.6

Display → Section 1.3

Soft keys
Selects items on the soft key menu that appears when setting up the GS820.
→ Section 4.1



Rotary knob, numeric keys, and cursor keys
Sets values or selects setup data or items.
→ Section 4.1

Output control key
Press to generate output or zero source.
→ Section 5.12

Output terminals
Connects the measurement leads that come with the package.
→ Sections 3.5 and 4.5

Power switch
→ Section 3.4

Trigger control key
A key used to generate a sweep start or source trigger or to hold a trigger.
→ Sections 2.6 and 6.5

Handle
Used to carry the GS820.
→ Section 3.1

Setup and execution keys
Keys used to change the settings or execute an operation.
Press a setup key to show the respective setup item. → Sections 1.4 and 4.1

ESC (DISPLAY) key
Switches the display or clears a soft key menu.
→ Section 4.1

SHIFT key
The keys enter the shifted state when you press the SHIFT key and the SHIFT key illuminates.
In this state, the item marked in purple characters below the key is controlled.

1.2 Rear Panel

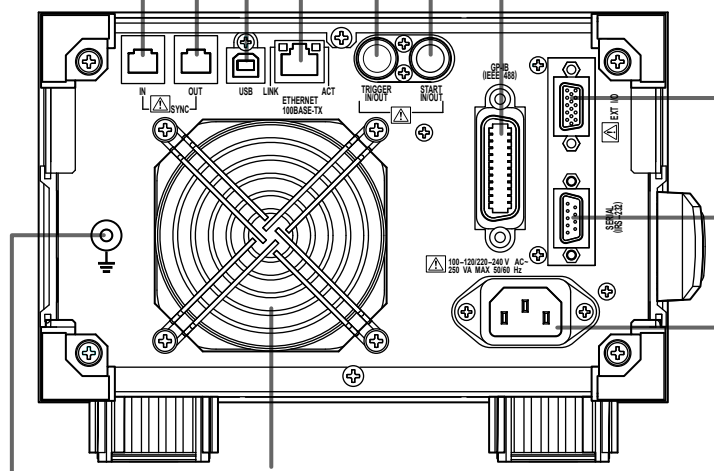
765601

I/O terminals for synchronized operation
Used to connect multiple GS820s and perform synchronized operation. → Section 10.3

USB port
Used to connect to a PC with a USB interface and control the GS820 with commands by way of the USB storage or USB-TMC function. → Section 4.6

Ethernet port
Connects to a LAN. → Section 13.2

BNC I/O terminals
Receives or transmits trigger signals and sweep signals. → Section 10.1



GP-IB connector
Used when controlling the GS820 with commands via the GP-IB interface. → Section 14.3

External I/O connector (15 pins)
Receives or transmits digital signals or transmits comparison results. → Section 10.2

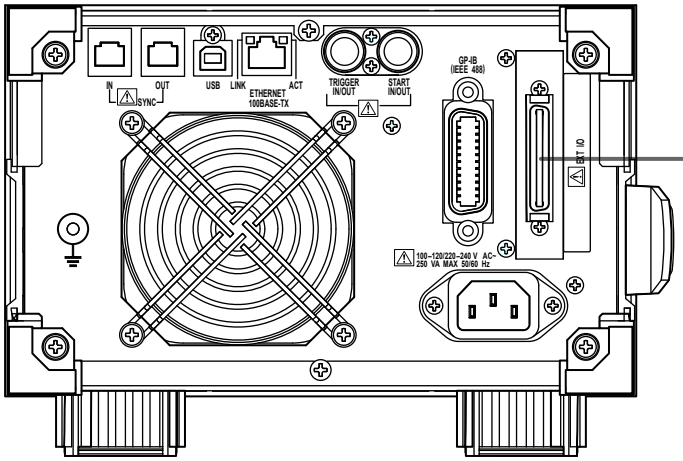
RS-232 connector (9 pins)
Used when controlling the GS820 with commands via the RS-232C interface. → Section 15.2

Power connector
Connects to a power supply. → Section 3.3

Cooling fan → Section 3.2

Functional ground terminal
Shields the measurement cable at ground potential. → Section 3.5

765602



External I/O connector (50 pins)
Receives or transmits 16-bit digital I/O signals in addition to the signals similar to those of the external I/O connector (15 pins) and RS-232 connector (9 pins) of the 765601. → Section 10.2

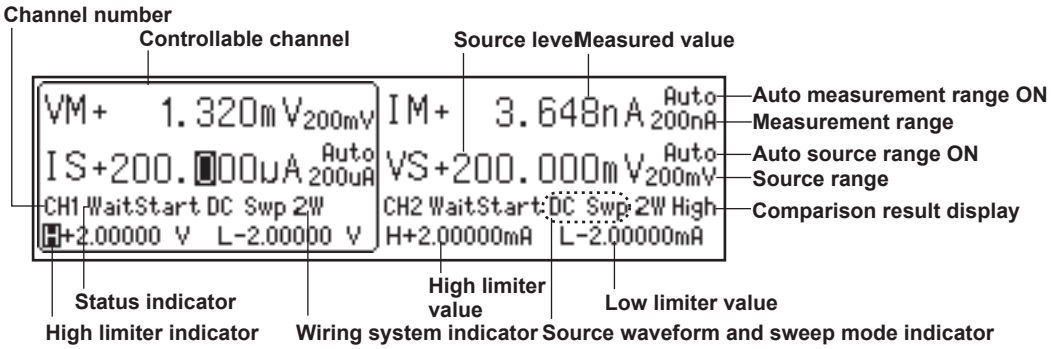
1.3 Display Mode and Displayed Contents

Display Mode

ESC (DISPLAY) to switch the display mode.

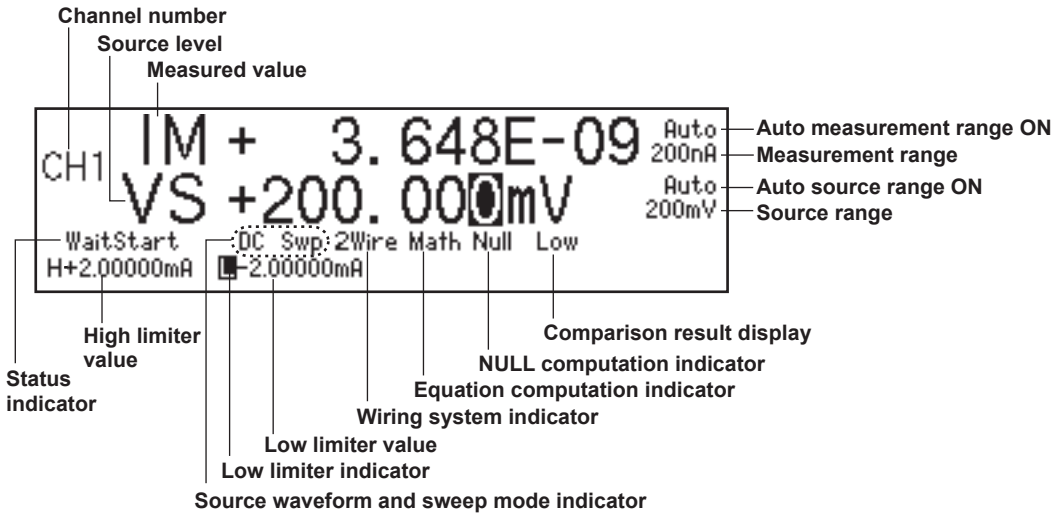
2-Channel Display

The left half of the display shows CH1 information, and the right half shows CH2 information. The channel that is currently controllable is displayed with a frame. Press **CH** to switch the controllable channel.



1-Channel Display

Displays information of the currently controllable channel.



Displayed Contents

Channel Number

CH1 or CH2

Status Indicator

Displays the various wait conditions during operation.

WaitTrigger: Waiting for trigger
WaitStart: Waiting for sweep start
Calculating: Sweep in preparation

Source Waveform and Sweep Mode Indicator

Displays the combination of the source waveform and sweep mode ON/OFF. The following four combinations are available.

Indication	Source Waveform	Sweep
DC	DC	OFF
Pls	Pulse	OFF
DC Swp	DC	ON
Pls Swp	Pulse	ON

Wiring System Indicator

Displays the selected wiring system.
2W/2Wire: Local sense
4W/4Wire: Remote sense

Equation Computation Indicator

Displays “MATH” when equation computation is ON.

NULL Computation Indicator

Displays “Null” when NULL computation is ON.

Comparison Result Display

Displays the judgment result of the comparison.
High: Greater than the upper limit
In: Within the range
Low: Less than the lower limit

High Limiter and Low Limiter Values

Displays the high limiter and low limiter values.

High Limiter Indicator

Highlighted when the high limiter is activated.

Low Limiter Indicator

Highlighted when the low limiter is activated.

Source Level

Displays the current source level. VS/IS at the front indicates the source function (voltage source or current source).

Measured Value

Displays the current measured value. IM/VM at the front indicates the measurement function (voltage measurement or current measurement). The display indicates “-----” when measurement is not performed and “+OVER” or “-OVER” when the measurement is over-the-range.

Auto Range ON

Displayed when auto range is selected.

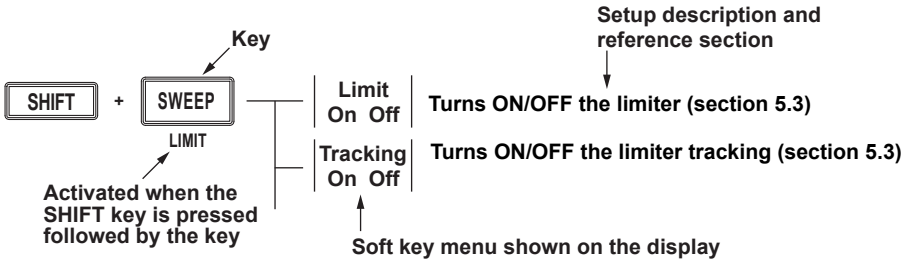
Source Range or Measurement Range

Displays the current range.

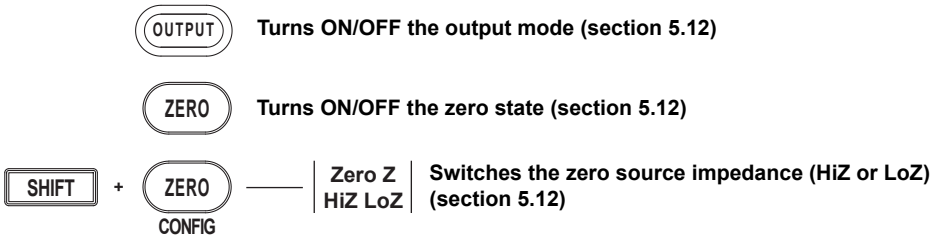
1.4 Key Groups and Menus

The GS820 has five key groups for each function, output control, operation control, SOURCE, MEASURE, and COMMON, as well as keys for switching the display and locking the keys. This section introduces each key group in a tree structure.

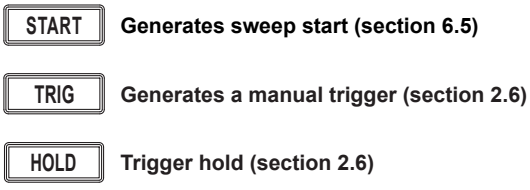
How to View the Tree Structure



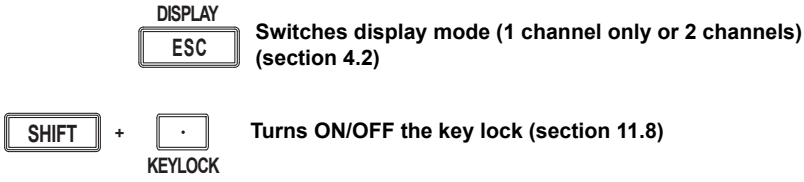
Output Control Group



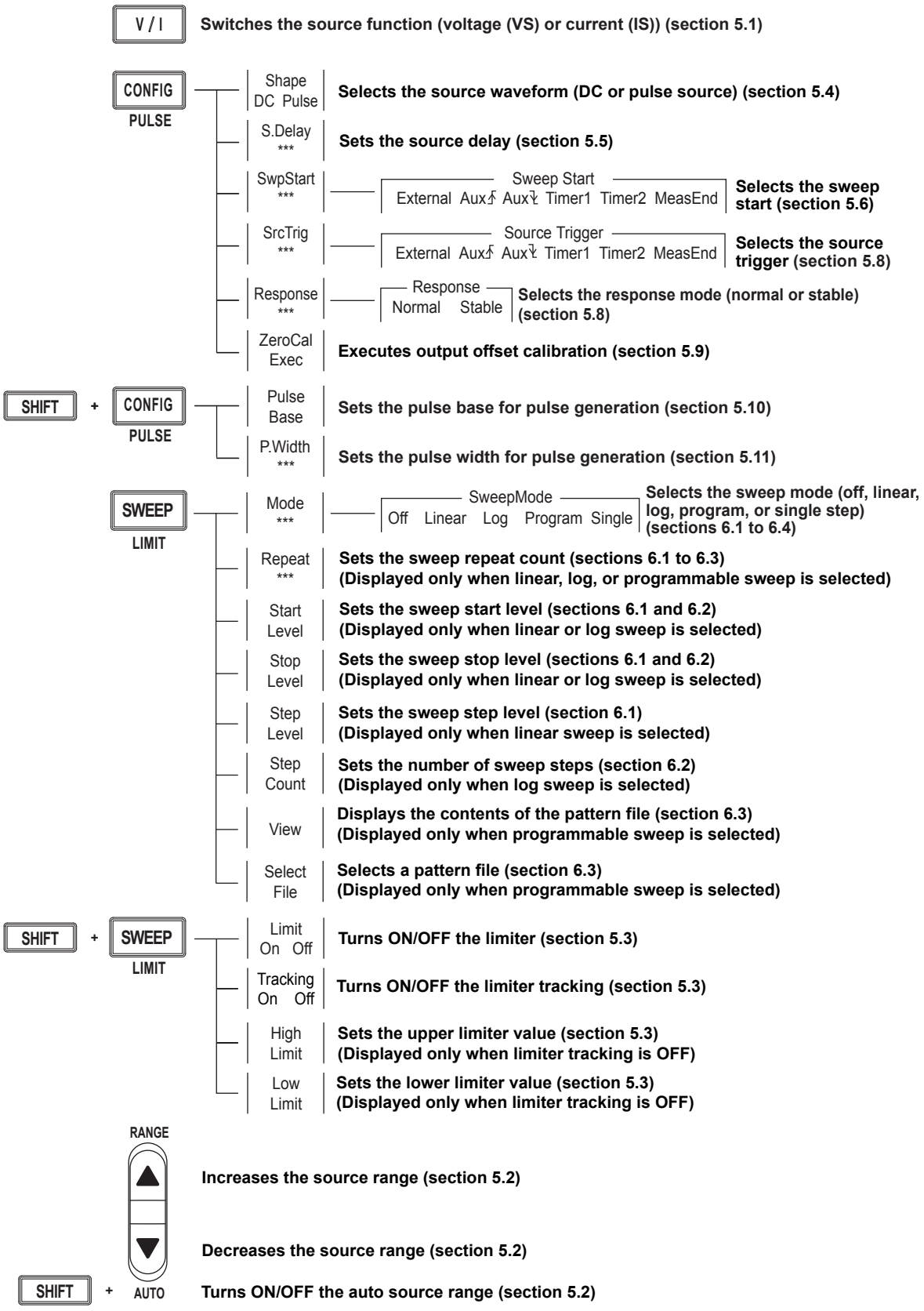
Trigger Control Group



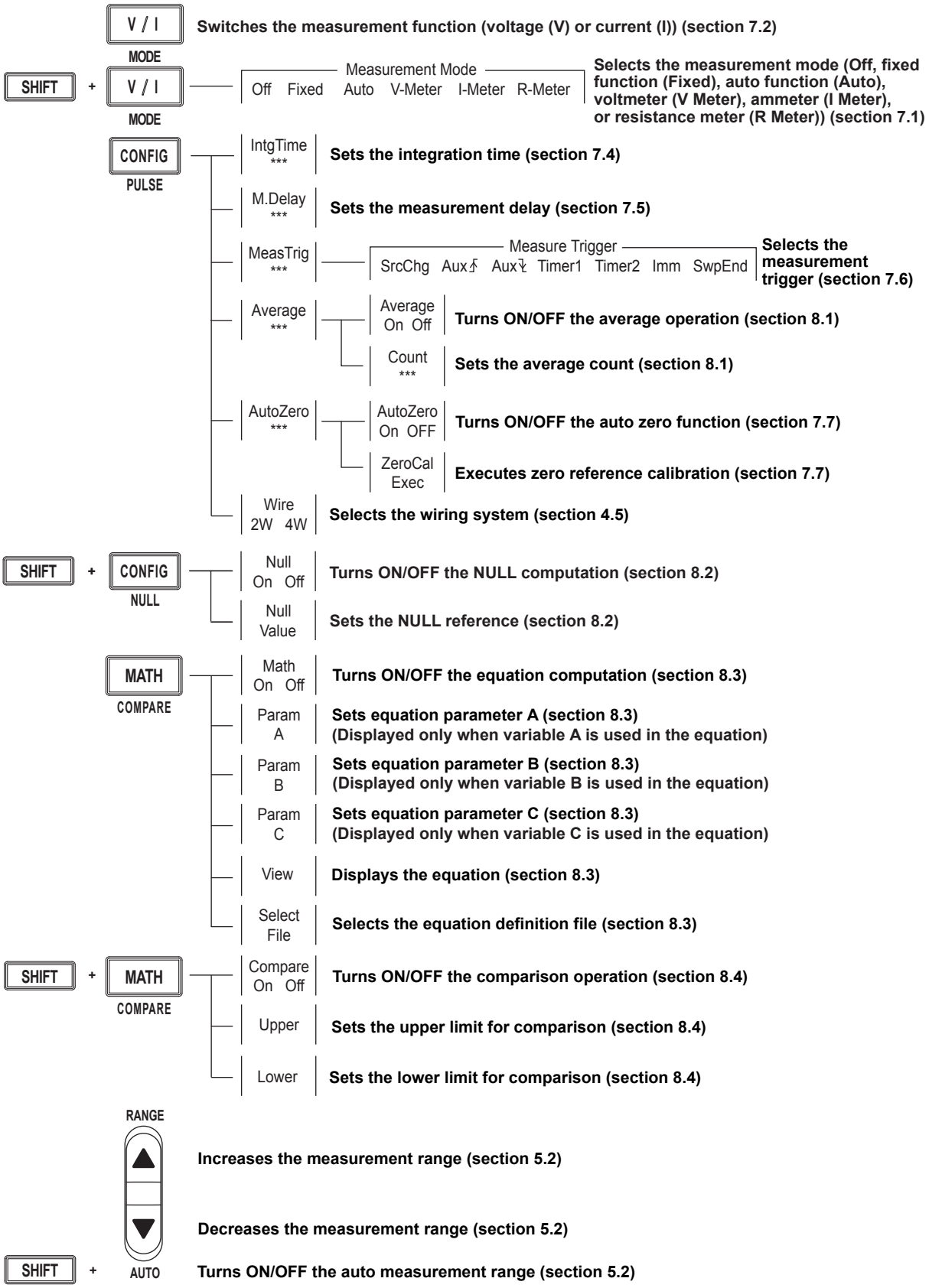
Display Switch and Key Lock



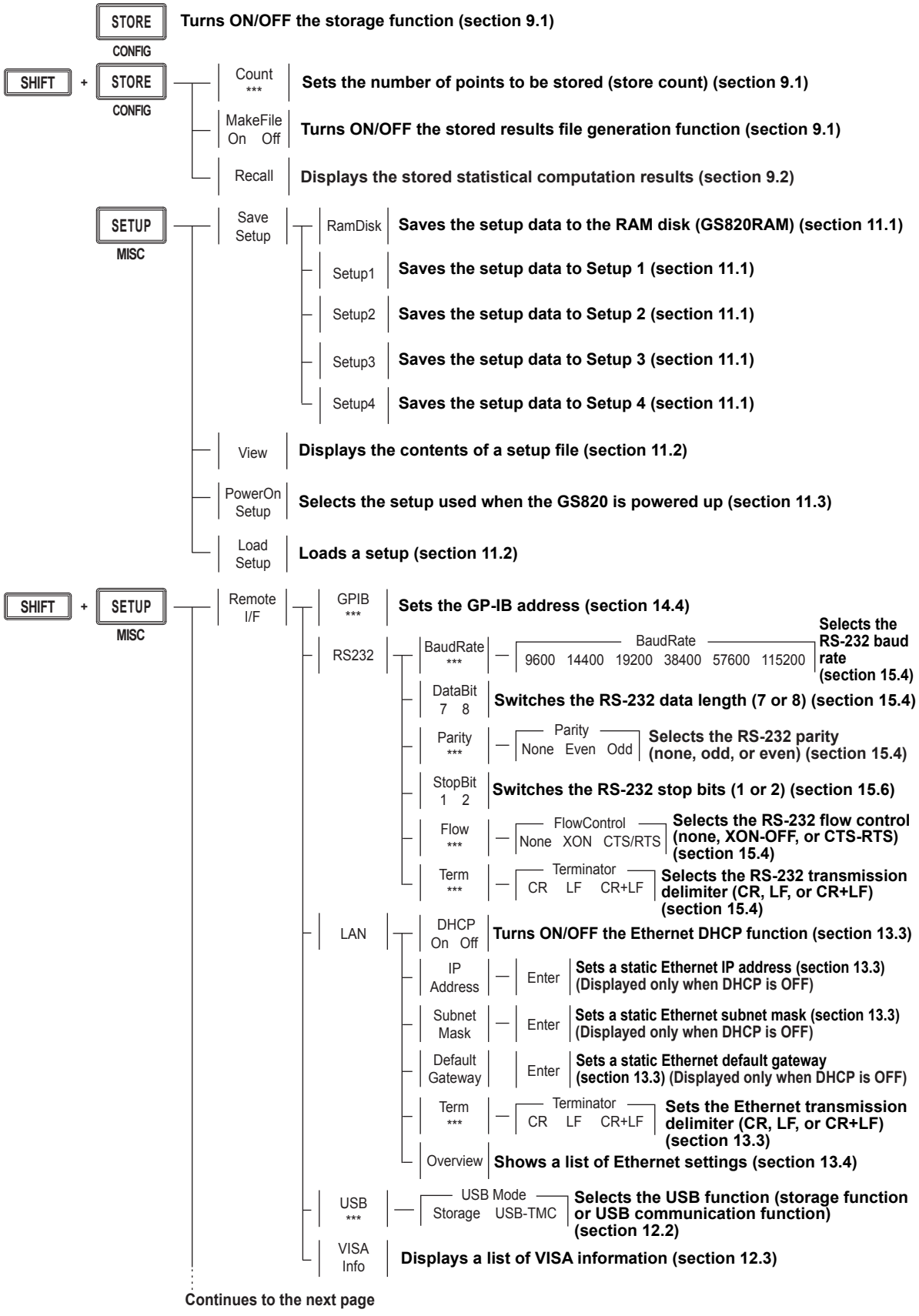
SOURCE group



MEASURE group



COMMON group



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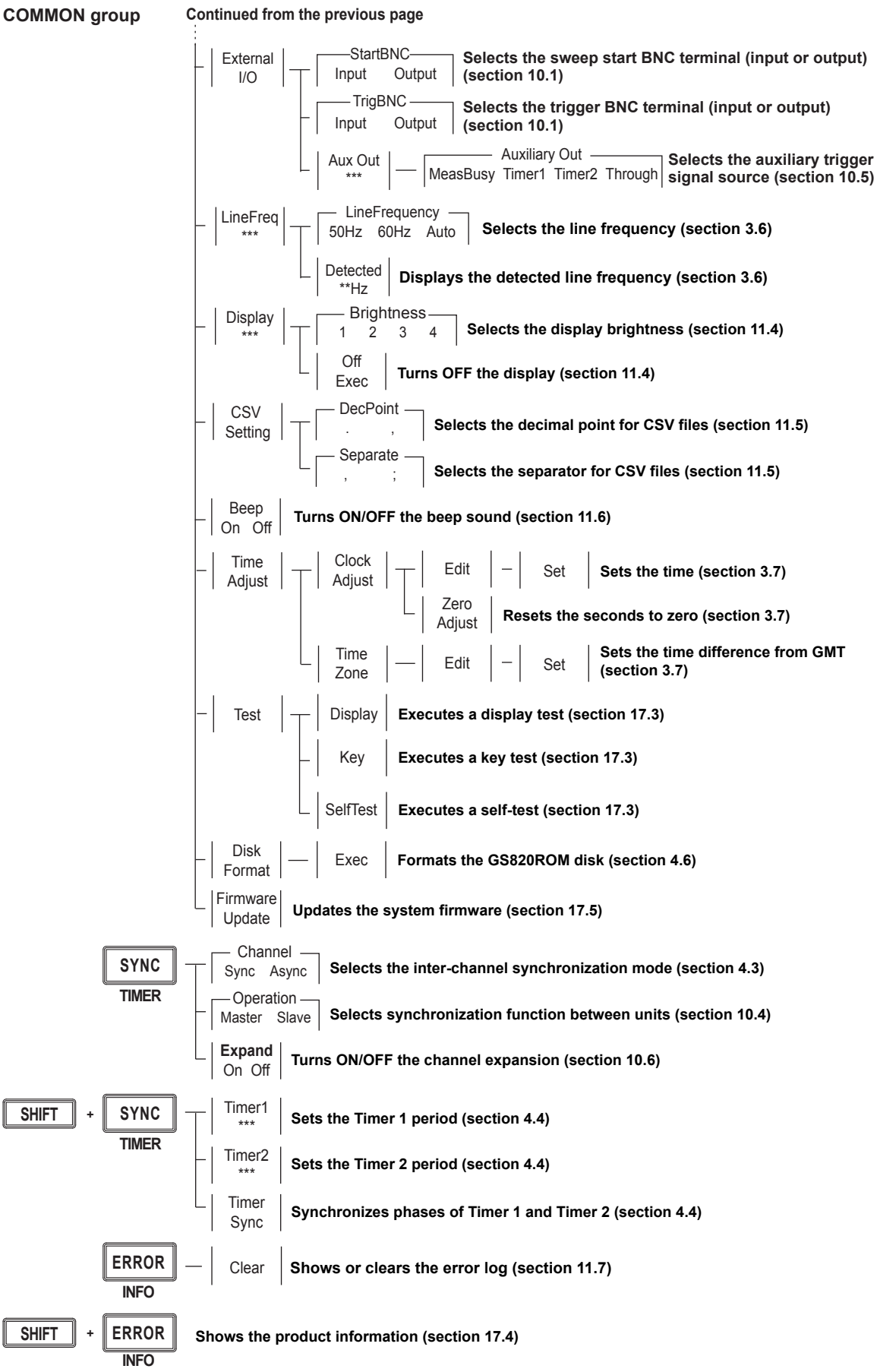

COMMON group
Continued from the previous page
External I/O
StartBNC
Input Output
Selects the sweep start BNC terminal (input or output) (section 10.1)
TrigBNC
Input Output
Selects the trigger BNC terminal (input or output) (section 10.1)
Aux Out ***
Auxiliary Out
MeasBusy Timer1 Timer2 Through
Selects the auxiliary trigger signal source (section 10.5)
LineFreq ***
LineFrequency
50Hz 60Hz Auto
Selects the line frequency (section 3.6)
Detected **Hz
Displays the detected line frequency (section 3.6)
Display ***
Brightness
1 2 3 4
Selects the display brightness (section 11.4)
Off Exec
Turns OFF the display (section 11.4)
CSV Setting
DecPoint
. ,
Selects the decimal point for CSV files (section 11.5)
Separate
, ;
Selects the separator for CSV files (section 11.5)
Beep
On Off
Turns ON/OFF the beep sound (section 11.6)
Time Adjust
Clock Adjust
Edit
Set
Sets the time (section 3.7)
Zero Adjust
Resets the seconds to zero (section 3.7)
Time Zone
Edit
Set
Sets the time difference from GMT (section 3.7)
Test
Display
Executes a display test (section 17.3)
Key
Executes a key test (section 17.3)
SelfTest
Executes a self-test (section 17.3)
Disk Format
Exec
Formats the GS820ROM disk (section 4.6)
Firmware Update
Updates the system firmware (section 17.5)
SYNC
TIMER
Channel
Sync Async
Selects the inter-channel synchronization mode (section 4.3)
Operation
Master Slave
Selects synchronization function between units (section 10.4)
Expand
On Off
Turns ON/OFF the channel expansion (section 10.6)
SHIFT + SYNC
TIMER
Timer1 ***
Sets the Timer 1 period (section 4.4)
Timer2 ***
Sets the Timer 2 period (section 4.4)
Timer Sync
Synchronizes phases of Timer 1 and Timer 2 (section 4.4)
ERROR
INFO
Clear
Shows or clears the error log (section 11.7)
SHIFT + ERROR
INFO
Shows the product information (section 17.4)

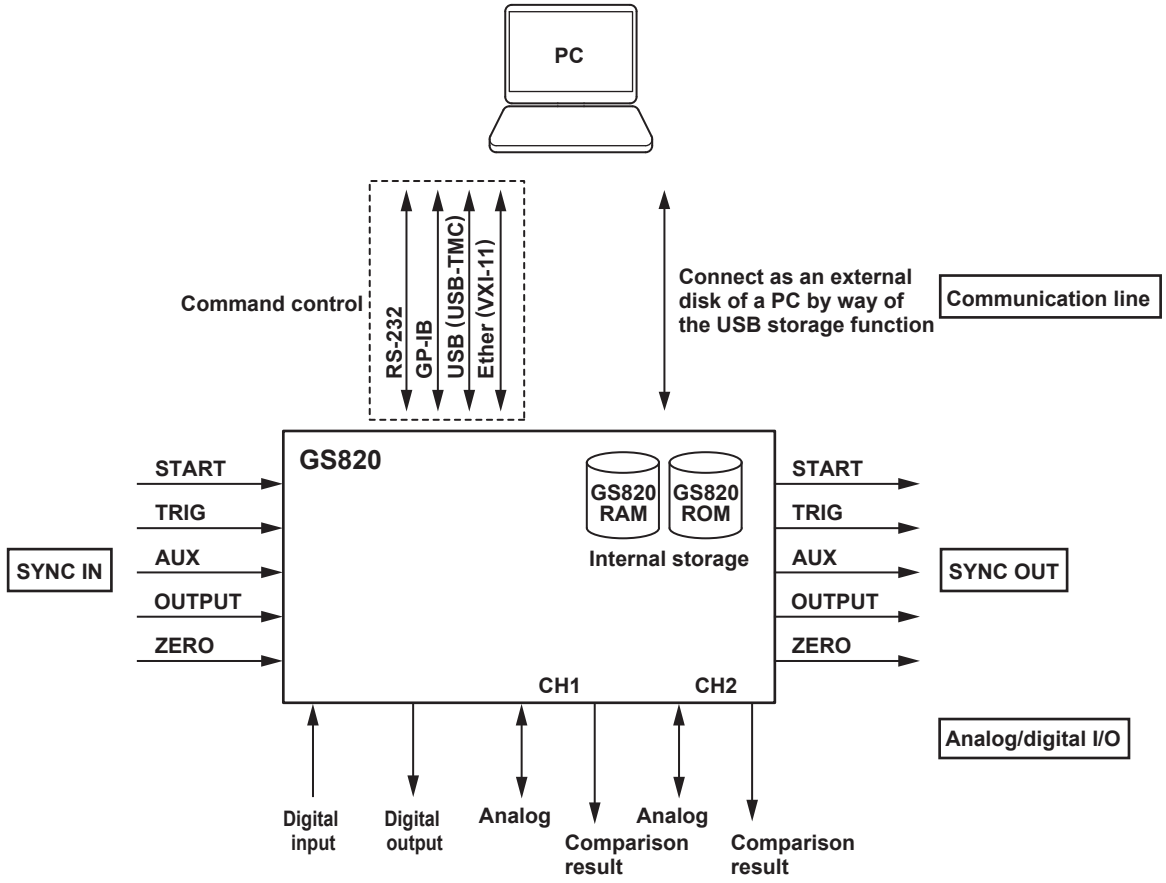
2.1 System Configuration and Block Diagram

Product Features and System Configuration

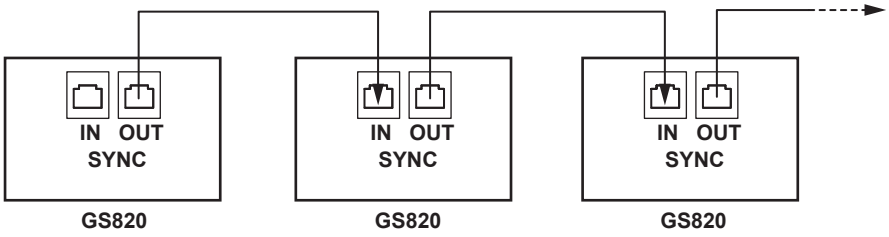
GS820 Features

- The GS820 is a source measure unit that has two mutually isolated channels that can be configured and operated independently.
- The source function (VS or IS) on each channel can be switched even while the output is ON. In addition, the measurement function (VM or IM) can be switched at any time.
- The GS820 compares the measured value of each channel to a threshold value (comparison operation function) and provides a terminal for delivering the comparison result.
- By using the external I/O connector on the rear panel, 2-bit (765601) or 16-bit (765602) digital output that can be driven from CH1 can be controlled in sync with the source operation. In addition, the 2-bit (765601) or 16-bit (765602) digital input can be output to a result file along with the measurement results.
- The I/O terminals for synchronous operation (SYNC IN/OUT) of multiple GS820s can be connected in a daisy chain to allow synchronization of output control and trigger. This increases the number of channels that can be controlled simultaneously. In addition, a channel expansion function is available that allows synchronous operation of up to 10 channels.
- The GS820 has a built-in 12-MB non-volatile storage (GS820ROM) for storing various settings and a 16-MB volatile storage (GS820RAM) for storing measurement results and the like. If the GS820 is connected to your PC using USB, the two storage memories becomes accessible from your PC as external disks. Because settings and results are saved in a general text file or CSV file, you can use a text editor, a general-purpose spreadsheet application, or the like to edit or draw graphs on your PC.
  In addition to the storage function, the USB can be used to perform command control by way of the USB-TMC protocol. Furthermore, command control can be performed by way of other communication interfaces such as GP-IB, RS-232, and Ethernet (VXI-11 protocol/7655 command socket). These interfaces allow multiple GS820s to be controlled simultaneously using commands. The Ethernet communication also has an FTP server function for the built-in storage and an HTTP server function that allows information to be viewed and the GS820 to be controlled from a browser.

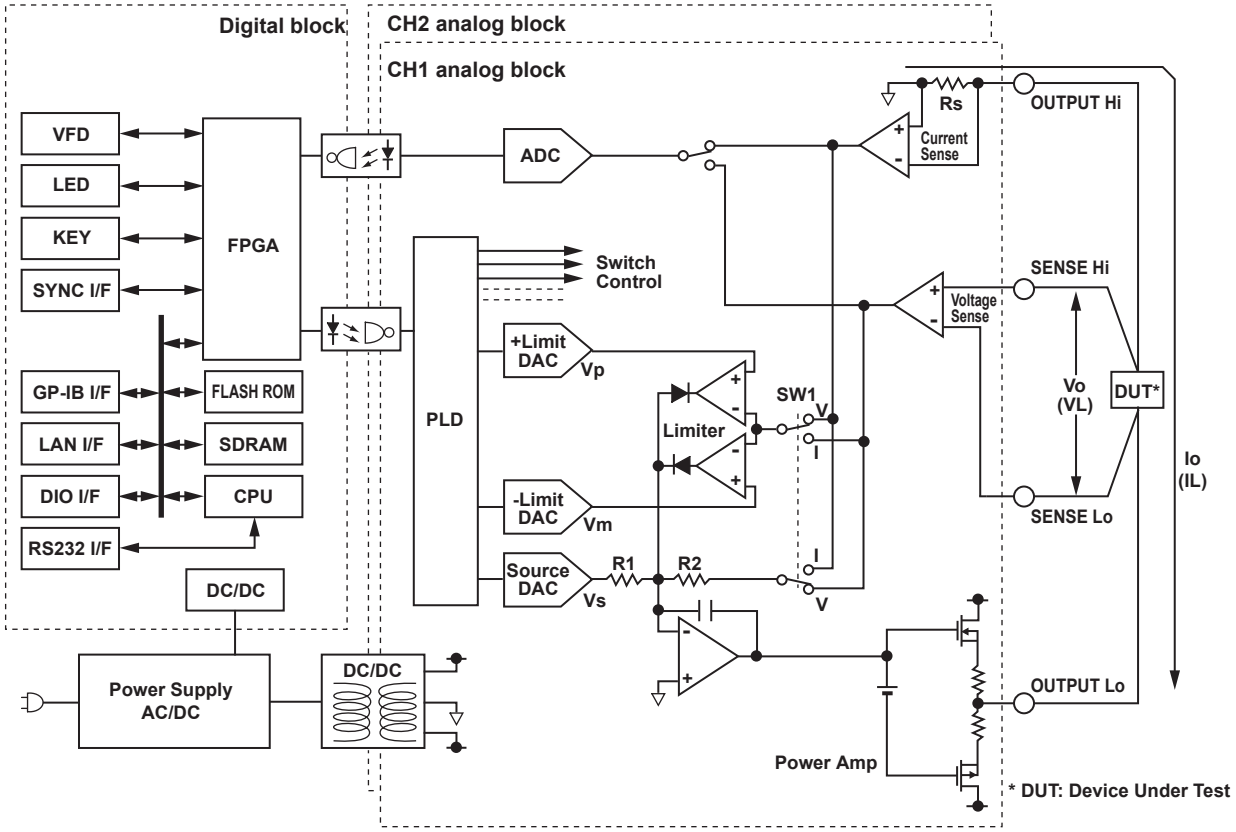
System Configuration Diagram



Synchronous Operation by Connecting the I/O Terminals for Synchronous Operation (SYNC IN/OUT)



Block Diagram



The GS820 consists of a digital section at ground potential and analog sections that are insulated from the digital section. The CH1 and CH2 analog sections are also mutually insulated. The power supply is a single output source. The desired circuit voltage is supplied to the digital section through a non-isolated DC-DC converter and to the analog sections through an isolated DC-DC converter.

The digital section consists of a CPU, FPGA, memories, and various interface circuits. The FPGA provides not only CPU peripheral circuits but also an interface for serially transferring the setup data of D/A converters (DACs) and switches to the analog section. The analog sections consist of fast, highly accurate op-amps, highly stable resistors, and the like. A PLD is employed at the interface to the digital section. The PLD sets the serial data sent from the digital section to each DAC and controls the operation sequence of each switch when the range is changed.

When operating as a voltage source, SW1 is connected to V, and source voltage Vo is a product of source DAC value Vs and R2/R1. If load current IL increases positively and IL × Rs exceeds positive limiter DAC value Vp, the diode of the limiter circuit will turn ON and suppress the load current to Vp/Rs. A similar operation takes place when the load current is negative.

When operating as a current source, SW1 is connected to I, and source current Io is a product of source DAC value Vs and (R2/R1)/Rs. If load voltage VL exceeds positive limiter DAC value Vp, the diode of the limiter circuit will turn ON and suppress the load voltage to Vp. A similar operation takes place when the load voltage is negative.

The GS820 is equipped with a measurement circuit that is separate from the source and limiter circuits and measures the voltage or current that is received using A/D converters (ADC).

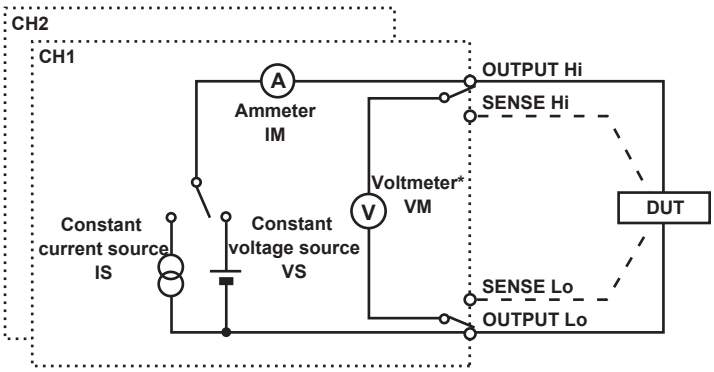
2.2 Source Measure Function of the GS820

This section describes the source measurement function, the basic function of the GS820.

GS820 Construction

The GS820 is equipped with two analog channels with each channel consisting of a constant voltage source (VS), a constant current source (IS), a voltmeter (VM), and an ammeter (IM). The two channels are isolated. Each channel allows voltage sensing using a two-wire system or a four-wire system by switching between local sense and remote sense.

GS820 construction



* For DUT voltage measurement

– – – Used to measure a four-wire system

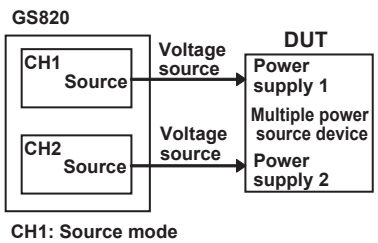
Source Function and Measurement Function

The GS820 has the following source and measurement functions.

- Voltage source and current measurement (VS&IM)
- Current source and voltage measurement (IS&VM)
- Voltage source (VS)
- Current source (IS)
- Voltmeter (VM)
- Ammeter (IM)
- Resistance meter (IS&VM)

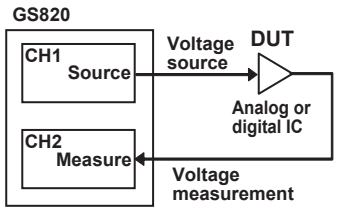
Combinations Source Function and Measurement Function

You can select the source function or the measurement function on each channel and arbitrarily combine the two channels.



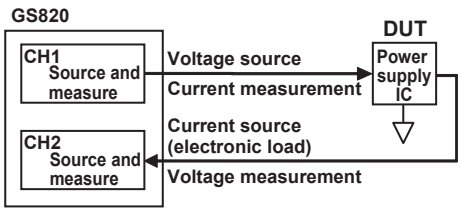
CH1: Source mode
CH2: Source mode

• DUT example
CPU, multi-core MPU, embedded device, hybrid IC, disk drive, and various board assemblies



CH1: Source mode
CH2: Measurement mode

• DUT example
Op Amp, comparator, logic IC, and various board assemblies



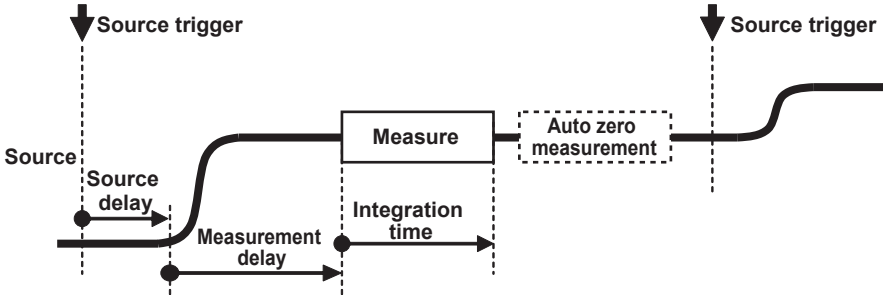
CH1: Source and measurement mode
CH2: Source and measurement mode

• DUT example
Three-terminal regulator, DC-DC converter, bipolar transistor, FET, and various board assemblies

Source and Measurement Timing

Basic Timing of Source and Measurement

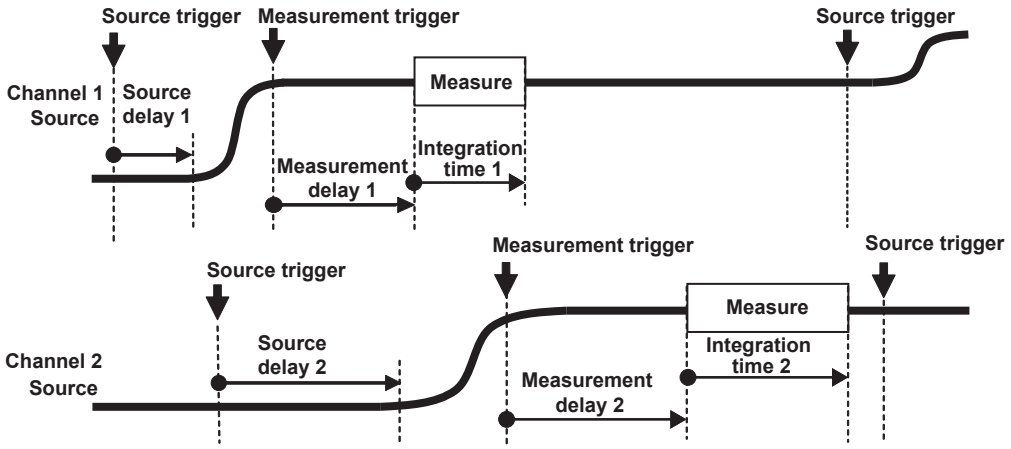
The GS820 has two source modes: DC source and pulse source. In either mode, source and measurement are carried out with a trigger input as the starting point. Measurement is performed over a preset integration time after starting the source operation. After the measurement, the auto zero measurement function, which measures the internal zero reference and performs offset correction in real-time, can be used.



For details on the source operation, see section 2.3, “Source.”
For details on the measurement operation, see section 2.4, “Measurement.”

Setting the Timing Using Triggers

The source trigger and measurement trigger can be selected separately. The source trigger includes two types of constant period timers, external signal input, auxiliary trigger, and measurement end. The measurement trigger includes source level change, sweep end, and immediate in addition to the triggers available for the source trigger. The auxiliary trigger can be an external signal or an event by way of a program. Source delay, measurement delay, and integration time can be set separately for each channel.

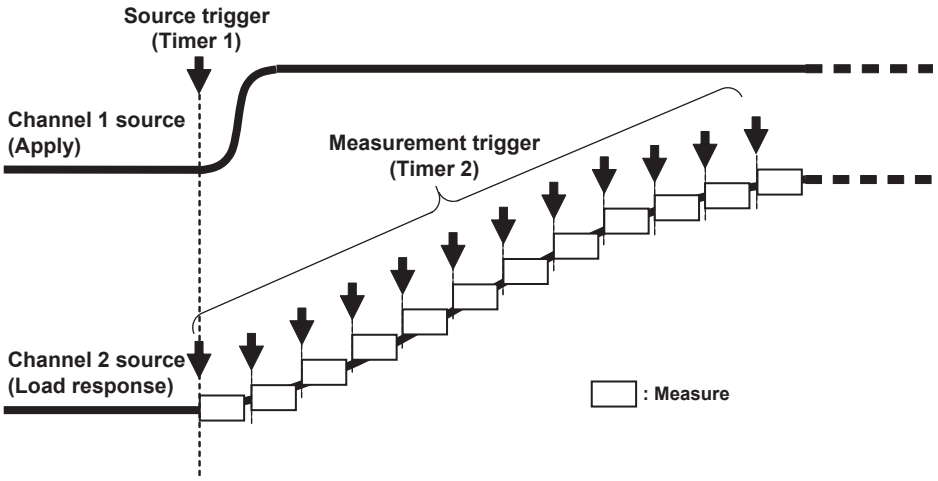


Source trigger: Timers 1 and 2 (constant period), external trigger, auxiliary trigger, and measurement end)
Measurement trigger: Timers 1 and 2 (constant period), source change, sweep end, external trigger, and auxiliary trigger)

For details on triggering, see section 2.6, “Triggering.”

Asynchronous Operation of Source and Measure

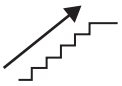
The GS820 can execute the trigger generation and measurement asynchronously. The figure below shows an example in which the source trigger is set to Timer1, the measure trigger is set to Timer2, and multiple measurements are performed on a single source trigger.



Sweep Function

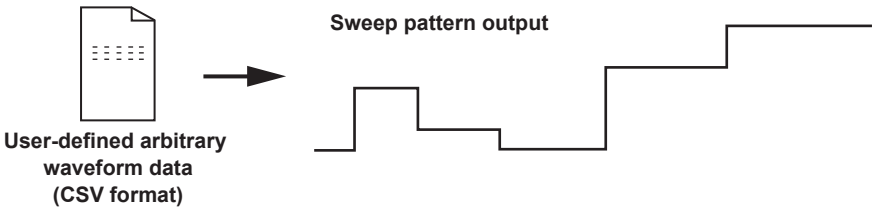
Preset Sweep

By setting parameters, a preset sweep (continuous output, linear sweep, or log sweep) can be performed in each source mode.

Source Mode	No Sweep	Linear Sweep	Log Sweep
DC source			
Pulse source			

programmable sweep

A programmable sweep can be performed by using user-defined arbitrary waveform data (CSV format) that you edited on a spreadsheet or text editor.
Because a programmable sweep allows the timing and control parameters to be swept simultaneously along with the source level, a control sequence can be executed in sync with the waveform generation timing.



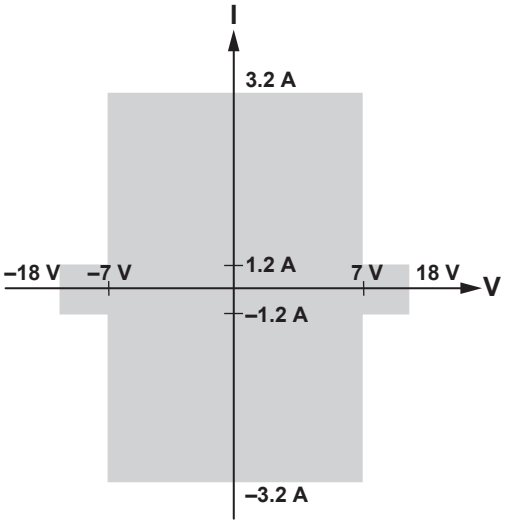
For details on the sweep function, see section 2.5, “Sweep.”

2.3 Source

Source Range

Source Range

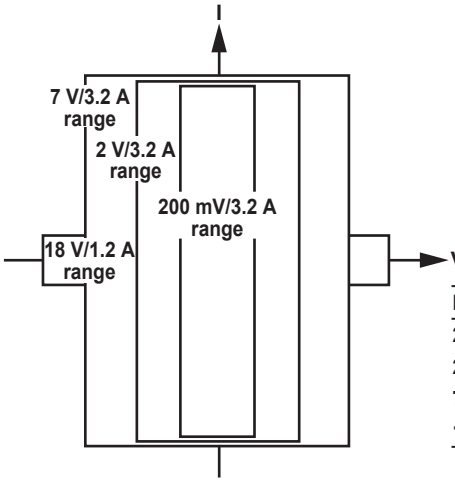
Indicates the range that the GS820 can generate or measure.



The source range is divided into several voltage ranges and current ranges. Voltage ranges and current ranges are used as source ranges or limiter ranges, respectively.

Voltage Range

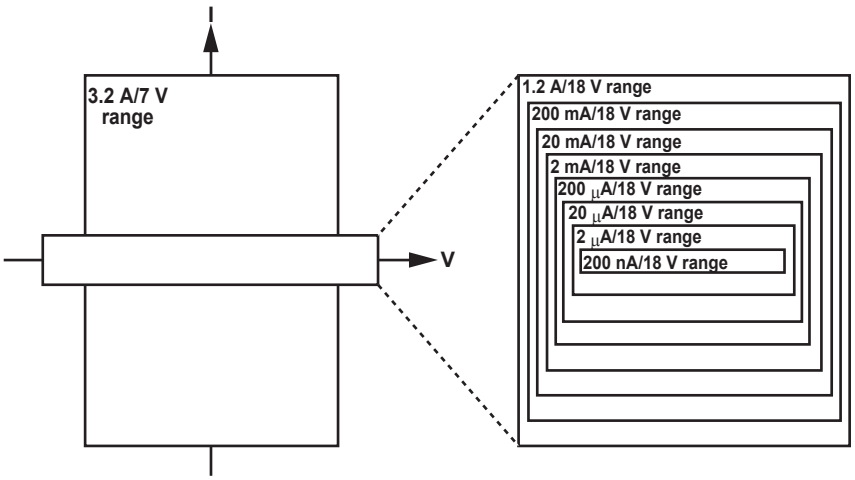
The voltage range consists of the voltage source range and voltage limiter range.



Range	Source Range	Resolution	Max. Load Current
200 mV	±200.000 mV	1 μV	±3.2 A
2 V	±2.00000 V	10 μV	±3.2 A
7 V	±7.0000 V	100 μV	±3.2 A
18 V	±18.0000 V	100 μV	±1.2 A

Current Range

The current range consists of the current source range and current limiter range.



Range	Source Range	Resolution	Max. Load Current
200 nA	±200.000 nA	1 pA	±18 V
2 μA	±2.00000 μA	10 pA	±18 V
20 μA	±20.0000 μA	100 pA	±18 V
200 μA	±200.000 μA	1 nA	±18 V
2 mA	±2.00000 mA	10 nA	±18 V
20 mA	±20.0000 mA	100 nA	±18 V
200 mA	±200.000 mA	1 μA	±18 V
1 A	±1.20000 A	10 μA	±18 V
3 A	±3.20000 A	10 μA	±7 V

Source Function (see section 5.1 for operating procedure)

The source function is voltage (VS) or current (IS).

Voltage (VS): Operates as a constant voltage source. The current limiter is enabled.

Current (IS): Operates as a constant current source. The voltage limiter is enabled.

Fixed Source Range and Auto Range (see section 5.2 for the procedure)

There are two source ranges: fixed range and auto range.

Fixed Source Range

The target range is specified directly. You can set the source level within the source range (see “Voltage Range” and “Current Range” on pages 2-7 and 2-8) of the specified range.

Auto Source Range

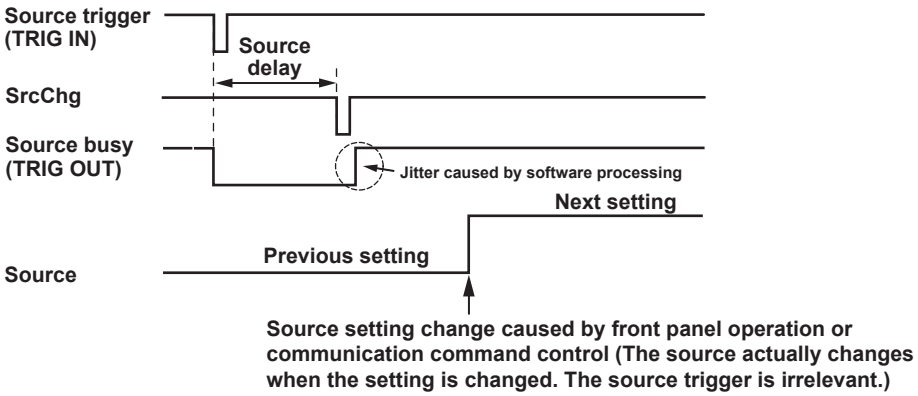
The GS820 automatically switches to the most suitable range according to the source level. This allows you to set the source level within the source range (see “Source Range” on page 2-7) without having to worry about the range. However, the output may be temporarily discontinuous if the range switches.

Source Action

Source action refers to a sequence of operation in which the source setting changes as a result of a source trigger.
The following four types of source action are available based on the combination of the source waveform and sweep mode.

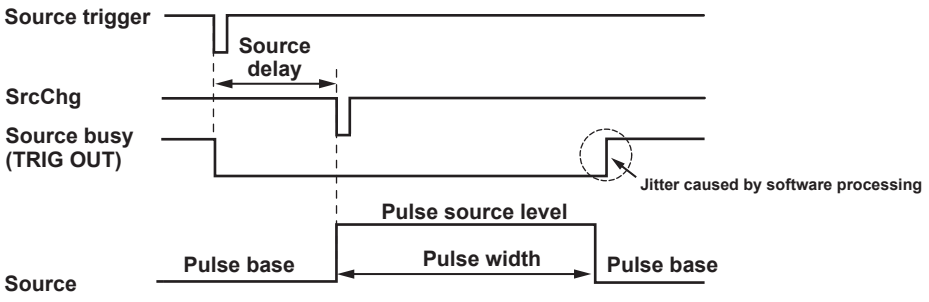
Source Action for DC Source

If the sweep function is OFF in DC source mode, the actual source setting will change at the time the setting change is instructed from a panel operation or communication command. SrcChg (source change) that is selectable as a measurement trigger is generated after the source delay time elapses from the time the source trigger is applied. In addition, source busy (TRIG OUT) is set low when the source trigger is applied and returns to high after the generation of SrcChg + software processing.



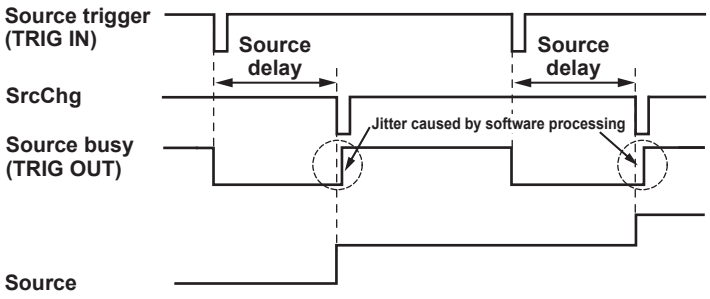
Source Action for Pulse Source

The source level in pulse source mode before the source trigger is applied is at the pulse base value. The source level changes to the pulse source level after the source delay elapses from the source trigger input and remains at that level over the pulse width. Then, the source level returns to the pulse base value. SrcChg (source change) that is selectable as a measurement trigger is generated after the source delay time elapses from the time the source trigger is applied at the pulse source timing. In addition, source busy (TRIG OUT) is set low when the source trigger is applied and returns to high after the end of the generation of the pulse source + software processing.



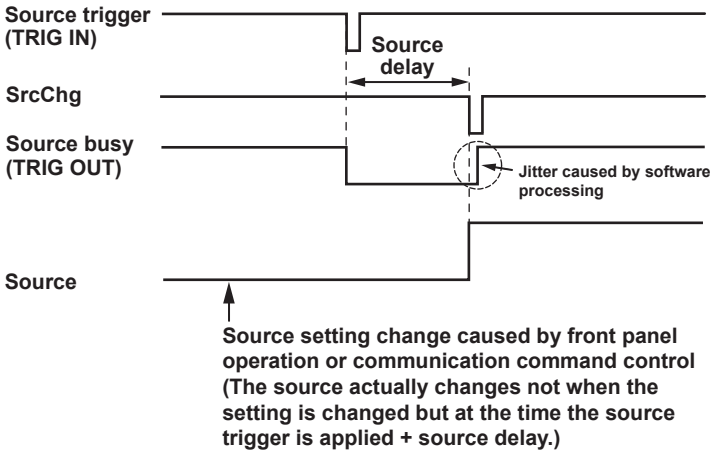
Source Action for Linear Sweep, Log Sweep, and Programmable Sweep

During the sweep period, the source setting changes to the next setting after the source delay time elapses from the time the source trigger is applied. SrcChg (source change) that is selectable as a measurement trigger is generated after the source delay time elapses from the time the source trigger is applied at the time the source setting is changed. In addition, source busy (TRIG OUT) is set low when the source trigger is applied and returns to high after the generation of SrcChg + software processing.



Source Action for Single-Step Sweep

The settings entered in advance is applied to the source after the source delay time elapses from the time the source trigger is applied. SrcChg (source change) that is selectable as a measurement trigger is generated after the source delay time elapses from the time the source trigger is applied at the time the source setting is changed. In addition, source busy (TRIG OUT) is set low when the source trigger is applied and returns to high after the generation of SrcChg + software processing.



Source Timing Adjustment Using the Source Delay (see section 5.5 for the procedure)

The source delay is the wait time from when the source trigger is applied to when the output actually changes. You can adjust the timing between the source trigger and the source change by changing this setting. It can also be used to adjust the timing between channels.

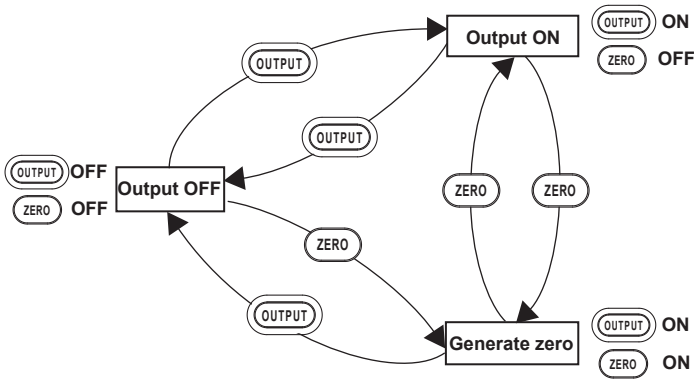
Output ON/OFF and Zero Source (see section 5.12 for the procedure)

There are three output modes: OFF, ON, or zero source.

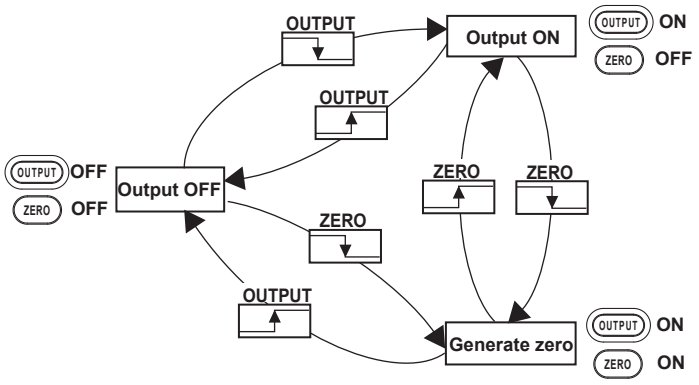
OFF: The output is disconnected, and source action and measurement action are stopped.

ON: The output is connected, and the GS820 is running in normal mode. Source action and measurement action are enabled.

Zero source: The output is connected, but the GS820 generates 0 V (during voltage source (VS)) or 0 A (during current source (IS)). Source action and measurement action are stopped.



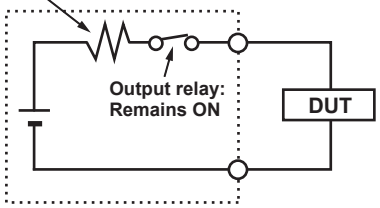
The GS820 can also be controlled using OUTPUT IN and ZERO IN of the input terminal for synchronous operation (SYNC IN) on the rear panel.



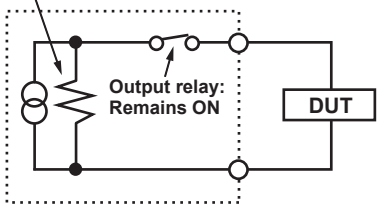
Zero Source Function

In addition to the generation of zero voltage or current, the zero source function of the GS820 allows the voltage applied to the load or the current supply to be limited at an extremely low level by setting the current or voltage limiter to the minimum setting (high impedance setting for zero voltage or low impedance setting for zero current). Using this function rather than turning the output OFF avoids the problems of output relay chattering and contact life and also allows the operating time of turning the output ON and OFF to be reduced.

Zero generation of voltage
- **Low impedance: Current limiter is set to the normal value**
- **High impedance: Current limiter setting is 10 nA**



Zero generation of current
- **Low impedance: Voltage limiter setting is 1 mV**
- **High impedance: Voltage limiter is set to the normal value**



Zero Source Impedance

You can select high impedance or low impedance for the impedance that is used during zero source. The default settings are high impedance (HiZ) in voltage source mode and low impedance (LoZ) in current source mode.

Note

A mechanical relay operates when switching between output ON and output OFF. Note the following points when using the GS820.

- It takes approximately 20 ms for the relay to stabilize.
- As the number of ON/OFF operations increases, effects begin to appear such as increases in the the time for the relay to stabilize. Though dependent on the load, the electrical life of the relay is around 100,000 times.
- If the output needs to be turned ON/OFF frequently, use the zero source function. For example, if you select high impedance for zero voltage source, the GS820 will simulate a relay OFF state.
  The output relay does not operate when switching between output ON and zero source.

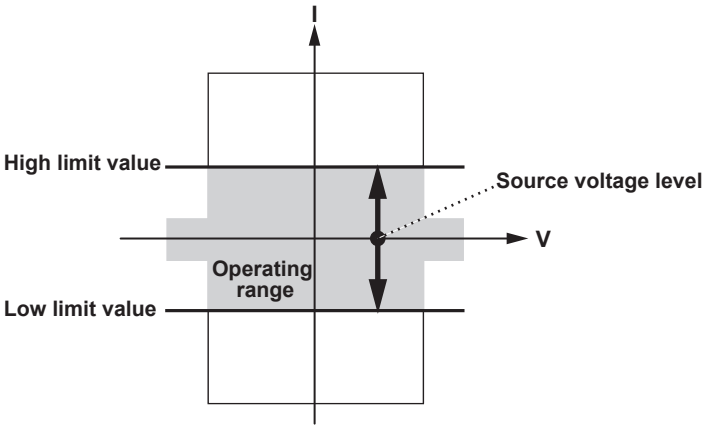
DUT Protection Using the Limiter (see section 5.3 for the procedure)

CAUTION

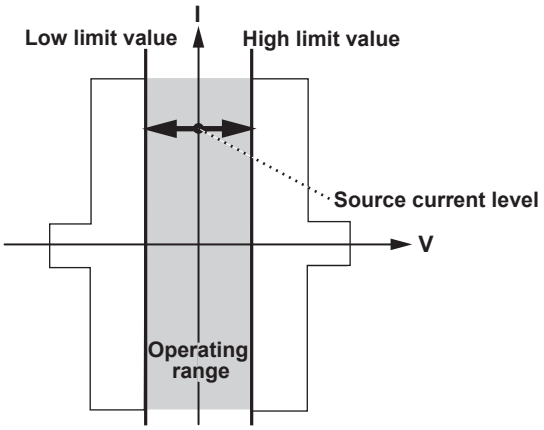
If a current source exceeding the current limiter setting is connected in voltage source mode; if a voltage source exceeding the voltage limiter setting is connected in current source mode; or if a load exceeding the source range above is connected, abnormal load is detected, and the output is turned OFF. Do not connect these types loads to the GS820. If connected, the GS820 may malfunction.

If a limiter is set, an additional limit can be placed within the source range. This limit can prevent damage to the connected device due to overcurrent or overvoltage. In voltage source mode, the current limiter is enabled. In current source mode, the voltage limiter is enabled.
If the limiter is turned OFF, the limiter function is disabled, and the entire source range described previously becomes the operating range.

Limiter Operation in Voltage Source Mode



Limiter Operation in Current Source Mode



The high and low limiter values can be set separately. If tracking is turned ON, a single absolute setting is enabled, and the limiter functions in the positive and negative ranges around zero.
If the high limiter is activated, the high limiter indicator (H) is displayed. If the low limiter is activated, the low limiter indicator (L) is displayed.
The range of the limiter value is always auto range. The best suitable range is selected according to the input value.

Response Mode (see section 5.8 for the procedure)

The response mode can be set for each channel. Select Normal mode or Stable mode according to the DUT or your objective.

Normal Mode

Normal mode in which the time to stabilize is short. Highly capacitive or inductive load may cause instability and oscillation.

Stable Mode

This mode is robust to capacitive and inductive loads, but the time to stabilize is longer than that of Normal mode.

Local Sense and Remote Sense (see section 4.5 for the procedure)

Two wiring systems, 2W (two-terminal connection or local sense) and 4W (four-terminal connection or remote sense), are available. When generating voltage and the current flowing through the load becomes large, the voltage drop in the lead wire can no longer be ignored. If this occurs, the effects from lead wire resistance can be alleviated and the desired voltage can be applied to the DUT by selecting the four-terminal connection and connecting the SENSE terminal near the DUT.

Offset Calibration (see section 5.9 for the procedure)

If offset calibration is executed, the measurement function of the GS820 is used to correct the zero point offset of the source level. For example, this function is used to correct the offset fluctuation that results when the ambient temperature changes drastically. However, because measurements are performed to calibrate all the ranges, the source and measurement operations are suspended for a few seconds while the calibration is in progress.

2.4 Measurement

Measurement Function and Measurement Range

Measurement Function (see section 7.2 for operating procedure)

The measurement function is voltage (VM) or current (IM). Switching the measurement function does not affect the source.

Voltage (VM): Measures voltage.

Current (IM): Measures current.

Measurement Range (see section 7.3 for the procedure)

When Measuring Voltage

Range	Measurement Range	Resolution
200 mV	±210.000 mV	1 μV
2 V	±2.100000 V	10 μV
7 V	±7.1000 V	100 μV
18 V	±18.0000 V	100 μV

When Measuring Current

Range	Measurement Range	Resolution
200 nA	±210.000 nA	1 pA
2 μA	±2.10000 μA	10 pA
20 μA	±21.0000 μA	100 pA
200 μA	±210.000 μA	1 nA
2 mA	±2.10000 mA	10 nA
20 mA	±21.0000 mA	100 nA
200 mA	±210.000 mA	1 μA
1 A	±1.30000 A	10 μA
3 A	±3.20000 A	10 μA

Fixed Measurement Range and Auto Range

There are two measurement ranges: fixed range and auto range.

Fixed Measurement Range

The target range is specified directly. This setting is used when you know the range of the measured value in advance. The measurable level is within the measurement range of the specified range (see “Measurement Range” described earlier). However, if the measurement function is the same as the source function, the measurement range is fixed to the source range. If the input is outside the present measurement range, over range results.

Auto Measurement Range

The GS820 automatically switches to the most suitable range according to the measured value. This setting is used when you do not know the range of the measured value. This setting allows you to make measurements without having to worry about the range. However, measurement takes longer, because additional measurements to detect the range are performed.

Measurement Mode (see section 7.1 for the procedure)

The following five modes are available. Fixed Function is the normal mode.

Measurement OFF (Off)

Does not perform measurements. Select this mode when only the source function is to be used.

Fixed Function

Measures using the specified measurement function.

Auto Function

Automatically selects the measurement function according to the following conditions. This mode is used to make measurements when there is a possibility of a limiter being activated.

- Current measurement (IM) when using voltage source (VS) and voltage measurement (VM) when using current source (IS)
- If a limiter is activated, the GS820 automatically switches to the other measurement function (from voltage measurement (VM) to current measurement (IM) or from current measurement (IM) to voltage measurement (VM)).

Voltmeter Mode (V-Meter)

Operates as a 0-A current source and functions as a voltmeter by measuring the voltage. In this mode, the source function, source range, limiter, and measurement function settings are fixed exclusively for Voltmeter Mode and cannot be changed. Measurement settings other than the measurement function can be changed.

Ammeter Mode (I-Meter)

Operates as a 0-V voltage source and functions as an ammeter by measuring the current. In this mode, the source function, source range, limiter, and measurement function settings are fixed exclusively for Ammeter Mode and cannot be changed. Measurement settings other than the measurement function can be changed.

Resistance Meter Mode (R-Meter)

Operates as a constant current source that generates a measuring current that is determined by the resistance measurement range, measures the voltage, and calculates the resistance as a result. In this mode, the source range, limiter, and measurement function settings are fixed exclusively for Resistance Meter Mode and cannot be changed. Measurement settings other than the measurement function can be changed.

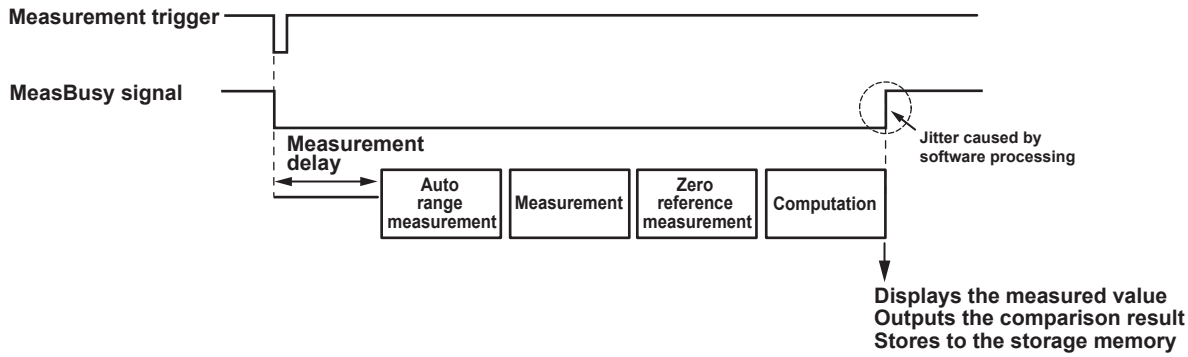
Resistance Measurement range	Measurement Range	Resolution	Measuring Current
200 mΩ	210.000 mΩ	1 μΩ	1 A
2 Ω	2.10000 Ω	10 μΩ	100 mA
20 Ω	21.0000 Ω	100 μΩ	10 mA
200 Ω	210.000 Ω	1 mΩ	10 mA
2 kΩ	2.10000 kΩ	10 mΩ	1 mA
20 kΩ	21.0000 kΩ	100 mΩ	100 μA
200 kΩ	210.000 kΩ	1 Ω	10 μA
2 MΩ	2.10000 MΩ	10 Ω	1 μA
20 MΩ	21.0000 MΩ	100 Ω	100 μA
200 MΩ	210.000 MΩ	1 kΩ	50 μA

Measurement Action

Measurement action refers to a sequence of measurement operations that is carried out as a result of a measurement trigger. If a measurement trigger is applied, the measurement operation will start after the measurement delay elapses. Measurement Busy (MeasBusy) is set low when a measurement trigger is applied and returns to high after the measurement operation is completed.

The entire measurement operation involves steps 1 to 4 below.

1. **Auto Range Measurement**
   If auto measurement range is ON and the GS820 decides that the measurement range is not appropriate, a measurement for determining the range is performed. If fixed measurement range is selected, nothing is performed.
   In some cases, several measurements are made.
2. **Measurement**
   The GS820 performs the target measurement. This measurement requires integration time + software processing time.
3. **Zero Reference Measurement (see the next page)**
   The GS820 performs zero reference measurement if the auto zero function is ON. This measurement requires integration time + software processing time. If the auto zero function is OFF, nothing is performed.
4. **Computation (see section 2.8)**
   The GS820 performs various computations. The processing time varies depending on the number of averaged points, the complexity of the equation, and so on.
   The GS820 computes the following four types in order.
   1. Averaging
      The moving average over the average count of measured values is the result. If averaging is OFF, nothing is performed.
   2. NULL computation
      Subtracts the NULL reference value from the measured value and makes the difference the result. If NULL computation is OFF, nothing is performed.
   3. Equation (MATH) computation
      Solves the built-in or user-defined equation. If equation computation is OFF, nothing is performed.
   4. Comparison operation
      Compares the measured value against the upper and lower limits and classifies the result into one of three types: Low (measured value < lower limit), IN (lower limit ≤ measured value ≤ upper limit), or High (upper limit < measured value). The result is shown on the display and output to the external I/O connector on the rear panel. If comparison operation is OFF, nothing is performed.



Note

If you change the GS820 settings while the measurement action is being carried out, the corresponding measurement becomes invalid. The measurement result display in this case becomes "-----," and the result is not stored.

Measurement Timing Adjustment Using the Measurement Delay (see section 7.5 for the procedure)

Measurement delay is the wait time from when a measurement trigger is applied to when the measurement operation is carried out. You can adjust the timing between the measurement trigger and the measurement operation by changing this setting. For example, you can set the time needed for the DUT to stabilize after the source is changed, so that measurement is performed at a stabilized point.

Highly Accurate Measurement and High-Speed Measurement

Certain measurement conditions allow highly accurate measurements or high-speed measurements depending on the settings. Note the following points when setting the GS820.

Local Sense and Remote Sense (see section 4.5 for the procedure)

Two wiring systems, 2W (two-terminal connection or local sense) and 4W (four-terminal connection or remote sense), are available (see page 2-11).
Four-terminal connection (4W) is effective when the current to be supplied is large and the voltage that appears across the DUT is small such as in a low resistance measurement or when measuring the resistance with high accuracy.

Integration time (see section 7.4 for the procedure)

An integrating A/D converter is used for the measurement. If you set a long integration time, the measurement takes longer, but the stability of the measured values increases. If the integration time is set to an integer multiple of the power line cycle (nPLC), it has an effect of eliminating the line frequency noise. To perform a highly accurate measurement, set an integer value.

Offset Calibration Function (see section 7.7 for the procedure)

Auto Zero Function

If the auto zero function is turned ON, the GS820 measures the internal zero reference for each measurement. The measured result is obtained by subtracting this value from the measured value canceling the offset drift of the measurement circuit in the GS820. However, if the auto zero function is ON, measurement is performed twice. Therefore, the measurement time is approximately twice the measurement time when the auto zero function is OFF. If speed takes precedence over accuracy, turn the auto zero function OFF.

Zero Calibration (Manual Zero) Function

If zero calibration is executed, the zero reference is measured on all measurement ranges and applied to subsequent measured results. If you are using the GS820 with the auto zero function turned OFF, execute zero calibration between measurement sequences as necessary.

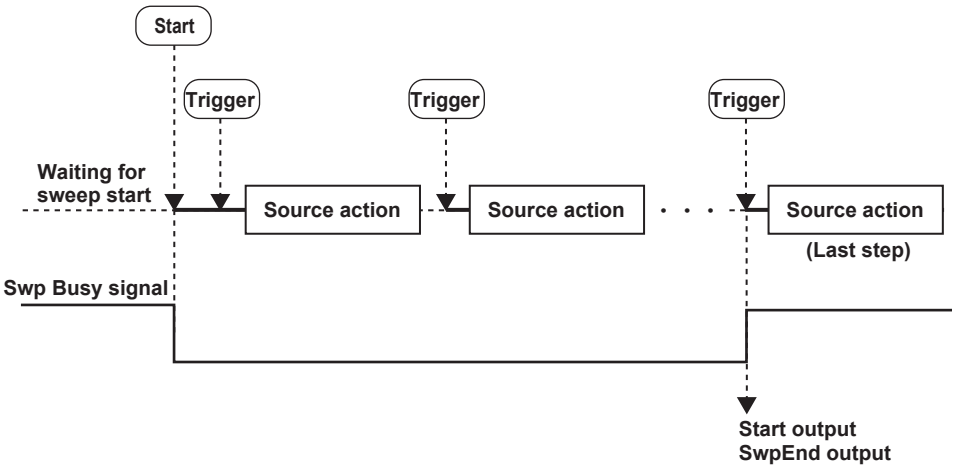
2.5 Sweep

Sweep Function of the GS820

There are four modes: linear sweep, log sweep, programmable sweep, and single-step sweep. To disable the sweep function, turn it OFF.

Basic Operation of Sweeps

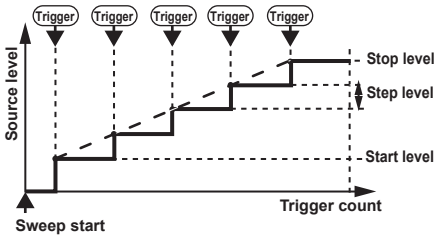
Sweep is an operation that repeats the source operation on a single trigger. For this operation to work, a source trigger that starts the source operation as well as a sweep start that triggers the sweep operation (see section 2.6, “Triggering”) are necessary.
If the sweep function is selected, the GS820 enters a start-wait state. If a start trigger is applied, the GS820 enters a trigger-wait condition. After the sweep starts, the GS820 changes the source level each time a source trigger is received and repeats the source action the specified number of counts (1 to 1000 or infinity (∞)). When a sweep operation is completed, the GS820 enters to the start-wait state again. To abort the sweep operation and make the GS820 enter the start-wait state, turn OFF the output or set to zero source and then turn ON the output again.
The SwpBusy (Sweep Busy) signal is transmitted from the output terminal for synchronous operation (SYNC OUT) on the rear panel. While this signal is at low level, the sweep operation is in progress. This signal can be used to control other units in sync with the end of the sweep operation. For details on the source trigger and SwpBusy signal, see section 2.6, “Triggering.”



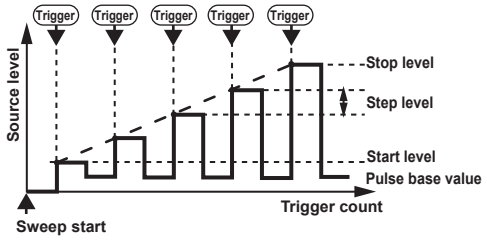
Linear Sweep (see section 6.1 for the procedure)

Performs a linear sweep operation at step levels at regular intervals from the specified start level to the stop level.

• When source waveform is DC



• When source waveform is pulse



Start Level, Stop Level, and Step Level

- **Setting Resolution of the Start level, Stop Level, and Step level for Voltage Source Mode**

|Start Level|	|Stop Level|	Step Level	Setting Resolution
0.000 mV	≤ X ≤	200.000 mV	1 μV
200.00 mV	< X ≤	2.00000 V	10 μV
2.0000 V	< X ≤	7.0000 V	100 μV
7.0000 V	< X ≤	18.0000 V	100 μV

- **Setting Resolution of the Start level, Stop Level, and Step level for Current Source Mode**

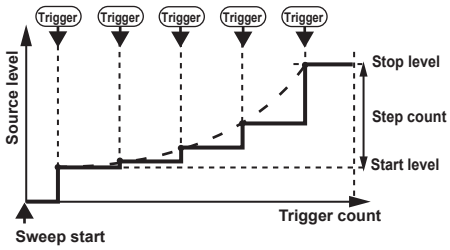
|Start Level|	|Stop Level|	Step Level	Setting Resolution
0.000 nA	≤ X ≤	200.000 nA	1 pA
200.00 nA	< X ≤	2.00000 μA	10 pA
2.0000 μA	< X ≤	20.0000 μA	100 pA
20.000 μA	< X ≤	200.000 μA	1 nA
200.00 μA	< X ≤	2.00000 mA	10 nA
2.0000 mA	< X ≤	20.0000 mA	100 nA
20.00 mA	< X ≤	200.000 mA	1 μA
200.00 mA	< X ≤	3.20000 A	10 μA

Log Sweep (see section 6.2 for the procedure)

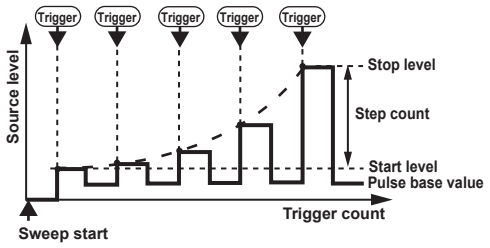
Sweeps the source level from the start level to the stop level in an exponential form divided by the step count.

The step count can be set to any value in the range of 2 to 100000. However, if the start value and stop value have opposite signs, an error occurs, and the sweep operation cannot be carried out.

• When source waveform is DC



• When source waveform is pulse



Start Level and Stop Level

- **Setting Resolution of the Start level and Stop Level for Voltage Source Mode**

|Start Level|	|Stop Level|		Setting Resolution
0.000 mV	≤ X ≤	200.000 mV	1 μV
200.00 mV	< X ≤	2.00000 V	10 μV
2.0000 V	< X ≤	7.0000 V	100 μV
7.0000 V	< X ≤	18.0000 V	100 μV

- **Setting Resolution of the Start level and Stop Level for Current Source Mode**

|Start Level|	|Stop Level|		Setting Resolution
0.000 nA	≤ X ≤	200.000 nA	1 pA
200.00 nA	< X ≤	2.00000 μA	10 pA
2.0000 μA	< X ≤	20.0000 μA	100 pA
20.000 μA	< X ≤	200.000 μA	1 nA
200.00 μA	< X ≤	2.00000 mA	10 nA
2.0000 μA	< X ≤	20.0000 mA	100 nA
20.000 mA	< X ≤	200.000 mA	1 μA
200.00 mA	< X ≤	3.20000 A	10 μA

Step Count

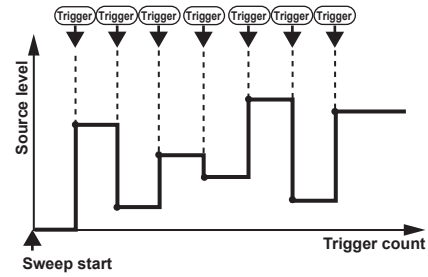
Set a value in the range from 2 to 100000.

Programmable Sweep (see section 6.3 for the procedure)

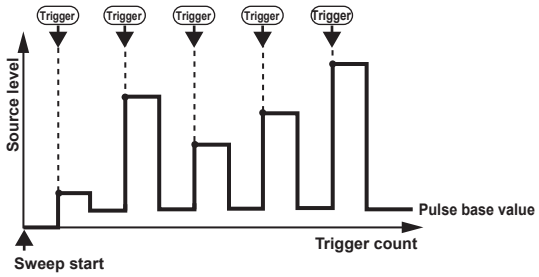
A programmable sweep created in advance on a PC (sweep pattern file in CSV format) is loaded into the GS820, and the GS820 sweeps the source level along the program file pattern. Arbitrary items other than the source level can also be swept simultaneously. The step count can be set to any value up to 100000. If the step count of the sweep pattern exceeds 100000, the first 100000 steps are loaded.

Programmable Sweep Example

• When source waveform is DC



• When source waveform is pulse



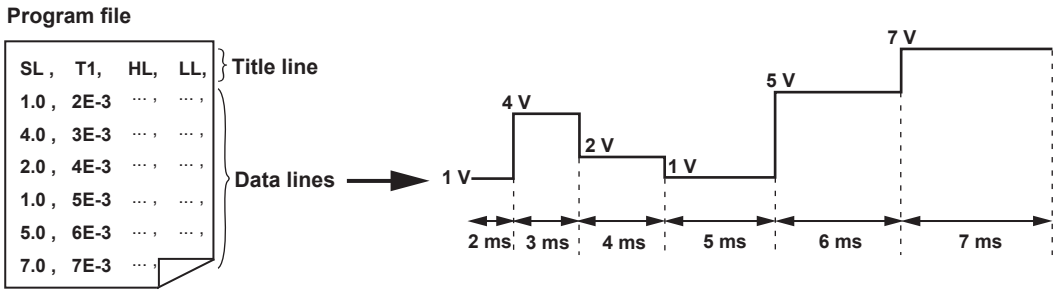
Program File

The program file is stored in the PROGRAM directory on the built-in non-volatile disk (GS820ROM) using the USB storage function (page 2-34).

Sample.csv that is stored in the PROGRAM directory when the GS820 is shipped from the factory or when the disk is formatted is a sample program file. The contents of the file can be viewed on the display.

Contents of the Program File

In programmable sweep, the GS820 loads arbitrary waveform data up to 100000 points in CSV format that has been edited on a spreadsheet application or a text editor and executes the sweep operation. The source level can be changed at a minimum interval of 100 μs.



Lines

The program file is a text file containing lines separated by line feed code (CR, LF, or CR+LF). Control parameters of at least a line are defined. If multiple items are defined in a line, each item is defined using integers, real numbers, and character strings with a separator (select comma or semicolon) between each item (CSV format). It is possible to add an arbitrary space or tab (white space) before or after each item. If a term is undefined, that item does not change from the previous setting.

Character String

- If a term is a character string, the entire character string can be enclosed in double quotations.
- If the start or end of the character string is a white space or if the character string includes a separator, it must be enclosed in double quotations.
- The characters in a character string is not case-sensitive.

Notation

The first line is a title line. The terms to be defined are expressed using the character strings in the table below.

Title[1]	Definition Description	Term Expression	
[CHn.]SF	CH1/CH2 source function	V/I 105	Character string
[CHn.]SR	CH1/CH2 source range	When SF=V: 0.2 to 18	Real number[2]
		When SF=I: 200E-9 to 3	Real number[2]
[CHn.]SL	CH1/CH2 source level	When SF=V: –8.0000 to +18.0000	Real number
		When SF=I: –3.20000 to +3.20000	Real number
CHn.]HL	CH1/CH2 high limit value	When SF=V: –3.20000 to +3.20000	Real number
		When SF=I: –18.0000 to +18.0000	Real number
[CHn.]LL	CH1/CH2 low limit value	When SF=V: –3.20000 to +3.20000	Real number
		When SF=I: –18.0000 to +18.0000	Real number
[CHn.]SD	CH1/CH2 source delay	0.000015 to 3600.000000	Real number
[CHn.]PW	CH1/CH2 pulse width	0.000050 to 3600.000000	Real number
CHn.]PB	CH1/CH2 pulse base	When SF=V: –18.0000 to +18.0000	Real number
		When SF=I: –3.20000 to +3.20000	Real number
[CHn.]MS	CH1/CH2 measurement ON/OFF	1/0	Integer
[CHn.]MF	CH1/CH2 measurement function	V/I	Character string
[CHn.]MR	CH1/CH2 measurement range	When MF=V: 0.2 to 18	Real number[2]
		When MF=I: 200E-9 to 3	Real number[2]
[CHn.]MD	CH1/CH2 measurement delay	0.000000 to 3600.000000	Real number
[CHn.]HC	CH1/CH2 comparison upper limit	–9.99999E±24 to +9.99999E±24	Real number
[CHn.]LC	CH1/CH2 comparison lower limit	–9.99999E±24 to +9.99999E±24	Real number
T1	Timer 1 period	0.000000 to 3600.000000	Real number
T2	Timer 2 period	0.000000 to 3600.000000	Real number
AT	Auxiliary trigger generation	1	Integer
DO	Digital output	0x0000 to 0xFFFF	Integer

[1] [CHn.] can be used to specify the channel in the title (n = 1 or 2).

[2] Interpreted as the smallest range including the real number.

Note

- The channel of the title line in which the channel is not specified is considered CH1.
- If a file in which one channel is defined is loaded, the data is applied to the channel in which the file is loaded regardless of the channel defined in the file.
  For example, if a program file in which CH2 is defined in the title line is loaded into CH1, the contents are applied to CH1 and not to CH2.

Single-Step Sweep (see section 6.4 for the procedure)

The new setting is not immediately applied to the source but applied based on a source trigger after the sweep operation is started.
Single-step sweep allows setting changes of multiple channels to be applied simultaneously. For example, if setting changes of multiple channels and trigger control are performed via communications from your PC, simultaneous sweep of multiple channels exceeding 100000 steps can be achieved.
Once a sweep operation is started using single-step sweep, the sweep operation is never automatically stopped. The sweep operation end when you turn the output OFF or set zero source.

Repeat Count of Sweeps (see sections 6.1, 6.2, and 6.3 for the procedure)

You can set a repeat count for linear sweep, log sweep, and programmable sweep. The selectable range is 1 to 1000 or infinity (∞). Specify zero for infinity (∞).
For example, if the repeat count is set to 5, the GS820 repeats the sweep operation five times when it receives a start trigger. Then, the GS820 returns to the start-wait state. If the repeat count is set to infinity (∞), the GS820 repeats the sweep operation until you turn the sweep operation or output OFF.

Starting the Sweep Operation (see section 6.5 for the procedure)

The sweep operation starts when you apply a sweep start signal or when you press START.

2.6 Triggering

Overview

The trigger function of the GS820 achieves various types of triggering through combinations. The following three types of triggers are available.

Source Trigger (see section 5.7 for the procedure)

This trigger is used to start a source action (see page 2-9). Select any of the following trigger sources.

- External trigger
- Auxiliary trigger rising edge (Aux↑)
- Auxiliary trigger falling edge (Aux↓)
- Timer1
- Timer2
- Measurement end (MeasEnd)

Measurement Trigger (see section 7.6 for the procedure)

This trigger is used to start a measurement action (see page 2-16). Select any of the following trigger sources.

- Source change (SrcChg)
- Auxiliary trigger rising edge (Aux↑)
- Auxiliary trigger falling edge (Aux↓)
- Timer1
- Timer2
- Immediate (Imm)
- Sweep end (SwpEnd)

Sweep Start (see section 5.6 for the procedure)

This trigger is used to start a sweep operation (see section 2.5, “Sweep”). Select any of the following trigger sources.

- External sweep start
- Auxiliary trigger rising edge (Aux↑)
- Auxiliary trigger falling edge (Aux↓)
- Timer1
- Timer2
- Measurement end (MeasEnd)

Each trigger source is described below.

External Trigger
The falling edge of a signal applied to TRIG IN of the input terminal for synchronous operation (SYNC IN, see section 10.3, “Synchronous Operation”) or TRIGGER IN of the BNC I/O terminal (see section 10.1, “Setting the BNC I/O Terminal”) on the rear panel is used as a trigger. A trigger can also be generated using the TRIG key on the front panel or the “`:TRIGger`” or “`*TRG`” communication command.

External Sweep Start
The falling edge of a signal applied to START IN of the input terminal for synchronous operation (SYNC IN, see section 10.3, “Synchronous Operation”) or START IN of the BNC I/O terminal (see section 10.1, “Setting the BNC I/O Terminal”) on the rear panel is used as a start signal. The sweep operation can also be started using the START key on the front panel or the “`:START`” command.

Timer1
100 μs to 3600.000000 s. Because the phase is reset when a sweep start signal is applied to CH1, the timer is normally used as a constant period trigger source for CH1. The period can be swept using the programmable sweep of CH1.

Timer2
100 μs to 3600.000000 s. Because the phase is reset when a sweep start signal is applied to CH2, the timer is normally used as a constant period trigger source for CH2. The period can be swept using the programmable sweep of CH2.

Source Change (SrcChg)
The source action is started at the time the source setting is changed.

Sweep End (SwpEnd)
A trigger is generated when the sweep operation is completed (at the time the last sweep start trigger is applied). If used as a measurement trigger, a measurement can be made after the pattern generation by the sweep operation.

Auxiliary Trigger (Aux↑)
A trigger is generated on the rising edge of the signal applied to AUX IN of the input terminal for synchronous operation (SYNC IN, see section 10.3, “Synchronous Operation”) on the rear panel or the rising edge of the auxiliary trigger source.

Auxiliary Trigger (Aux↓)
A trigger is generated on the falling edge of the signal applied to AUX IN of the input terminal for synchronous operation (SYNC IN, see section 10.3, “Synchronous Operation”) on the rear panel or the rising edge of the auxiliary trigger source. A trigger can also be generated using the SHIFT+START key on the front panel or the “`:TRIGger:AUXiliary`” communication command.

Immediate (Imm)
The end of a source action becomes the trigger for the next source action. This is used such as when you need to repeat measurements at high speeds.

Measurement End (MeasEnd)
If used as a source trigger when the sweep operation is OFF, the combination of a source action and a measurement action can be repeated at high speeds.
If used as a sweep start when the sweep operation is ON, the combination of a sweep operation and a measurement action can be repeated at high speeds. However, the measurement trigger must be set to Sweep End in this case.

Auxiliary Trigger Source (see section 10.5 for the procedure)

You can select from the following four types.

Measurement Busy (MeasBusy)

This signal is set low when a measurement trigger is applied to CH1 and set high when the measurement action is completed. In essence, this signal indicates that measurement is in progress on CH1.

Timer1

Generates a 10-μs low-level pulse in sync with the constant period timer 1.

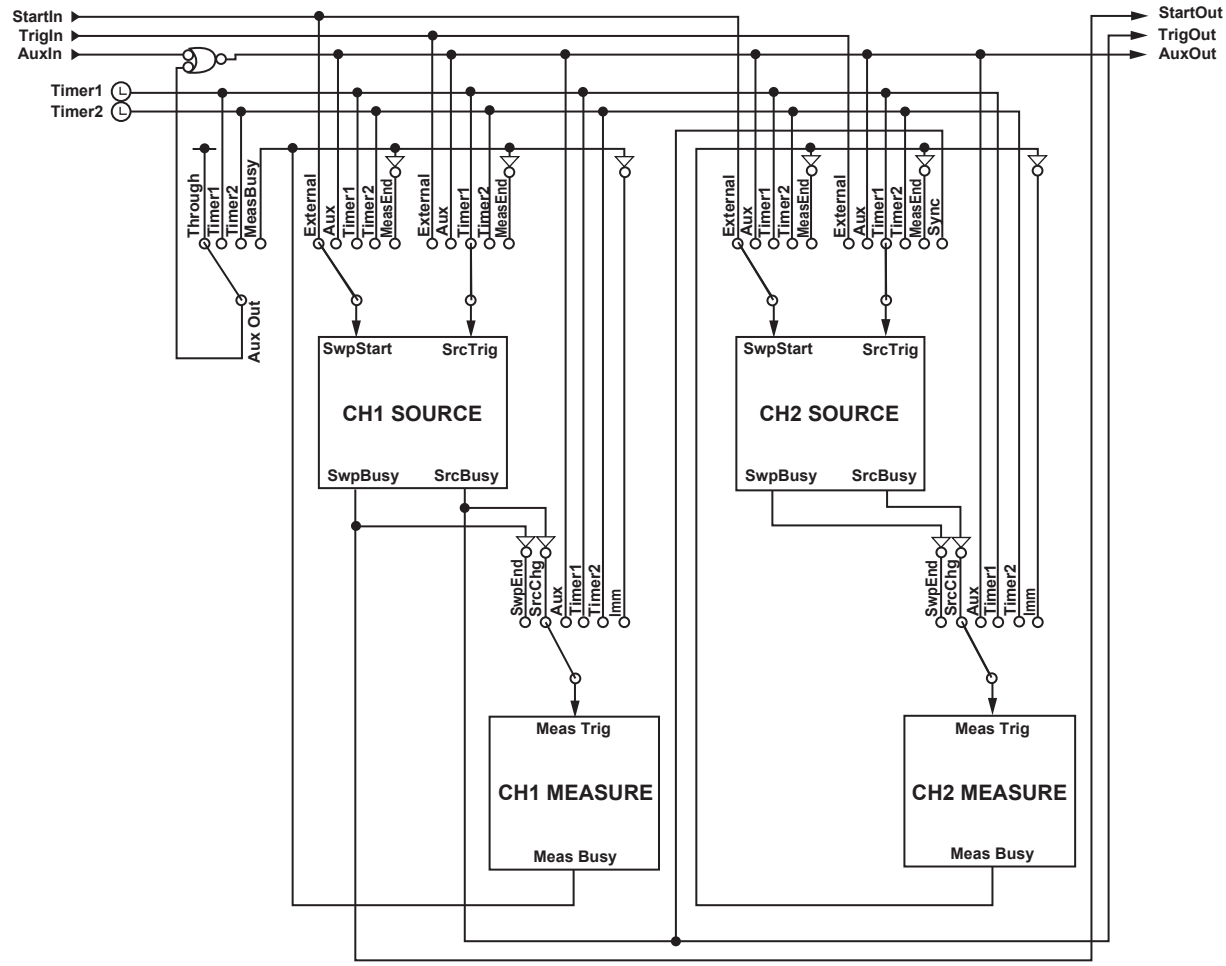
Timer2

Generates a 10-μs low-level pulse in sync with the constant period timer 2.

Through

Passes through the auxiliary trigger signal received from AuxIn without any change.

Trigger Block Diagram



Sweep Start Output, Trigger Output, and Auxiliary Trigger Output (see section 10.1 and 10.3 for the procedure)

The GS820 can output the sweep start, source trigger, and auxiliary trigger signals from the SYNC OUT terminal (output terminal for synchronous operation) or the BNC output terminal to the subsequent GS820s that are connected.

StartOut

A sweep busy for CH1 (set to low when sweep start is applied and set to high when the sweep operation is completed).

TrigOut

A source busy for CH1 (set to low when a source trigger is applied and set to high when the source action is completed).

AuxOut

An auxiliary trigger output for CH1. This signal is a logic OR of its own auxiliary trigger input and a specified auxiliary trigger source signal.

Trigger Hold

The trigger hold function temporarily stops source triggers and measurement triggers. A mask is applied when the HOLD key on the front panel is pressed or when the "`:TRIGger:HOLD ON`" communication command is received, and the source action and measurement action stop. To resume, press the HOLD key again or send the "`:TRIGger:HOLD OFF`" communication command.

Sampling Error

The sampling error indicator on the front panel indicates that a trigger has been discarded. The indicator illuminates if any of the errors below occurs on CH1 or CH2.

- A new source trigger occurred while a source action was in progress (Source Busy is low).
- A new measurement trigger occurred while a measurement action was in progress (Measurement Busy is low).
- A new sweep start trigger occurred while a sweep operation was in progress (Sweep Busy is low).

If sampling errors occur, the trigger generation timing may be too fast. If the sampling error indicator illuminates, check the selected trigger source, timer period, and so on.

2.7 Synchronization and External I/O

Synchronization Function and External I/O of the GS820

Synchronization Function

There are two types of synchronization functions on the GS820. One is the inter-channel synchronization in which synchronous or asynchronous is specified between two channels. The other is the inter-unit synchronization in which master or slave is specified for the synchronous operation of multiple GS820s that are connected.

External I/O

There are three types external I/O terminals on the GS820. They are the I/O terminals for synchronous operation (SYNC IN/OUT), BNC I/O terminals (TRIGGER IN/OUT and START IN/OUT), and external I/O terminal (Ext I/O). Because each terminals is independent, separate functions can be assigned and used simultaneously.

Inter-Channel Synchronization (see section 4.3 for the procedure)

If two channels are synchronized, the output condition, sweep start, source trigger, and measurement trigger settings can be linked. To operate the two channels independently, select asynchronous. Select synchronous or asynchronous operation between channels before starting to specify source and measurement settings.

Synchronous Operation (I/O Terminal for Synchronous Operation (SYNC IN/OUT)) (see section 10.3 for the procedure)

Synchronous operation can be achieved among multiple GS820s that are connected by using the I/O terminal for synchronous operation (SYNC IN/OUT) on the rear panel. Specify master or slave in the inter-unit synchronization settings. By operating the master unit, the slave units that are connected can be configured, and measurement results can be acquired by way of a program file. For the connection, a synchronous operation cable (758960) that is sold separately is connected in a daisy chain. The second unit is connected to the first unit; the third unit is connected to the second unit; and so on. Up to five units (10 channels) can be connected in this way.

Sweep start, source trigger, auxiliary trigger, and output condition (source ON/OFF and zero source ON/OFF) can be operated in sync.

Note

If inter-channel synchronization is set to asynchronous while synchronous operation is performed among multiple GS820s that are connected, CH1 of each GS820 will be synchronized.

BNC I/O (TRIGGER IN/OUT and START IN/OUT) (see section 10.1 for the procedure)

I/O terminals for sweep start and source trigger. You can select input or output for each terminal. The terminals can be used for synchronous operation.

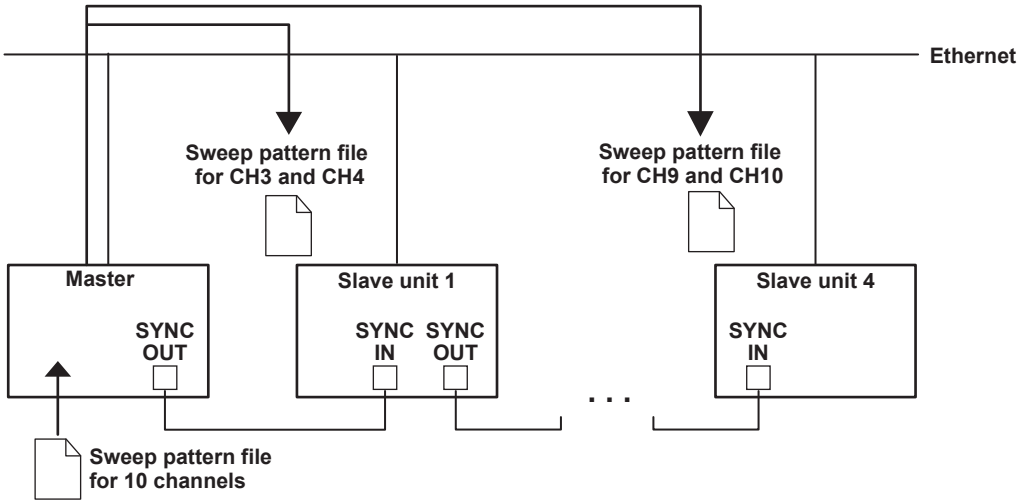
External I/O (Ext I/O) (see section 10.2 for the procedure)

This terminal can be used to output the comparison operation results. If the interlock input is set to low level, the output is turned OFF. The 765601 has two bits each for the digital output that can be changed in sync with the source operation and the digital input that can be read in sync with the measurement operation. The 765602 has 16 bits each for the digital input and output.

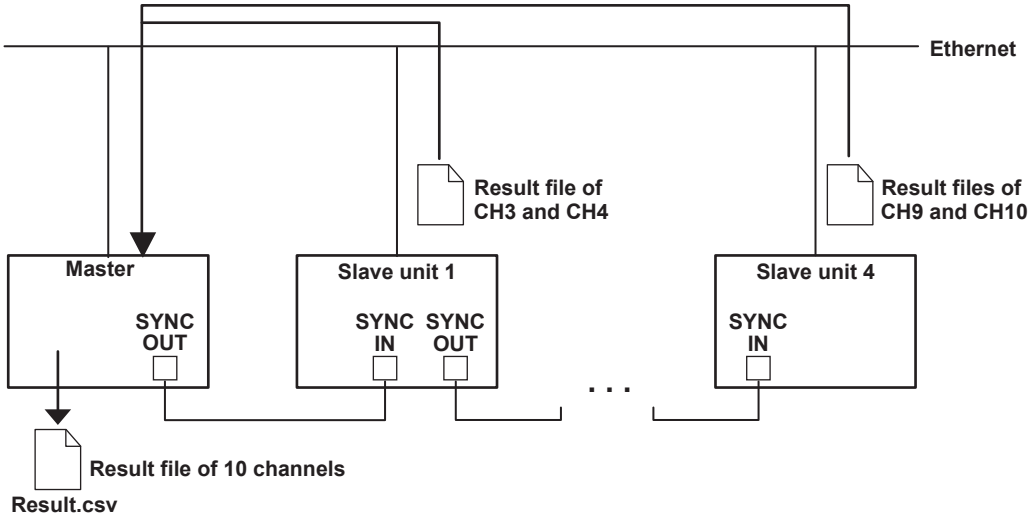
Channel Expansion Function (see section 10.6 for the procedure)

Allows the master unit to handle up to 10 channels. A program file in which the channel expansion is defined is loaded into the master unit and distributed to the slave units via the Ethernet network. After a measurement is completed, the stored results can be consolidated into a single file (Result.csv). This function can be used when sourcing voltage or current and making measurements in an application that requires three or more channels to be operated in sync. For example, it can be used in the electrical characteristic measurements and GO/NO-GO tests of multiple-pin electronic devices, multi functional semiconductor ICs, electronic circuits, board assemblies, and the like.

Distribution of programmable sweep pattern files



Combining of result files at the end of storage



2.8 Computation

Averaging (Moving Average) (see section 8.1 for the procedure)

If averaging is turned ON, the measured values are summed over the average count and divided by the average count to obtain the result (average). Therefore, the stability of the measured results increases. The average count can be set in the range of 2 to 256. If the number of measurements does not reach the average count, the average over the number of measurements is displayed.

NULL Computation (see section 8.2 for the procedure)

In NULL computation, a difference with respect to a given value can be displayed. The measured value when the NULL computation is turned ON is taken to be the NULL value. For subsequent measured values, the measured results are obtained by subtracting this NULL value.

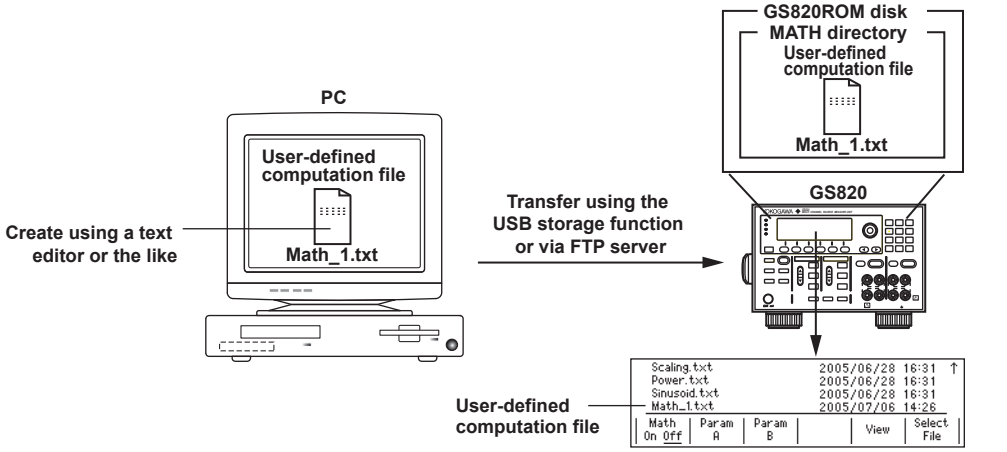
Measure result = measured value - NULL value

When the NULL computation is switched from OFF to ON, the current measured value becomes the NULL value. If you change the NULL value when the NULL computation is OFF, it is automatically turned ON.

Equation Computation (see section 8.3 for the procedure)

In equation computation, the GS820 performs computation by parsing the user-defined file that is stored in the MATH directory on the built-in GS820ROM disk (see a description of the USB storage function on page 2-34). Four arithmetic operations, trigonometric functions, and the like can be performed on variables such as source values and measured values as well as constants.

A user-defined file is created on your PC and transferred to the GS820ROM disk by way of the USB storage function or an FTP server (see section 13.5, “Web Server Function”).



The built-in computation file is also a definition file for the equation computation that is available in the MATH directory when the GS820 is shipped from the factory or created when the disk is formatted (see page 4-9).

- **Decibel (dB.txt)**
  ML = A*log(abs(ML/B)): Computes the decibel value of the measured value with respect to B.
- **Percent (Percent.txt)**
  ML = (ML/A)*100: Computes the percentage of the measured value with respect to A.
- **Scaling (Scaling.txt)**
  ML = A*ML+B: Scales the measured value.
- **Power (Power.txt)**
  ML = V*I: Calculates the power from the source level and measured value.
- **Resistance (Resistance.txt)**
  ML = V/I: Calculates the resistance from the source level and measured value.

User-Defined File Format

A text file consisting of statements.
For the notation of the definition file of equation computation, see section 8.5, “User-Defined Computation.”

Comparison Operation (see section 8.4 for the procedure)

The measured value is compared against a preset upper and lower limits and classified into over the upper limit (High), within the range (In), or under the lower limit (Low). The classification result is shown on the screen and also output to the external I/O connector. For details on the external I/O, see section 10.2, “Pin Assignments of the External I/O Connector (EXT I/O).”

2.9 Store/Recall (Statistical Computation Value Display)

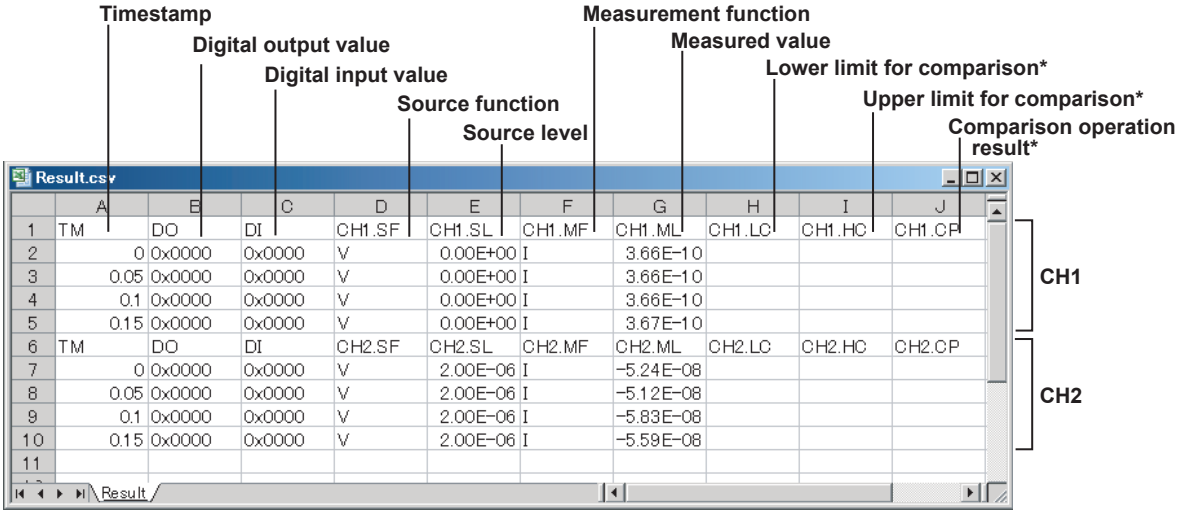
Executing and Stopping the Storage Operation (see section 9.1 for the procedure)

This function stores the measured results in the storage memory from when the storage is turned ON until the specified number of points are stored. The storage count can be set in the range of 1 to 100000. If the storage operation is aborted before reaching the specified storage count, the stored results up to that point is stored. If the stored results file generation function is turned ON, the stored results are output to a result file (Result.csv) on the built-in GS820RAM (see the description of the USB storage function on page 2-34) when the storage is completed. If the stored results file generation function is OFF, the stored results are not converted into a file. In this case, the stored results are read using the communication function.

Result File (see section 9.1 for the procedure)

If the stored results file generation function is turned ON before starting the storage operation, the contents of the storage memory are output to a result file (Result.csv) on the built-in GS820RAM when the storage is completed. A result file includes the elapsed times from the storage start point (timestamps), digital output values, digital input values, source function, source level, measurement function, measured values, comparison lower limit, comparison upper limit, and comparison results.

Example of a Result File



	A	B	C	D	E	F	G	H	I	J
1	TM	DO	DI	CH1.SF	CH1.SL	CH1.MF	CH1.ML	CH1.LC	CH1.HC	CH1.CP
2	0	0x0000	0x0000	V	0.00E+00	I	3.66E-10			
3	0.05	0x0000	0x0000	V	0.00E+00	I	3.66E-10			
4	0.1	0x0000	0x0000	V	0.00E+00	I	3.66E-10			
5	0.15	0x0000	0x0000	V	0.00E+00	I	3.67E-10			
6	TM	DO	DI	CH2.SF	CH2.SL	CH2.MF	CH2.ML	CH2.LC	CH2.HC	CH2.CP
7	0	0x0000	0x0000	V	2.00E-06	I	-5.24E-08			
8	0.05	0x0000	0x0000	V	2.00E-06	I	-5.12E-08			
9	0.1	0x0000	0x0000	V	2.00E-06	I	-5.83E-08			
10	0.15	0x0000	0x0000	V	2.00E-06	I	-5.59E-08			
11										

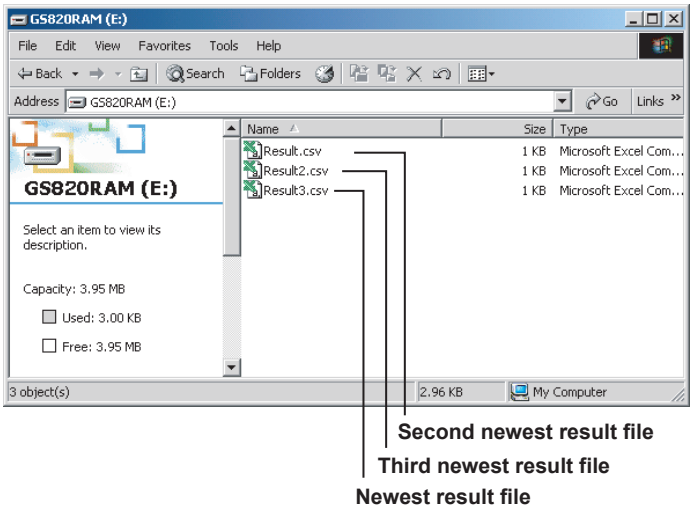
*** Displays the results only when comparison operation is ON.**

Note

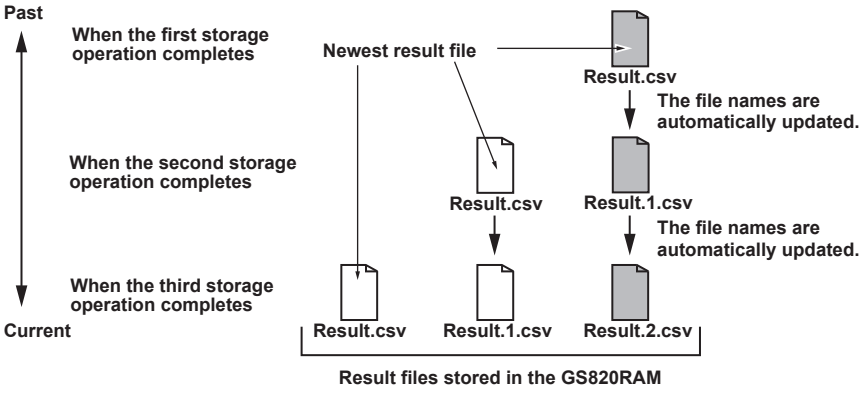
- Only the stored result of channels on which measurement is executed are output to the result file. If the storage count of CH1 and CH2 are both zero, a result file is not created.
- If the measurement function is set to Auto, the measurement function that is indicated in the result file is as follows:
  If the source function is voltage (V), the measurement function is indicated as current (I).
  If the source function is current (I), the measurement function is indicated as voltage (V).
- If the measurement function is set to Auto and a limiter is activated, the measurement function switches to the source function. The source function when a limiter is activated is indicated as follows:
  If the source function is voltage (V), the source function is indicated as current (I).
  If the source function is current (I), the source function is indicated as voltage (V).
  The limit level is indicated for the source level when a limiter is activated.

The name of the most recent result file is always Result.csv. Up to 33 result files are numbered and stored within the size of the GS820RAM (16 MB). When the storage operation is repeated, the result file is automatically numbered, and the file name is automatically updated. If two storage operations are completed, the most recent file will be Result.csv, and the previous result file will be Result1.csv. If the storage operation is repeated further, the result file name will change as follows: Result.csv, Result1.csv, Result2.csv, Result3.csv, and so on. Up to 32 result files are automatically numbered. If the number of result files exceeds 33, the files are deleted in order from the oldest file. However, if the size of the new result file is large such as when the storage count is large, multiple result files may be deleted so that the capacity of the GS820RAM is not exceeded when the most recent result file is created. For example, the files size when two channels are used and the storage count is set to maximum (100000) is greater than 15 MB. Therefore, only one file can be created on the GS820RAM disk.

GS820RAM Containing Result Files

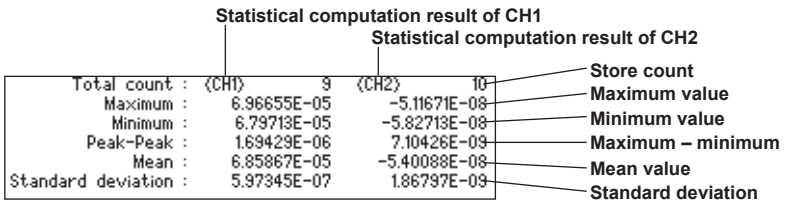


Result File Numbering



Recalling Statistical Computation Values (see section 9.2 for the procedure)

The statistical computation results of the most recent measured values in the storage memory can be displayed. The statistical computation parameters are the storage count, maximum value, minimum value, maximum value – minimum value, average value, and standard deviation.



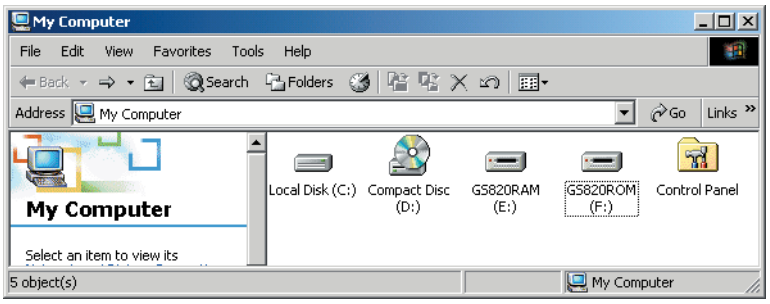
Reading the Storage Result via Communications (see section 9.2 for the procedure)

If the stored results file generation function is OFF, the storage result in the GS820RAM can be read directly using the communication function. You can set the format used to read the data to ASCII or binary.
In addition, statistical computation values can also be read using the communication function.

2.10 Other Functions

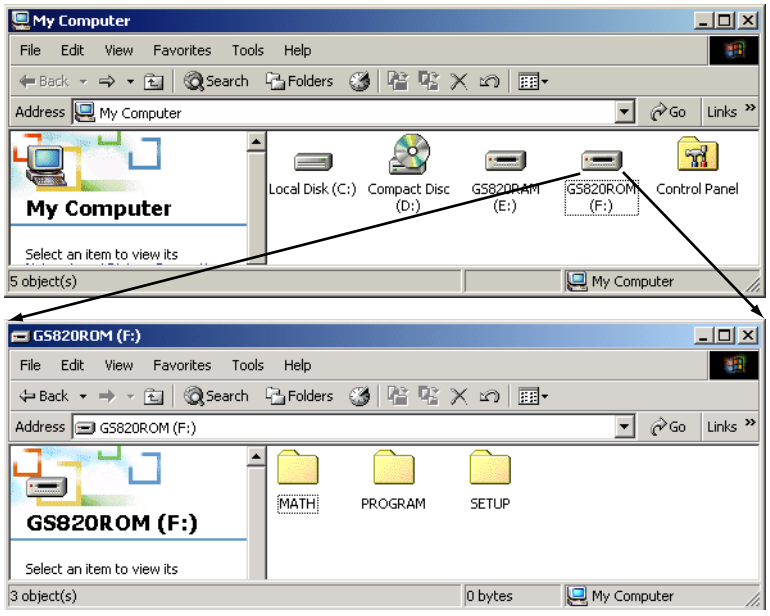
USB Storage Function (see section 4.6 for the procedure)

The GS820 has a 12-MB non-volatile disk (GS820ROM) and a 16-MB volatile disk (GS820RAM) for internal memories. If the GS820 is connected to your PC using a USB cable, these disks become accessible as removable disk from your PC. Source patterns and computation definition files that you create using a general-purpose spreadsheet application can be stored to the non-volatile disk (GS820ROM) through simple drag-and-drop operation on your PC.
The volatile disk (GS820RAM) stores the measured results. By loading a measurement result file in your PC, you can process the data or draw graphs on a general-purpose spreadsheet application. The system file that is used to update the GS820 system is also stored on this disk.



Non-Volatile Disk (GS820ROM)

GS820ROM is a non-volatile disk that retains the data on the disk even when the power is turned OFF. It contains three directories, MATH, PROGRAM, and SETUP. Equation definition files, programmable sweep files, and the like can be stored on this disk to be used on the GS820.



MATH

A directory for storing the definition files of equations. The files in this directory can be selected for the equation computation.
By factory default, built-in computation files are stored in this directory. The built-in computation files are not erased even if the disk is formatted.

PROGRAM

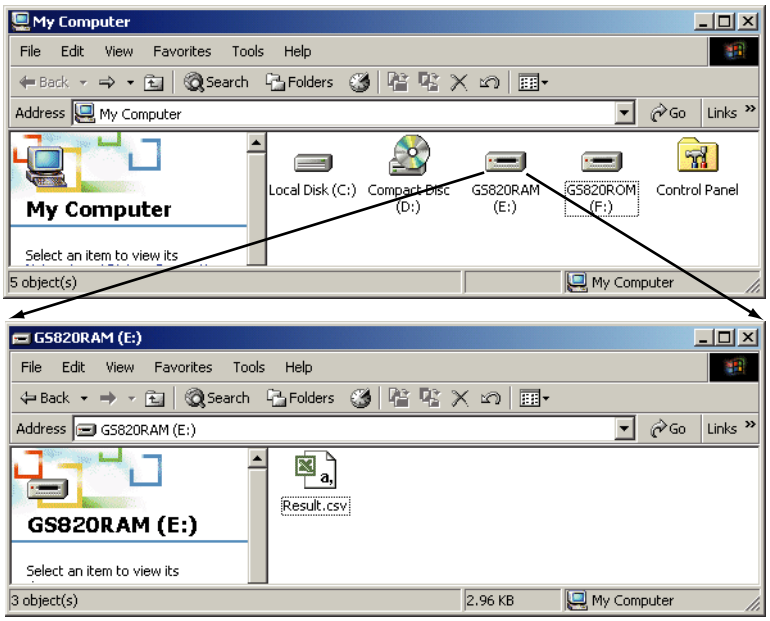
A directory for storing the pattern files of programmable sweeps. The files in this directory can be selected by the programmable sweep function.
By factory default, sample program files are stored in this directory. The sample program files are not erased even if the disk is formatted.

SETUP

A directory for storing the GS820 panel settings. Any of the files in this directory can be selected as a setup file.
By factory default, a default setup file is stored in this directory. The default setup file is not erased even if the disk is formatted.

Volatile Disk (GS820RAM)

GS820RAM is a RAM disk that is automatically formatted when the power is turned ON. A result file (Result.csv) is created in this directory when the storage operation is carried out. If the settings are saved to the GS820RAM, the current settings are saved to a file named Setup.txt.
This disk is normally used to transfer files that the GS820 generates to your PC. However, a system file is transferred from your PC to this disk when updating the system firmware. For details, see section 17.5, “Updating the System Firmware.”



Note

You can create subdirectories and write files to GS820RAM, but be sure that the disk does not become full. The data on this disk is lost when the power is turned OFF.

Formatting the Disk

You can format the disk if you want to reset the GS820 to factory default conditions, if the non-volatile or volatile disk cannot be detected on your PC, or if you believe the data on the disk is corrupt.

USB Communication (Command Control by Way of USB-TMC) (see chapter 12 for the procedure)

A USB2.0 device interface. This interface allows access to the USB storage function as well as allow command control from a VISA library using a USB-TMC device driver of VISA (Virtual Instrument Software Architecture) as defined by the VXI Plug&Play System Alliance.

Ethernet Communications (see chapter 13 for the procedure)

A LAN interface with auto switching between 10 Mbps and 100 Mbps. You can assign a static address for the IP address or obtain an address dynamically from a DHCP server. The following four functions are available.

Command Control Using VXI-II

An Ethernet standard VXI-11 device driver. Allows command control from a VISA library.

Panel Control Using a Browser (see section 10.2 for the procedure)

A Web server function. Allows you to display the front panel image of the GS820 and remotely control the GS820 on a Web browser.

File Transfer with FTP Clients

Up to five clients can establish FTP connections by way of the anonymous FTP server function. The non-volatile disk (GS820ROM) and volatile disk (GS820RAM) can be handled as a PC file server. Program files and the like can be transferred and measurement result data can be loaded into your PC via the FTP protocol.
For a description of GS820ROM and GS820RAM, see “USB Storage Function” on page 2-34.

Command Control Using Port 7655

A command mnemonic stream parsing server that can connect up to five clients. The terminator (CR, LF, or CR+LF) can be specified.

Each server function is independent. Therefore, for example, the GS820 can be controlled using commands while transferring files using FTP.

GP-IB Communications (see chapter 14 for the procedure)

An interface used to control the GS820 using commands. You can specify the same settings as you would using the front panel keys of the GS820 and output setup data and measured data. Because the command control of the GS820 is mutually independent, other communication functions can be used while controlling the GS820 using the GP-IB.

RS-232 Communications (see chapter 15 for the procedure)

An interface used to control the GS820 using commands. You can specify various parameters such as baud rate (9600 bps to 115200 bps), flow control (none, XON-OFF, or CTS-RTS), and terminator (CR, LF, or CR+LF). Because the command control of the GS820 is mutually independent, other communication functions can be used while controlling the GS820 using the RS-232.

Saving and Loading Setup Data (see sections 11.1 and 11.2 for the procedure)

The current settings can be saved to a setup file (Setup1.txt to Setup4.txt) on the non-volatile disk (GS820ROM). The saved setup data can be loaded to restore the settings. The setup data can also be saved to the volatile disk (GS820RAM). This feature can be used to pass the setup file (Setup.txt) to your PC.
The setup file is a text file containing communication commands. The file can be edited later on your PC.
For a description of GS820ROM and GS820RAM, see “USB Storage Function” on page 2-34.

Selecting the Settings Applied at Power ON (see section 11.3 for the procedure)

The GS820 settings at power-on can be changed from the default settings to the settings selected by the user. If one of the saved setup files is selected as the settings applied at power-on, the GS820 starts up using the specified settings for subsequent power-ons. If the selected file is deleted or renamed, the GS820 will start up with default settings.

Setting the Display Brightness or Turning OFF the Display (see section 11.4 for the procedure)

You can set the display brightness. You can turn OFF the display to prolong the service life of the display. The setting is retained even if the power is turned OFF.

Selecting the Decimal Point and Separator Notations of CSV Files (see section 11.5 for the procedure)

You can select the decimal point (period or comma) and the separator (comma or semicolon) notations used in the program pattern files and storage files of measured results that are output in CSV format.

Turning the Beep Sound ON/OFF (see section 11.6 for the procedure)

You can select whether the GS820 generates a beep sound when you operate the GS820 incorrectly, when an error occurs during operation, or when the computation is turned ON. The setting is retained even if the power is turned OFF.

Error Log Display (see section 11.7 for the procedure)

Displays error information such as runtime errors and communication command errors stored in the error memory in order from the oldest error.

Key Lock (see section 11.8 for the procedure)

You can lock the panel keys so that the settings are not changed by mistake.

Self-Test (see section 17.3 for the procedure)

You can test the display and keys.

Viewing the Product Information (see section 17.4 for the procedure)

Displays the product name, serial number, firmware version, logic version, product model, and calibration date.

Updating the System Firmware (see section 17.5 for the procedure)

The system firmware of the GS820 can be updated by transferring the most recent system file from your PC to the volatile disk (GS820RAM, see “USB Storage Function” on page 2-34).

3.1 Handling Precautions

Read the Safety Precautions

Safety Precautions

If you are using the G820 for the first time, make sure to read “Safety Precautions” on pages v and vi.

Do Not Remove the Case

Do not remove the case from the instrument. Some sections inside the instrument have high voltages that are extremely dangerous. For internal inspection and adjustment, contact your nearest YOKOGAWA dealer.

Unplug If Abnormal Behavior Occurs

If you notice any symptoms of trouble such as unusual odors or smoke coming from the instrument, immediately turn OFF the power switch and unplug the power cord. If these symptoms occur, contact your nearest YOKOGAWA dealer.

Correct the Problem If Output Is Forcibly Turned OFF

If the GS820 detects an internal circuit error due to an excessive external input or oscillation in the GS820, the GS820 forcibly turns OFF the output, turns ON the ERROR key, and displays the error message “Hardware input abnormal error.” If this happens, remove the cause of the problem such as the load connected externally, and turn the output ON again. If the output still turns OFF after correcting the problem, the GS820 may have malfunctioned. Contact your nearest YOKOGAWA dealer. Note that the error display remains until you manually clear it (see section 11.7, “Error Log Display”) or read the error information via communications even if the GS820 recovers.

Turn the Power Switch OFF If Overheat Is Detected

If the GS820 detects an overheat condition such as when the inlet or vent holes for the cooling fan are obstructed or the fan is stopped, the GS820 forcibly turns the output OFF and displays an “Abnormal Temperature” warning. If this happens, immediately turn OFF the power switch. Provide adequate space around the GS820 or check and remove foreign objects caught in the cooling fan on the rear panel. If the same warning appears when you turn ON the power switch after waiting a substantial amount of time, the GS820 may have malfunctioned. Contact your nearest YOKOGAWA dealer.

Turn the Power Switch OFF If Overload Is Detected

If the internal power supply is overloaded due to an excessive external input or internal oscillation, the GS820 forcibly turns the output OFF and displays a “Circuit Protection” warning. If this happens, immediately turn OFF the power switch. If the same warning appears when you turn ON the power switch after removing the cause of the problem such as the load connected externally, the GS820 may have malfunctioned. Contact your nearest YOKOGAWA dealer.

Handle the Power Cord with Care

Nothing should be placed on top of the power cord. The power cord should also be kept away from any heat sources. When unplugging the power cord from the outlet, never pull by the cord itself. Be sure to hold and pull by the plug. If the power cord is damaged, check the part number indicated on page iii and purchase a replacement.

General Handling Precautions

Do Not Place Objects on Top of the Instrument

Never place objects containing water on top of the instrument, otherwise a breakdown may occur.

Do Not Apply Shock or Vibration

Do not apply shock or vibration as it may cause a malfunction. In addition, applying shock to the input/output terminal or the connected cable can cause electrical noise to enter or output from the instrument.

Keep Electrically Charged Objects Away from the Instrument

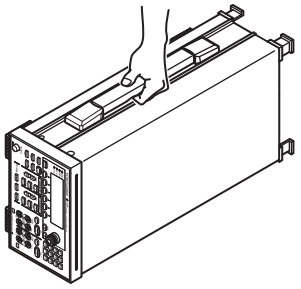
Keep electrically charged objects away from the input connectors. They may damage the internal circuitry.

Turn OFF the Power during Periods of Extended Non-Use

Turn OFF the power switch and remove the power cord from the outlet.

Carry the Instrument Properly

First, remove the power cord and connection cables. The instrument weighs approximately 8 kg. To carry the instrument, use the handle as shown in the figure below, and move it carefully.



Cleaning

When wiping off dirt from the case or operation panel, turn OFF the power switch and remove the power cord from the outlet. Then, gently wipe with a soft dry clean cloth. Do not use volatile chemicals such as benzene or thinner for cleaning, as they may lead to discoloration or deformation.

3.2 Installation

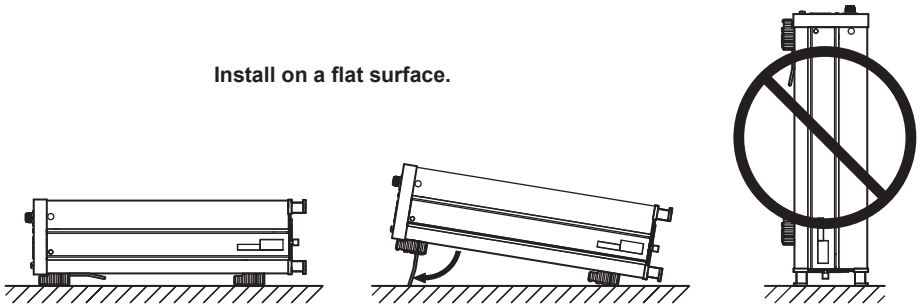
Installation Orientation

WARNING

To prevent fire, never use the instrument with the rear panel facing down. There are outlet holes for the cooling fan on the rear panel. Placing the instrument with the rear panel down can cause a fire when the instrument malfunctions.

- Place the instrument in a horizontal position as shown at the left of the figure below or inclined position using the stand as shown at the center of the figure below.
- When using the stand, pull it forward until it locks (perpendicular to the bottom surface of the instrument). If you are installing the instrument on a slippery surface, attach the rubber feet (two pieces) to the rear feet on the bottom panel.
- If you are not using the stand, return it to the original position while pressing the leg section of the stand inward.

Install on a flat surface.



Installation Location

Install the instrument in a place that meets the following conditions.

Ambient Temperature and Humidity

Use the instrument in the following environment.

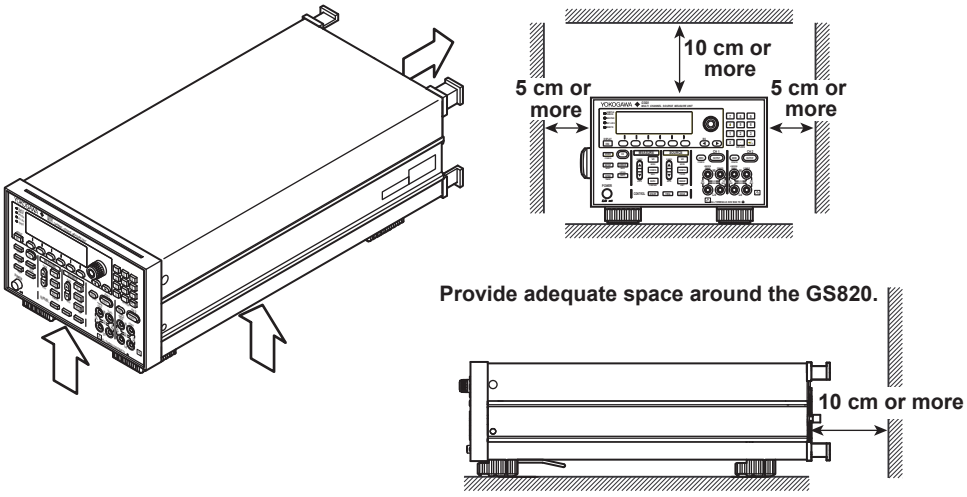
- Ambient temperature: 5 to 40°C
  However, in order to obtain highly accurate measurements, operate the instrument in the 23 ±5°C temperature range.
- Ambient humidity: 20 to 80% RH
  No condensation should be present. In order to obtain highly accurate measurements, operate the instrument in the 50 ±10% RH range.

Note

Condensation may occur if the instrument is moved to another place where the ambient temperature is higher, or if the temperature changes rapidly. If condensation occurs, allow the instrument adjust to the environment for at least an hour before using the instrument.

Well-Ventilated Location

There are inlet holes on the bottom side of the instrument. In addition, there are vent holes for the cooling fan on the rear panel. To prevent internal overheating, allow for enough space around the instrument (see the figure below) and do not block the inlet and vent holes.



Do Not Install the Instrument in the Following Places

- In direct sunlight or near heat sources.
- Where an excessive amount of soot, steam, dust, or corrosive gas is present.
- Near strong magnetic field sources.
- Near high voltage equipment or power lines.
- Where the level of mechanical vibration is high.
- On a unstable place.

Storage Location

When storing the instrument, avoid the following places.

- Where the relative humidity is 80% or higher.
- In direct sunlight.
- Where the temperature is 60°C or higher.
- Near a high humidity source.
- Where the level of mechanical vibration is high.
- Where corrosive or explosive gas is present.
- Where an excessive amount of soot, dust, salt, and iron are present.
- Where water, oil, or chemicals may splash.

We strongly recommend you store the instrument in an environment with a temperature between 5 and 40°C and a relative humidity between 20 to 80%RH.

Rack Mount

When rack mounting the GS820, use the rack mount kit that is sold separately. For the procedure to rack mount the GS820, see the User's Manual included in the rack mount kit.

Name	Model	Notes
Rack mount kit	751533-E3	For EIA single mount
Rack mount kit	751534-E3	For EIA dual mount
Rack mount kit	751533-J3	For JIS single mount
Rack mount kit	751534-J3	For JIS dual mount

3.3 Connecting to the Power Supply

Before Connecting the Power

To prevent electric shock and damage to the instrument, follow the warnings below.

WARNING

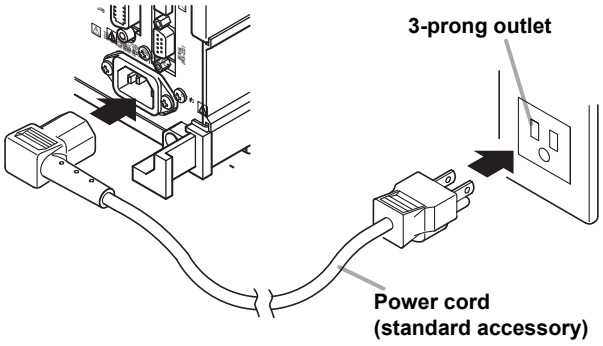
- Before connecting the power cord, ensure that the source voltage matches the rated supply voltage of the instrument and that it is within the maximum rated voltage of the provided power cord.
- Connect the power cord after checking that the power switch of the instrument is turned OFF.
- To prevent electric shock or fire, be sure to use the power cord for the instrument that is supplied by YOKOGAWA.
- Make sure to connect protective earth grounding to prevent electric shock. Connect the power cord to a three-prong power outlet with a protective earth terminal.
- Do not use an extension cord without protective earth ground. The protective features of the instrument will be rendered ineffective.
- Use an AC outlet that complies with the power cord provided and securely connect the protective grounding. If such an AC outlet is unavailable and protective grounding cannot be furnished, do not use the instrument.

Connecting the Power Cord

1. Check that the power switch of the instrument is turned OFF.
2. Connect the power cord plug to the power connector on the rear panel. (Use the power cord that comes with the package.)
3. Connect the plug on the other end of the power cord to the outlet that meets the conditions below. The AC outlet must be of a three-prong type with a protective earth ground terminal.

Item	Specifications
Rated supply voltage	100 to 120 VAC, 200 to 240 VAC
Permitted supply voltage range	90 to 132 VAC, 180 to 264 VAC
Rated power supply frequency	50/60 Hz
Permitted power supply frequency range	48 to 63 Hz
Maximum power consumption	Approx. 250 VA

* The instrument can use a 100-V or a 200-V system for the power supply. Check that the voltage supplied to the instrument is less than or equal to the maximum rated voltage of the provided power cord (see page iii) before using it.



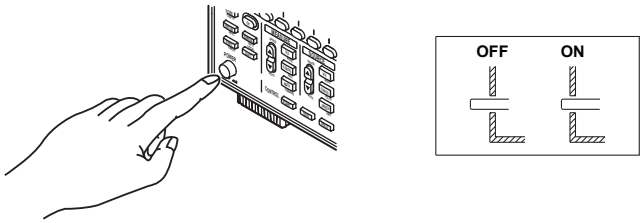
3.4 Turning the Power Switch ON/OFF

Check These Items before Turning ON the Power

- Check that the instrument is installed properly (see section 3.2, “Installation”).
- Check that the power cord is connected properly (see section 3.3, “Connecting the Power Supply”).

Location of the Power Switch and ON/OFF Operation

The power switch is located at the lower left on the front panel. The power switch is a push button. Press the button once to turn it ON and press it again to turn it OFF.



Power ON Operation

Self-test starts automatically when the power switch is turned ON. If the test completes successfully, the GS820 is set according to the setup file selected in section 11.3, “Selecting the Settings Applied at Power ON.”

Note

- If the GS820 does not operate as described above when the power switch is turned ON, turn OFF the power switch and check the following:
- Check that the power cord is securely connected.
- Check that the voltage supplied from the power outlet is correct. See section 3.3.
- You can initialize the settings of the GS610. See section 11.3.
  If the GS820 still fails to power up when the power switch is turned ON after checking these items, it is probably a malfunction. Contact your nearest YOKOGAWA dealer for repairs.
- If you are turning the power switch ON after turning it OFF, allow at least 5 s before turning it ON.

To Make Accurate Measurements

In the installation location indicated in section 3.2, allow the instrument to warm up for at least 60 minutes after the power switch is turned ON.

Shutdown Operation

The setup data and measured results immediately before the power switch is turned OFF are not retained. The same is true when the power cord gets disconnected from the outlet. We recommend that you save important setup data to the SETUP directory on the non-volatile disk (GS820ROM) (see “USB Storage Function” on page 2-34).

3.5 Wiring Precautions

WARNING

- Be sure to turn OFF the GS820 output when connecting the DUT.
- Do not connect a voltage source in voltage source mode or a current source in current source mode. An incorrect connection may damage the GS820.
- Do not connect a load that exceeds the maximum output indicated below across the OUTPUT Hi and OUTPUT Lo or across the SENSE Hi and SENSE Lo terminals.

Voltage Source Range	Maximum Output
200 mV range	±3.2 A
2 V range	±3.2 A
7 V range	±3.2 A
18 V range	±1.2 A

Current Source Range	Maximum Output
200 nA range	±18 V
2 μA range	±18 V
20 μA range	±18 V
200 μA range	±18 V
2 mA range	±18 V
20 mA range	±18 V
200 mA range	±18 V
1 A range	±18 V
3 A range	±7 V

- The maximum allowable voltage between the case and each terminal is ±250 Vpeak. Applying a voltage exceeding this value can damage the GS820.
- Keep the voltage that is generated across OUTPUT Hi and SENSE Hi and across OUTPUT Lo and SENSE Lo less than or equal to ±0.5 Vpeak.
- When making a four-terminal connection, be careful that the connection to the SENSE terminal does not get cut. If the voltage is not sensed correctly, abnormal voltage will appear across the OUTPUT Hi and OUTPUT Lo terminals.
- When making a two-terminal connection, use the OUTPUT terminals. If the SENSE terminals are used, the current flows through the SENSE line prohibiting the GS820 from generating correcting and causing damage.

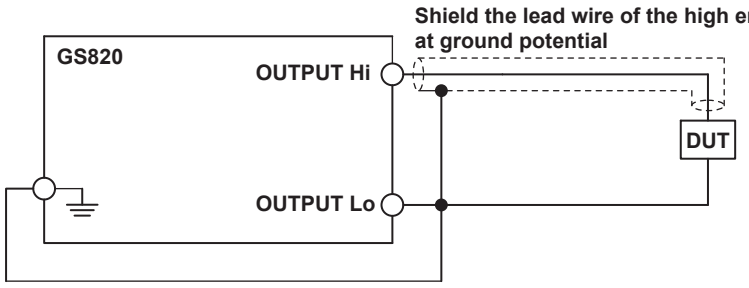
CAUTION

- Use conducting wires that have adequate margins of withstand voltage and current capacity with respect to the voltage or current to be used.
- To prevent oscillations due to stray capacitance and lead inductance, use twisted-pair lead wires to connect to the OUTPUT Hi and OUTPUT Lo terminals. Likewise, use twisted-pair lead wires to connect to the SENSE Hi and SENSE Lo terminals. In particular, wire the lead wires short in the case of a high-capacity load in a four-terminal connection in voltage source mode.

Note

Susceptibility to the effects of noise increases when sourcing or measuring minute currents. Take measures such as using shielded wires. Making a connection as shown in the figure below is effective using the functional ground terminal on the rear panel.

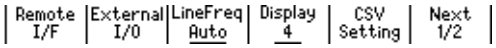
Measure against noise when handling minute currents



3.6 Setting the Line Frequency

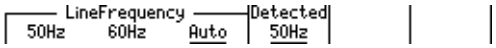
Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **LineFreq** soft key to display the LineFrequency menu.

   The line frequency that is currently detected is displayed under **Detected**.



3. Press the soft key corresponding to the desired line frequency.

Explanation

If Auto is selected, the line frequency is automatically selected when the GS820 is turned ON. Select Auto in normal cases.

Note

The line frequency specified here is related to the integration time (see section 7.4, “Setting the Integration Time”). The integration time is set to an integer multiple of the PLC (Power Line Cycle). 1 PLC is the time corresponding to 1 line cycle.

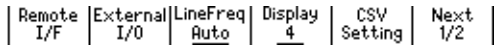
<<Corresponding Command Mnemonic>>

```
:SYSTem:LFRequency 50|60
:SYSTem:LFRequency:AUTO 1|0|ON|OFF
```

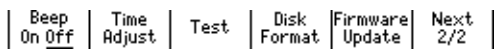
3.7 Setting the Date, Time, and the Time Difference from GMT (Greenwich Mean Time)

Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



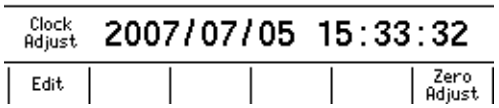
2. Press the **Next 1/2** soft key.



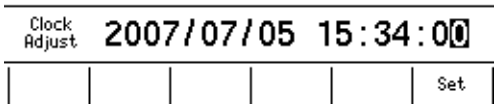
3. Press the **Time Adjust** soft key.

Setting the Date and Time

4. Press the **Clock Adjust** soft key to display the date/time setup screen.



5. Press the **Edit** soft key.



6. Press the **<** and **>** keys to move the cursor to the desired position.

7. Use the **rotary knob** or **numeric keys** to set the date and time.

8. Press the **Set** soft key to confirm the setting.

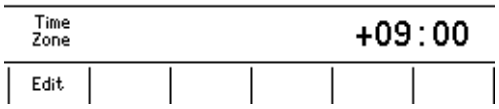
Synchronizing the Clock

9. Press the **Zero Adjust** soft key to synchronize the clock by resetting the seconds to zero.

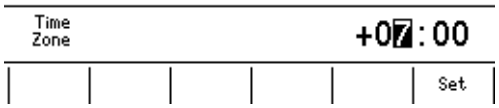
If the seconds is greater than equal to 30 seconds, the clock is set to 0 seconds of the next minute.

Setting the Time Difference from GMT (Greenwich Mean Time)

4. Press the **Time Zone** soft key.



5. Press the **Edit** soft key.



6. Press the **<** and **>** keys to move the cursor to the desired position.

7. Use the **rotary knob** or **numeric keys** to set the time difference.

8. Press the **Set** soft key to confirm the setting.

Explanation

Setting the Date and Time

- Date (Year/Month/Day)
  Set the year, month and day.
- Time (Hour/Minute/Second)
  Set the time using a 24-hour clock.

Note

- The date and time settings are backed up with the lithium battery when the power is turned OFF.
- Leap year information is retained.

Setting of the Time Difference from GMT

Set the time difference in the range of –12 hours 00 minutes to 13 hours 00 minutes. For example, Japan standard time is ahead of GMT by 9 hours. In this case, set Hour to 9 and Minute to 00.

Checking the Standard Time

Check the standard time for the region where the GS820 is to be used using one of the following methods.

- Check the date and time setting on your PC.
- Check the website at the following URL:http://www.worldtimeserver.com/

Note

The GS820 does not support Daylight Savings Time. To set the Daylight Savings Time, adjust the time difference from GMT.

<<Corresponding Command Mnemonic>>

```
:SYSTem:CLOCk:DATE <character string>
:SYSTem:CLOCk:TIME <character string>
:SYSTem:CLOCk:TZONe <character string>
:SYSTem:CLOCk:ADJust
```

4.1 Basic Operation of Keys and Rotary Knob and How to Enter Values

Basic Operation of Keys and Rotary Knob and How to Enter Values

Settings Keys

Pressing a setting key such as **CONFIG** and **SWEEP** causes a soft key menu to appear at the bottom section of the display.

Soft Keys

Press a soft key to make a choice on the soft key menu or to execute an operation.

Rotary Knob

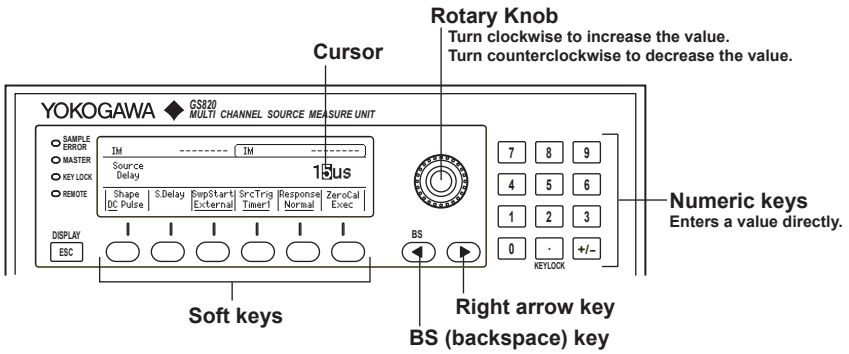
After selecting a setup item using soft keys, you turn the rotary knob to change a value in the numeric entry area.

Numeric Keys

After selecting a setup item using soft keys, you can directly enter a value for the item that has a numeric entry area by pressing the numeric keys.

BS Key and Right Arrow Key

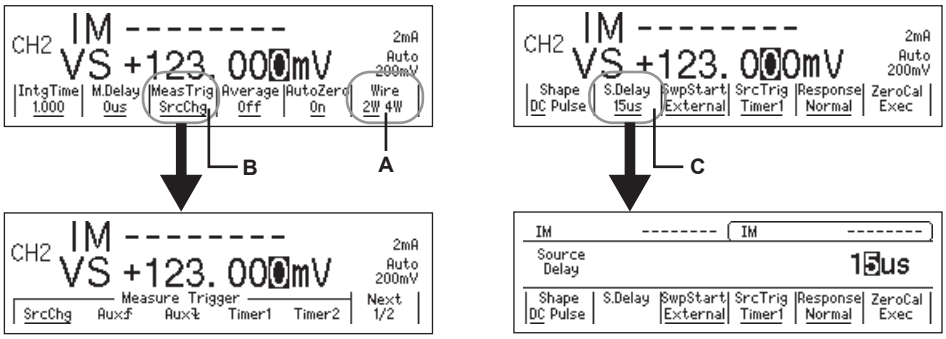
Press these keys to move between digits in the numeric entry area. If you are entering a value using the numeric keys, you can press the BS key to erase the entered characters one character at a time. Pressing the right arrow key erases all the entered characters.



How to Operate the Setup Menu

Procedure

1. Press a key to display a corresponding setup menu.
2. Press a soft key corresponding to an item.



A: The setting switches each time you press a corresponding soft key. The underlined item is selected.

B: Press a corresponding soft key to display the selection menu. Press a soft key corresponding to a desired choice to make the selection.

C: Press a corresponding soft key to select an item to be changed with the numeric keys or rotary knob. Enter the value directly by pressing the numeric keys or set the value by turning the rotary knob. Press the BS (backspace) and right arrow keys to move the cursor or erase the value.

Note

If the setup menu shows Next 1/2, you can press the soft key corresponding to Next 1/2 to show the 2/2 menu. To show the 1/2 menu again, press the Next 2/2 soft key.

How to Erase the Setup Menu

ESC (DISPLAY) to clear the setup menu. If the menu that is shown is under multiple menu levels, press **ESC(DISPLAY)** to move up a level in the menu hierarchy.

Note

The procedure to clear the setup menu is not written in the procedural explanations in this manual.

4.2 Switching the Display Channel

Switching the Displayed Channel

For 2-Channel Display

Each time you press **CH**, the controllable channel switches. A frame is shown around a controllable channel.

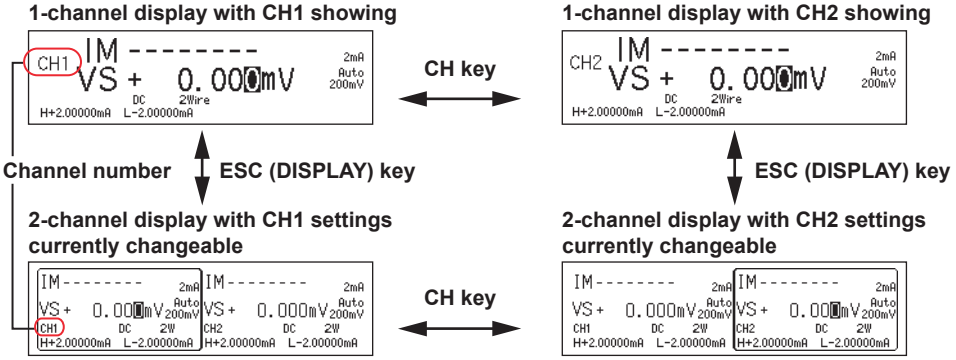
For 1-Channel Display

Each time you press **CH**, CH1 and CH2 toggles.
The channel shown on the display is the controllable channel.

Switching the Display

Each time you press **ESC (DISPLAY)** the display switches between 1-channel display and 2-channel display.

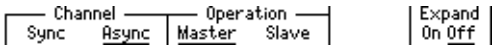
Switching the Channel and Switching the Display



4.3 Setting the Inter-Channel Synchronization Mode

Procedure

1. Press **SYNC** to display the SYNC menu.



2. On the Channel menu, press the Sync or Async soft key.

Explanation

Inter-Channel Synchronization Mode

Inter-channel synchronization mode specifies whether two channels are to be operated in sync. The following two modes are available.

Sync: The two channels are synchronized (CH2 follows CH1). When selected, the SYNC key illuminates.

Async: The two channels are operated as independent channels.

The default setting is Async.

Operation When Inter-Channel Synchronization Is Enabled

- The CH2 source trigger is fixed to the trigger that is input through the input terminal for synchronous operation, SYNC IN, on the rear panel and synchronizes to the CH1 trigger output at all times.
- The CH2 sweep start is set to the same trigger source as CH1.
- The CH2 output ON/OFF and zero source follows the CH1 condition.

Note

Inter-channel synchronization mode causes the settings to be common between the two channels.

<<Corresponding Command Mnemonic>>

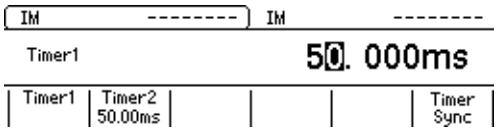
```
:SYNChronize:CHANnel 1|0|ON|OFF
```

4.4 Setting the Timer Period

Procedure

1. Press **SHIFT+SYNC(TIMER)** to display the Timer menu.

2. Press the Timer1 or Timer2 soft key.



3. Use the **rotary knob** or **numeric keys&< >** to set the timer period.
   If you use the numeric keys, press the soft key for the desired unit to confirm the value.

Synchronizing the Timers

2. Press the **Timer Sync** soft key.

Explanation

The timers a general-purpose timers for the two channels. They can be used for the following trigger sources.
Sweep start (section 5.6)
Source trigger (section 5.7)
Measurement trigger (section 7.6)

Selectable Range

100 μs to 3600.000000s

Synchronizing the Timers

Timer1 and Timer2 run at independent periods. If you want to run the two timers in sync, you can align the phase.

Note

If you are using the timer period to perform a programmable sweep, set the CH1 source trigger to Timer1 and CH2 source trigger to Timer2. This will cause the phases of Timer1 and Timer2 to be automatically reset at the sweep start of CH1 and CH2, respectively.

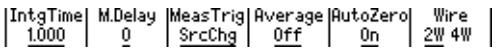
<<Corresponding Command Mnemonic>>

```
:TRIGger:TIMer1 <time>|MINimum|MAXimum
:TRIGger:TIMer2 <time>|MINimum|MAXimum
:TRIGger:TSYNc
*TRG
```

4.5 Selecting the Wiring System (Remote Sense or Local Sense)

Procedure

1. Press **CONFIG** in the MEASURE section of the front panel to display the CONFIG menu.



2. Press the **Wire** soft key to select 4W or 2W.

Explanation

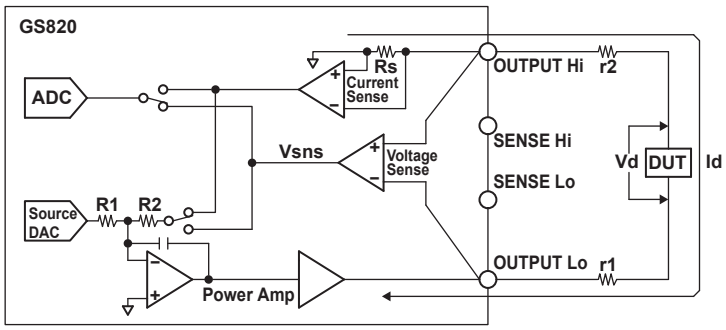
The GS820 has two wiring systems: 2W and 4W.
2W: Two-terminal connection (local sense)
4W: Four-terminal connection (remote sense)
The connection diagrams are given on the next page.

WARNING

- When making a four-terminal connection, be careful that the connection to the SENSE terminal does not get cut. If the voltage is not sensed correctly, abnormal voltage will appear across the OUTPUT Hi and OUTPUT Lo terminals.
- When making a two-terminal connection, use the OUTPUT terminals. If the SENSE terminal is used, the GS820 will not be able to generate the voltage or current correctly and may break.

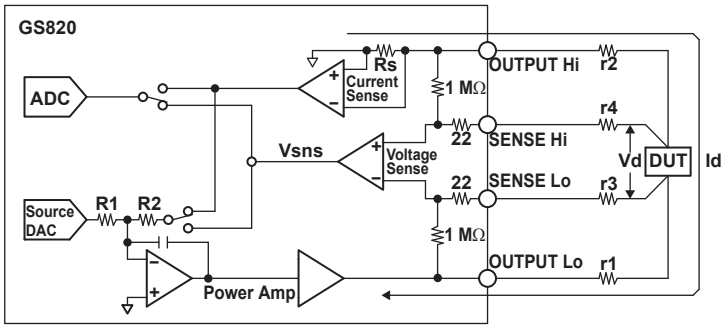
When measuring voltage in current source mode and the current becomes large, the voltage drop in the lead wire can no longer be ignored. In such case, the voltage can be measured without receiving the effects of the lead wire resistance by selecting the four-terminal connection (4W) and connecting the SENSE terminal near the DUT. The effects of the lead wires appear also in voltage source mode. In this case also, using the four-terminal connection (4W) allows the specified voltage to be applied to the DUT without receiving the effects of the lead wire resistance.

Two-terminal connection



A difference of Id × (r1 + r2) appears across Vd and Vsns. This difference cannot be ignored if Id is large even if r1 and r2 are small.

Four-terminal connection



A difference of $\mathrm{Id} \times \left\{ \frac{r_1 \cdot (r_3 + 22\ \Omega)}{1\ \mathrm{M}\Omega + r_3 + 22\ \Omega + r_1} + \frac{r_2 \cdot (r_4 + 22\ \Omega)}{1\ \mathrm{M}\Omega + r_4 + 22\ \Omega + r_2} \right\}$ **appears across Vd and Vsns, but this difference can be ignored if r1 to r4 are small.**

r1 to r4: Lead wire resistance
Id: Current flowing through the DUT
Vd: Voltage applied to the DUT
Vsns: Voltage sensed by the GS820
(= voltage source value and measured current value)

Note

- If 4W (four-terminal connection) is used, the source voltage across the OUTPUT Hi and OUTPUT Lo terminals will be larger than the voltage generated on the load. If the source voltage across the OUTPUT Hi and OUTPUT Lo terminals exceeds the source range, the GS820 will not be able to generate the voltage correctly, and abnormal load detection may be activated causing the output to be turned OFF. Be sure that the source voltage across the OUTPUT Hi and OUTPUT Lo terminals do no exceed the source range.
- To prevent oscillations due to stray capacitance and lead inductance, use twisted-pair lead wires to connect to the OUTPUT Hi and OUTPUT Lo terminals. Likewise, use twisted-pair lead wires to connect to the SENSE Hi and SENSE Lo terminals. In particular, wire the lead wires short in the case of a high-capacity load in a four-terminal connection in voltage source mode.

<<Corresponding Command Mnemonic>>

`[:CHANnel<n>]:SENSe:REMote 1|0|ON|OFF`

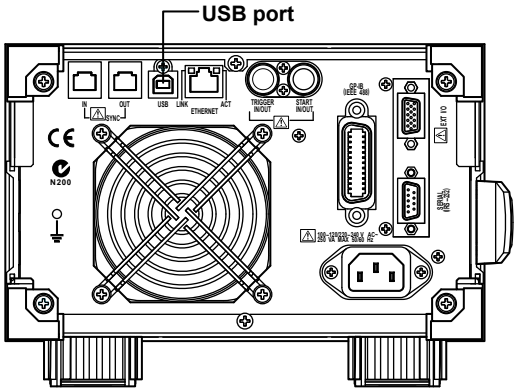
4.6 USB Storage Function

Connection Cable

Use a USB cable for the type B connector (receptacle).

How to Connect the USB Cable

1. Connect a USB cable to the USB port on the GS820 rear panel.

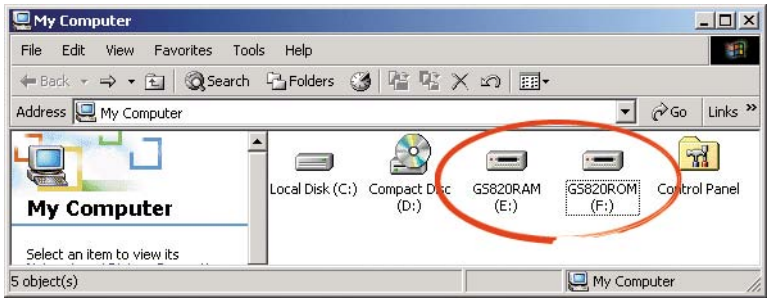


2. Connect the other end of the cable to the USB port on your PC.

Note

- Connect the USB cable by inserting the connector firmly into the USB connector.
- Do not insert a USB cable into an I/O terminal other than the USB port as this may damage the GS820.
- If the USB communication is set to the command control function by way of USB-TMC (see section 12.2, “Selecting the USB Interface Function”), the USB storage function cannot be used.

3. After connecting the USB cable correctly, turn ON the power switch of the GS820. Two removable disks named GS820ROM and GS820RAM appear within My Computer on your PC.



USB Storage Function

GS820ROM

A 12-MB non-volatile disk with preset directories for different purposes. Various files are stored in the appropriate directories.

- **MATH**
  Stores definition files of equation computation that are selected during equation computation.
  When shipped from the factory and when the disk is formatted, built-in computation files are stored in this directory.
- **PROGRAM**
  Stores programmable sweep pattern files that you select when carrying out programmable sweep.
  When shipped from the factory or when the disk is formatted, sample pattern files are stored in this directory.
- **SETUP**
  Stores the GS820 panel setup data that you select when loading settings.
  When shipped from the factory or when the disk is formatted, a default setup file is stored in this directory.

GS820RAM

A 16-MB RAM disk that is automatically formatted when the power is turned ON. It is a volatile disk used to exchange files with your PC. The result file (Result.csv) is created in this directory when the storage operation is carried out. If the settings are saved to the GS820RAM, the current settings are saved to a file named Setup.txt.
When updating the system firmware, the system file (System.srec) is written in this directory from your PC. For details, see section 17.5, “Updating the System Firmware.”

Formatting the Disk

If GS820ROM cannot be detected on your PC, if you want to set the GS820 to factory default conditions, or if the disk is corrupt, you must format the disk.

Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.

Remote I/F	External I/O	LineFreq Auto	Display 4	CSV Setting	Next 1/2

2. Press the **Next 1/2** soft key.

3. Press the **DiskFormat** soft key.

Beep On Off	Time Adjust	Test	Disk Format	Firmware Update	Next 2/2

4. Press the **Exec** soft key to execute the search.

					Exec

Note

- Always format the disk from the GS820 menu. If you format the disk from your PC, default directories such as MATH and default files are not created.
- You can also create subdirectories and write files to the disk, but be sure that the disk does not become full.
- Do not change the existing directory names such as MATH. If you do, you will no longer be able to select files from the GS820.

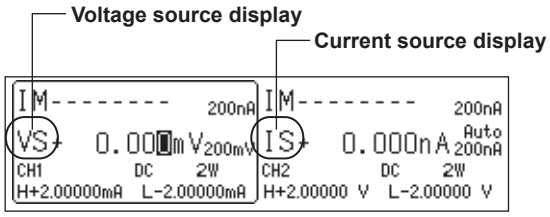
5.1 Switching the Source Function

Procedure

1. Press **V/I** in the SOURCE section of the front panel.
Voltage (VS) and current (IS) switch alternately each time you press this key.

Explanation

Display Example of Source Function



<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SOURce:FUNCtion VOLTage|CURRent
```

5.2 Setting the Source Range

Procedure

There are two source ranges: fixed range and auto range.

Changing the Fixed Range

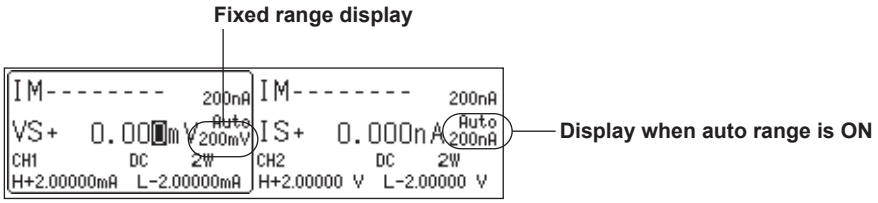
1. Press the △ or ▽ key under **RANGE** in the SOURCE section of the front panel to change the source range.

Turning Auto Range ON/OFF

1. Press **SHIFT+▽ (AUTO)** in the SOURCE section of the front panel. The auto range function turns ON and Auto appears in the display.
   If you press **SHIFT+▽ (AUTO)** again or if you press △ or ▽ to change the range when auto range is ON, auto range turns OFF and fixed range is enabled.

Explanation

Display Example of Source Range



Fixed Range

- **Voltage Source Range**

Source Range	Range Generated	Resolution	Max. Load Current
200 mV	±200.000 mV	1 μV	±3.2 A
2 V	±2.00000 V	10 μV	±3.2 A
7 V	±7.0000 V	100 μV	±3.2 A
18 V	±18.0000 V	100 μV	±1.2 A

- **Current Source Range**

Source Range	Range Generated	Resolution	Max. Load Voltage
200 nA	±200.000 nA	1 pA	±18 V
2 μA	±2.00000 μA	10 pA	±18 V
20 μA	±20.0000 μA	100 pA	±18 V
200 μA	±200.000 μA	1 nA	±18 V
2 mA	±2.00000 mA	10 nA	±18 V
20 mA	±20.0000 mA	100 nA	±18 V
200 mA	±200.000 mA	1 μA	±18 V
1A	±1.20000 A	10 μA	±18 V
3A	±3.20000 A	10 μA	±7 V

Auto Range

If turned ON, the minimum range that includes the source level will be automatically selected.

- **Source Voltage Level in Voltage Source Mode and Source Range Selected Automatically**

Condition	Selected Range	Resolution
0.000 mV ≤ |X|≤ 200.000mV	200mV	1μV
200.00mV < |X|≤ 2.00000V	2V	10μV
2.0000V < |X|≤ 7.0000V	7V	100μV
7.0000V < |X|≤ 18.0000V	18V	100μV

X is 1) Source voltage level (for DC source mode)
2) Source voltage level and pulse base (for pulse source mode)

- **Source Current Level in Current Source Mode and Source Range Selected Automatically**

Condition	Selected Range	Resolution
0.000nA ≤ |X|≤ 200.000 nA	200 nA	1 pA
200.00 nA < |X|≤ 2.00000 μA	2 μA	10 pA
2.0000 μA < |X|≤ 20.0000 μA	20 μA	100 pA
20.000 μA < |X|≤ 200.000 μA	200 μA	1 nA
200.00 μA < |X|≤ 2.00000 mA	2 mA	10 nA
2.0000 mA < |X|≤ 20.0000 mA	20 mA	100 nA
20.000 mA < |X|≤ 200.000 mA	200 mA	1 μA
200.00 mA < |X|≤ 1.20000 A	1 A	10 μA
1.20000 A < |X|≤ 3.20000 A	3 A	10 μA

X is 1) Source current level (for DC source mode)
2) Source current level and pulse base (for pulse source mode)

Note

- If you change the range while a capacitive or inductive load such as a capacitor or coil is connected, an abnormal load may be detected due to the energy built up in the load, and the output may turn OFF.
- If the range is changed, a transient glitch will occur in the output for several μs to several hundred μs. If you want to avoid the glitch when the source level changes, use a fixed range that will cover the maximum necessary value rather than using auto range.
- Changing the range normally does not change the specified source level. However, fractions may be rounded within the range or if the source level falls outside the range, the source level is set to the maximum value (minimum value if negative) in the new range.
- If you enter a source level exceeding the specified range, the maximum value of the source range is displayed, and a beep sound (see section 11.6, “Turning the Beep Sound ON/OFF”) is generated (only if the beep sound is ON).

<<Corresponding Command Mnemonic>>

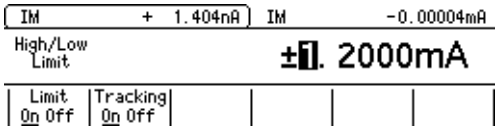
```
[:CHANnel<n>]:SOURce[:VOLTage]:RANGe <voltage>|MINimum|MAXimum|UP|DOWN
[:CHANnel<n>]:SOURce[:VOLTage]:RANGe:AUTO 1|0|ON|OFF
[:CHANnel<n>]:SOURce[:CURRent]:RANGe <current>|MINimum|MAXimum|UP|DOWN
[:CHANnel<n>]:SOURce[:CURRent]:RANGe:AUTO 1|0|ON|OFF
```

5.3 Setting the Limiter

Procedure

Turning the Limiter ON/OFF

1. Press **SHIFT+SWEEP(LIMIT)** to display the Limiter setup menu.



2. Press the **Limit** soft key to turn the limiter On or Off.

Turning the Tracking ON/OFF

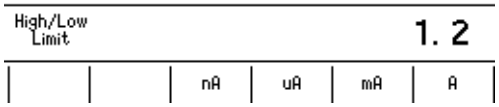
3. Press the **Tracking** soft key to turn the tracking function On or Off.

Setting the Limit Values

- **If Tracking Is Turned On**

4. Use the **rotary knob** or **numeric keys&< >** to set the absolute value of the high limit and low limit values.

   If you use the numeric keys, press the soft key for the desired unit to confirm the value.

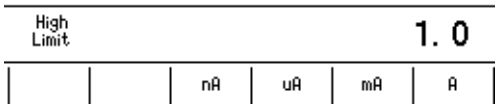


- **If Tracking Is Turned Off**

4. Press the **High Limit** soft key. The screen for setting the high limit value appears.

5. Use the **rotary knob** or **numeric keys&< >** to set the limit value.

   If you use the numeric keys, press the soft key for the desired unit or the Enter soft key to confirm the value.



6. Press the **Low Limit** soft key. The screen for setting the low limit value appears.
7. Use the **rotary knob** or **numeric keys&< >** to set the limit value.

   If you use the numeric keys, press the soft key for the desired unit to confirm the value.

Explanation

Turning the Limiter ON/OFF

ON: The limiter is activated at the specified limit values.

OFF: The limiter is activated at the boundary of the source range (see section 2.3). However, the limit values are not displayed.

Tracking

ON: Sets the limit values with the same absolute value but with opposite signs.

Example High limit value: +1.00000 mA
Low limit value: –1.00000 mA

OFF: Set the limit values to arbitrary positive and negative values.

Example High limit value: +1.50000 mA
Low limit value: –1.00000 mA

Setting the Limit Values

In voltage source mode, the current limiter is enabled. In current source mode, the voltage limiter is enabled.

The optimal limiter range for the specified limit values is automatically selected.

- **Current Limiter**

| Setting |[1]	Range	Resolution	Minimum Setting[2]
10.000 nA to 200.000 nA	200 nA	1 pA	10 nA
200.001 nA to 2.00000 μA	2 μA	10 pA	10 nA
2.00001 μA to 20.0000 μA	20 μA	100 pA	100 nA
20.0001 μA to 200.000 μA	200 μA	1 nA	1 μA
200.001 μA to 2.00000 mA	2 mA	10 nA	10 μA
2.00001 mA to 20.0000 mA	20 mA	100 nA	100 μA
20.0001 mA to 200.000 mA	200 mA	1 μA	1 mA
200.001 mA to 1.20000 A	1 A	10 μA	10 mA
1.20001 A to 3.20000 A	3 A	10 μA	10 mA

1: Larger of the two values |high limit value| or |low limit value| if tracking is OFF
2: Minimum setting if tracking is OFF.

- **Voltage Limiter**

| Setting |[1]	Range	Resolution	Minimum Setting[2]
1.000 mV to 200.000 mV	200 mV	1 μV	1 mV
200.001 mA to 2.00000 V	2 V	10 μV	1 mV
2.00001 V to 7.0000 V	7 V	100 μV	5 mV
7.0001 V to 18.0000 V	18 V	100 μV	5 mV

1: Larger of the two values |high limit value| or |low limit value| if tracking is OFF
2: Minimum setting if tracking is OFF.

Display When a Limiter Is Activated

When the high limiter is activated: High limiter activation display (H)

When the low limiter is activated: Low limiter activation display (L)

Note

- If the limit values are set outside the source range, the limiter is activated at the boundary of the source range. For example, if the source range is set to 18 V and the limit value is set to 3A in voltage source mode, the limiter is activated at 1.2 A.
- If the limiter range is changed, a transient glitch is generated at the output.

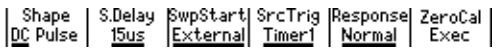
<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection[:STATe] 1|0|ON|OFF
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LINKage 1|0|ON|OFF
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LEVel <voltage>|MINimum|MAXimum
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:UPPer <voltage>|MINimum|MAXimum
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LOWer <voltage>|MINimum|MAXimum
[:CHANnel<n>]:SOURce[:CURRent]:PROTection[:STATe] 1|0|ON|OFF
[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LINKage 1|0|ON|OFF
[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LEVel <current>|MINimum|MAXimum
[:CHANnel<n>]:SOURce[:CURRent]:PROTection:UPPer <current>|MINimum|MAXimum
[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LOWer <current>|MINimum|MAXimum
```

5.4 Selecting the Source Waveform and Source Level

Procedure

1. Press **CONFIG** in the SOURCE section of the front panel to display the CONFIG menu.



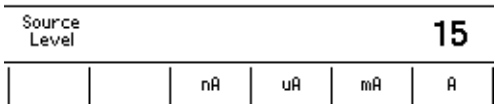
Selecting the Source Waveform

2. Press the **Shape** soft key to select DC or Pulse.

Setting the Source Level

3. Use the **rotary knob** or **numeric keys&< >** to set the source level.

If you use the numeric keys, press the soft key for the desired unit to confirm the setting.



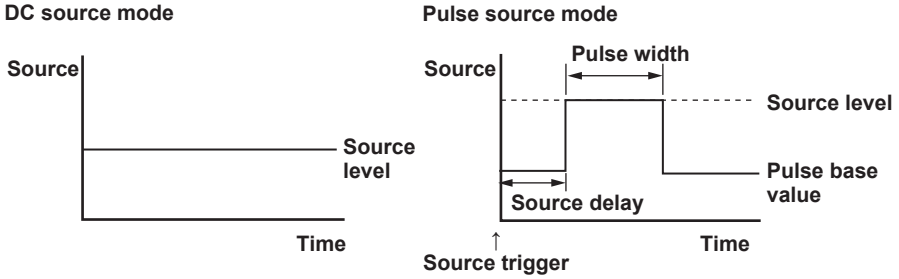
Note

The source level can be changed while setting other items or while the output is ON.

Explanation

Source Waveform

There are two source modes: DC source and pulse source.



If you select the pulse source mode, set the pulse base value (see section 5.10, “Setting the Pulse Base Value”) and pulse width (see section 5.11, “Setting the Pulse Width”).

Selectable Range of Source Level

See the source range for fixed range in section 5.2, “Setting the Source Range.”

Note

Because there is output capacitance indicated below across the OUTPUT Hi and OUTPUT Lo terminals of the GS820, the following effects are present.

- If the load changes drastically such as when a short circuit occurs in voltage source mode, a large transient discharge current is generated from the output capacitance.
- If a voltage source (power supply, amplifier, signal generator, and the like) is connected as a load, the load voltage source may be unstable due to the output capacitance.
- If the source level is low in current source mode or if the current limiter setting is low in voltage source mode, take the time needed to charge or discharge the output capacitance into consideration for the response time of the source level.

Response Mode	Output Capacitance
Normal	3000 pF or less
Stable	6000 pF or less

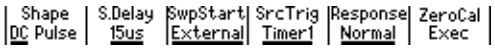
<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SOURce:SHAPe DC|PULSe
[:CHANnel<n>]:SOURce[:VOLTage]:LEVel <voltage>|MINimum|MAXimum
[:CHANnel<n>]:SOURce[:CURRent]:LEVel <current>|MINimum|MAXimum
```

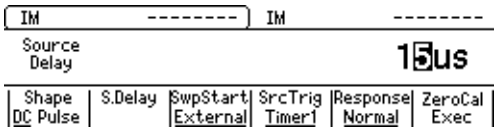
5.5 Setting the Source Delay

Procedure

1. Press **CONFIG** in the SOURCE section of the front panel to display the CONFIG menu.



2. Press the **S.Delay** soft key to display the source delay setup screen.



3. Use the **rotary knob** or **numeric keys&< >** to set the source delay.

   If you use the numeric keys, press the soft key for the desired unit to confirm the setting.

Explanation

Source Delay

A wait time from when the trigger is generated until the source operation is started. Set the source delay to adjust the phase difference between channels when synchronizing multiple channels or to correct the timing of the external trigger signal.

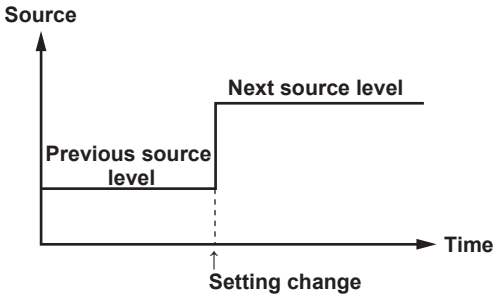
Selectable Range

15 μs to 3600.000000 s

Relationship between the Source Operation and Source Delay

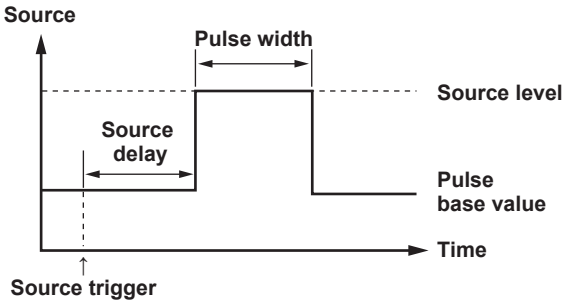
If Sweep is OFF (DC Source Mode)

The source delay is not used. The setting changes when you change the setting from the panel keys or communication command.



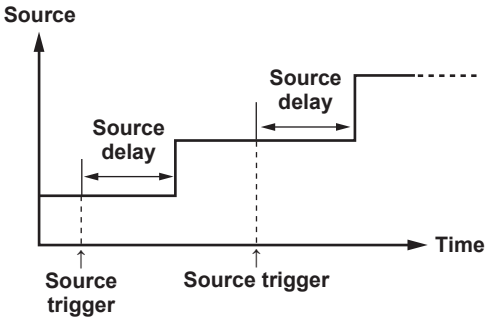
For Pulse Source Mode

The GS820 outputs the pulse base value in steady-state condition and outputs the source level of a specified pulse width after the source delay elapses from the trigger point.



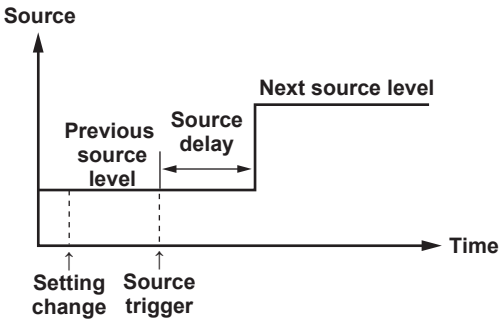
For Linear Sweep, Log Sweep, and Programmable Sweep

The GS820 executes a step within a predefined pattern sweep after the source delay elapses from the source trigger point.



For Single-Step Sweep

After the setting is changed from the front panel or communication command, the setting change is actually executed after the source delay elapses from the source trigger point.



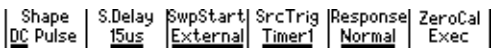
<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SOURce:DELay <time>|MINimum|MAXimum
```

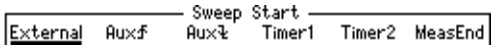
5.6 Selecting the Sweep Start Source

Procedure

1. Press **CONFIG** in the SOURCE section of the front panel to display the CONFIG menu.



2. Press the **SwpStart** soft key to display the Sweep Start menu.



3. Press the soft key corresponding to the desired sweep start signal source.

Explanation

Sweep Start Source

A signal source used to start the sweep operation. Select from the items below.

External: External start
Aux↑: Auxiliary trigger (rising edge)
Aux↓: Auxiliary trigger (falling edge)
Timer1
Timer2
MeasEnd: At the end of a measurement

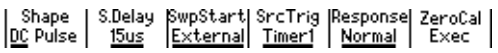
<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SWEep:TRIGger EXTernal|AUXiliary|TIMer1|TIMer2|SENSe
[:CHANnel<n>]:SWEep:TRIGger:AUXiliary:POLarity NORMal|INVerted
```

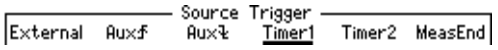
5.7 Selecting the Source Trigger

Procedure

1. Press **CONFIG** in the SOURCE section of the front panel to display the CONFIG menu.



2. Press the **SrcTrig** soft key to display the Source Trigger menu.



3. Press the soft key corresponding to the desired source trigger.

Explanation

Source Trigger

A signal source used to trigger the source operation. Select from the items below.

External: External trigger
Aux↑: Auxiliary trigger (rising edge)
Aux↓: Auxiliary trigger (falling edge)
Timer1
Timer2
MeasEnd: At the end of a measurement

Note

A sampling error occurs if a new source trigger is generated while a source action is in progress.

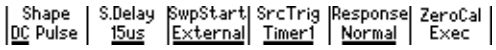
<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SOURce:TRIGger EXTernal|AUXiliary|TIMer1|TIMer2|SENSe
[:CHANnel<n>]:SOURce:TRIGger:AUXiliary:POLarity NORMal|INVerted
```

5.8 Selecting the Response Mode

Procedure

1. Press **CONFIG** in the SOURCE section of the front panel to display the CONFIG menu.



2. Press the **Response** soft key to display the Response menu.

3. Press the soft key corresponding to the desired response mode.

Explanation

Response Mode

Select an appropriate response mode according to the DUT used or the application objective.

Normal: The response time is short, but the GS820 may become unstable and oscillate when a highly inductive or capacitive load is connected.

Stable: This mode is robust to inductive and capacitive loads, but the response time is longer.

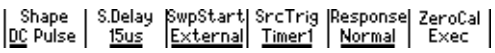
<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SOURce:RESPonse NORMal|STABle
```

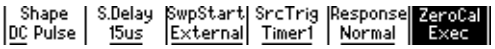
5.9 Offset Calibration

Procedure

1. Press **CONFIG** in the SOURCE section of the front panel to display the CONFIG menu.



2. Press the **ZeroCalExec** soft key to execute the calibration.
   The **ZeroCalExec** indicator in the display is highlighted while the calibration is in progress.



Explanation

Offset calibration is executed to correct the offset drift in the source level that is caused by temperature changes and the like.

Note

- Because measurements are performed to calibrate all the ranges in an offset calibration, the source and measurement operations are suspended for a few seconds while the calibration is in progress.
- The results of the calibration are lost when the power is turned OFF.

<<Corresponding Command Mnemonic>>

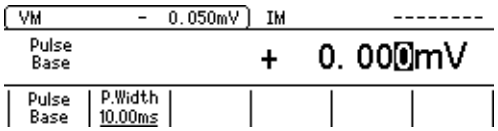
```
*CAL?
```

5.10 Setting the Pulse Base

Procedure

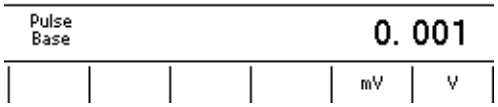
1. Press **SHIFT+CONFIG(PULSE)** in the SOURCE section of the front panel to display the PULSE menu.

2. Press the **Pulse Base** soft key to display the pulse base setup screen.



3. Use the **rotary knob** or **numeric keys&< >** to set the pulse base value.

   If you use the numeric keys, press the soft key for the desired unit to confirm the setting.



Explanation

Selectable Range of Pulse Base Value

See the source range for fixed range in section 5.2, “Setting the Source Range.”

Note

If the source range is set to auto range, the range appropriate for the larger of the two values |source value| and |pulse base value| is applied.

<<Corresponding Command Mnemonic>>

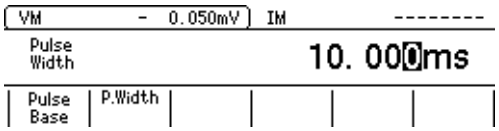
```
[:CHANnel<n>]:SOURce[:VOLTage]:PULSe:BASE <voltage>|MINimum|MAXimum
[:CHANnel<n>]:SOURce[:CURRent]:PULSe:BASE <current>|MINimum|MAXimum
```

5.11 Setting the Pulse Width

Procedure

1. Press **SHIFT+CONFIG(PULSE)** in the SOURCE section of the front panel to display the PULSE menu.

2. Press the **P.Width** soft key.



3. Use the **rotary knob** or **numeric keys&< >** to set the pulse width.

   If you use the numeric keys, press the soft key for the desired unit to confirm the setting.

Explanation

Selectable Range of Pulse Width

50 μs to 3600.000000 s

<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SOURce[:VOLTage]:PULSe:WIDTh <time>|MINimum|MAXimum
[:CHANnel<n>]:SOURce[:CURRent]:PULSe:WIDTh <time>|MINimum|MAXimum
```

5.12 Turning the Output ON/OFF and Zero Source

Procedure

Turning the Output ON/OFF

Press the OUTPUT key. The **OUTPUT** key illuminates while the output is ON.

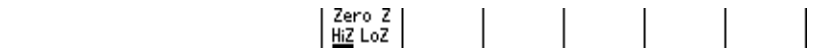
If you press **OUTPUT** while the output is ON, the output will stop. When the output stops, the **OUTPUT** key turns OFF.

Zero Source

Press **ZERO** when the source is ON or when the output is OFF to generate a zero level signal. The ZERO and OUTPUT keys illuminate while a zero level signal is being generated. Press ZERO again to turn the output ON causing the OUTPUT key to illuminate.

Selecting the Zero Source Impedance

1. Press **SHIFT+ZERO (CONFIG)** to display the zero impedance menu.



2. Press the **Zero Z** soft key to select HiZ or LoZ.

Explanation

Turning the Output ON/OFF

The output relay switches between ON and OFF.

Note

When the output relay operates, the source level is set to zero.

- **When Output Is ON**
  The output relay turns ON with the source level set to zero. After the output relay switches, the source level is changed to the specified source level.
- **When Output Is OFF**
  The source level is set to zero and then the output relay is turned OFF.

Zero Source

The GS820 generates 0V in voltage source mode and 0A in current source mode.

Setting the Zero Source Impedance

The impedance for generating a zero level signal can be selected.

	Voltage Source Mode	Current Source Mode
High impedance (HiZ)	The limiter is at the minimum setting (10 nA).	The limiter retains the present setting.
Low impedance (LoZ)	The limiter retains the present setting.	The limiter is at the minimum setting (1 mV).

<<Corresponding Command Mnemonic>>

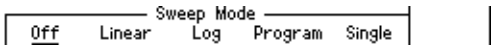
```
[:CHANnel<n>]:OUTPut[:STATe] 1|0|ON|OFF|ZERO
[:CHANnel<n>]:SOURce[:VOLTage]:ZERO:IMPedance HIGH|LOW
[:CHANnel<n>]:SOURce[:CURRent]:ZERO:IMPedance HIGH|LOW
```

6.1 Setting the Linear Sweep

Procedure

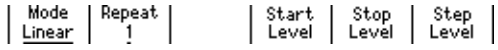
1. Press **SWEEP** to display the Mode menu.

2. Press the **Mode** soft key to display the Sweep Mode menu.



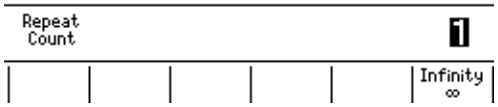
Selecting the Linear Sweep Mode

3. Press the **Linear** soft key to display the Linear Sweep menu.



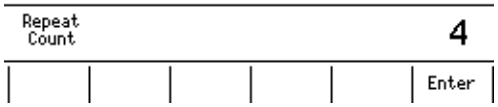
Setting the Repeat Count

4. Press the **Repeat** soft key to display the Repeat Count menu.



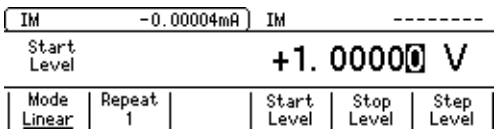
5. Use the **rotary knob** or **numeric keys&< >** to set the repeat count. Press the **Infinity** soft key to set infinity (∞).

If you use the numeric keys, press the **Enter** soft key to confirm the setting.



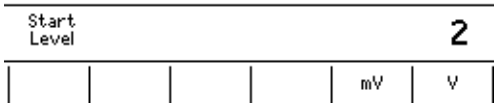
Setting the Start Level

6. Press the **Start Level** soft key to display the Start Level menu.



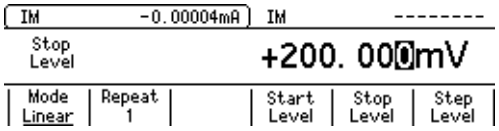
7. Use the **rotary knob** or **numeric keys&< >** to set the start level.

If you use the numeric keys, press the soft key for the desired unit to confirm the setting.



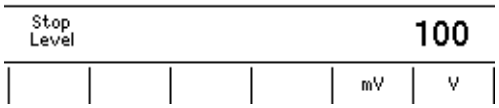
Setting the Stop Level

8. Press the **Stop Level** soft key to display the Stop Level menu.



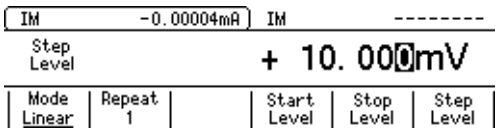
9. Use the **rotary knob** or **numeric keys&< >** to set the stop level.

If you use the numeric keys, press the soft key for the desired unit to confirm the setting.



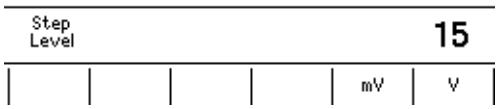
Setting the Step Level

10. Press the **Step Level** soft key to display the Step Level menu.



11. Use the **rotary knob** or **numeric keys&< >** to set the step level.

If you use the numeric keys, press the soft key for the desired unit to confirm the setting.



Starting the Sweep Operation

12. If the output is OFF or the GS820 is generating a zero level signal, turn the output ON (see section 5.12, “Turning the Output ON/OFF and Zero Source”).

13. When a sweep start source is applied, the sweep operation starts (see section 6.5, “Starting the Sweep Operation.”).

Explanation

Repeat Count

Set a value between 1 and 1000 or infinity (∞). If the repeat count is set to infinity (∞), the GS820 repeats the sweep operation until you turn the sweep operation or output OFF.

Start Level, Stop Level, and Step Level

- **Setting Resolution of the Start level, Stop Level, and Step level in Voltage Source Mode**

|Start Level|	|Stop Level|	Step level	Setting Resolution
0.000 mV	≤ X ≤	200.000 mV	1 μV
200.00 mV	< X ≤	2.00000 V	10 μV
2.0000 V	< X ≤	7.0000 V	100 μV
7.0000 V	< X ≤	18.0000 V	100 μV

- **Setting Resolution of the Start level, Stop Level, and Step level in Current Source Mode**

|Start Level|	|Stop Level|	Step level	Setting Resolution
0.000 nA	≤ X ≤	200.000 nA	1 pA
200.00 nA	< X ≤	2.00000 μA	10 pA
2.0000 μA	< X ≤	20.0000 μA	100 pA
20.000 μA	< X ≤	200.000 μA	1 nA
200.00 μA	< X ≤	2.00000 mA	10 nA
2.0000 mA	< X ≤	20.0000 mA	100 nA
20.00 mA	< X ≤	200.000 mA	1 μA
200.00 mA	< X ≤	3.20000 A	10 μA

Note

- If the sweep count calculated from the start level, stop level, and step level exceeds 100000 points, an error occurs, and the sweep operation can be carried out only up to 100000 points.
- If the source range is set to auto range, the range may be changed during the sweep operation, because the GS820 constantly selects the most suitable range.
- If set to fixed range, the sweep operation is carried out in the range best suited to the source level with the highest resolution.

<<Corresponding Command Mnemonic>>

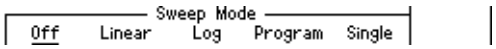
```
[CHANnel<n>]:SOURce:MODE SWEep
[CHANnel<n>]:SOURce[:VOLTage]:SWEep:SPACing LINear
[CHANnel<n>]:SOURce[:VOLTage]:SWEep:STARt <voltage>|MINimum|MAXimum
[CHANnel<n>]:SOURce[:VOLTage]:SWEep:STOP <voltage>|MINimum|MAXimum
[CHANnel<n>]:SOURce[:VOLTage]:SWEep:STEP <voltage>|MINimum|MAXimum
[CHANnel<n>]:SOURce[:CURRent]:SWEep:SPACing LINear
[CHANnel<n>]:SOURce[:CURRent]:SWEep:STARt <current>|MINimum|MAXimum
[CHANnel<n>]:SOURce[:CURRent]:SWEep:STOP <current>|MINimum|MAXimum
[CHANnel<n>]:SOURce[:CURRent]:SWEep:STEP <current>|MINimum|MAXimum
```

6.2 Setting the Log Sweep

Procedure

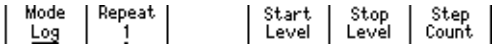
1. Press **SWEEP** to display the SWEEP menu.

2. Press the **Mode** soft key to display the Sweep Mode menu.



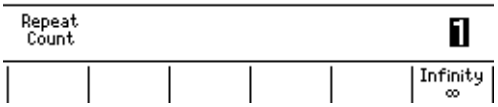
Selecting the Log Sweep Mode

3. Press the **Log** soft key to display the Log Sweep menu.



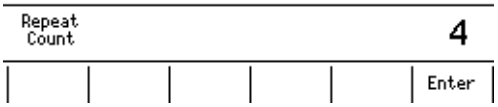
Setting the Repeat Count

4. Press the **Repeat** soft key to display the Repeat Count menu.



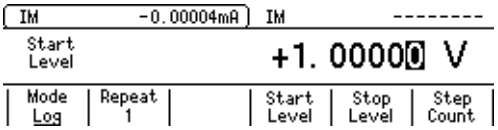
5. Use the **rotary knob** or **numeric keys&< >** to set the repeat count. Press the **Infinity** soft key to set infinity (∞).

If you use the numeric keys, press the **Enter** soft key to confirm the setting.



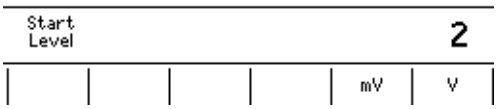
Setting the Start Level

6. Press the **Start Level** soft key to display the Start Level menu.



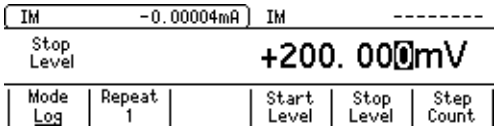
7. Use the **rotary knob** or **numeric keys&< >** to set the start level.

If you use the numeric keys, press the soft key for the desired unit to confirm the setting.



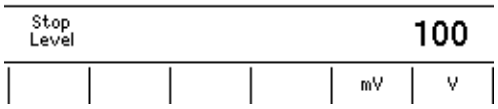
Setting the Stop Level

8. Press the **Stop Level** soft key to display the Stop Level menu.



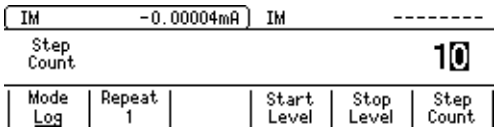
9. Use the **rotary knob** or **numeric keys&< >** to set the stop level.

If you use the numeric keys, press the soft key for the desired unit to confirm the setting.



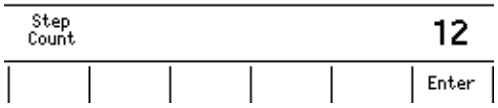
Setting the Step Count

10. Press the **Step Count** soft key to display the Step Count menu.



11. Use the **rotary knob** or **numeric keys&< >** to set the step count.

If you use the numeric keys, press the **Enter** soft key to confirm the setting.



Starting the Sweep Operation

12. If the output is OFF or the GS820 is generating a zero level signal, turn the output ON (see section 5.12, “Turning the Output ON/OFF and Zero Source”).

13. When a sweep start source is applied, the sweep operation starts (see section 6.5, “Starting the Sweep Operation.”).

Explanation

Repeat Count

Set a value between 1 and 1000 or infinity (∞). If the repeat count is set to infinity (∞), the GS820 repeats the sweep operation until you turn the sweep operation or output OFF.

Start Level and Stop Level

- **Setting Resolution of the Start level and Stop Level in Voltage Source Mode**

|Start Level|	|Stop Level|		Setting Resolution
0.000 mV	≤ X ≤	200.000 mV	1 μV
200.00 mV	< X ≤	2.00000 V	10 μV
2.0000 V	< X ≤	7.0000 V	100 μV
7.0000 V	< X ≤	18.0000 V	100 μV

- **Setting Resolution of the Start level and Stop Level in Current Source Mode**

|Start Level|	|Stop Level|		Setting Resolution
0.000 nA	≤ X ≤	200.000 nA	1 pA
200.00 nA	< X ≤	2.00000 μA	10 pA
2.0000 μA	< X ≤	20.0000 μA	100 pA
20.000 μA	< X ≤	200.000 μA	1 nA
200.00 μA	< X ≤	2.00000 mA	10 nA
2.0000 μA	< X ≤	20.0000 mA	100 nA
20.00 mA	< X ≤	200.000 mA	1 μA
200.00 mA	< X ≤	3.20000 A	10 μA

Step Count

Set a value in the range from 2 to 100000.

Note

- If the start level and stop level have opposite signs, an error occurs, and the sweep operation cannot be carried out. In addition, if the start level or stop level is zero, an error occurs, and the sweep operation cannot be carried out.
- If the source range is set to auto range, the range may be changed during the sweep operation, because the GS820 constantly selects the most suitable range.
- If set to fixed range, the sweep operation is carried out in the range best suited to the source level with the highest resolution.

<<Corresponding Command Mnemonic>>

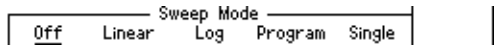
```
[CHANnel<n>]:SOURce:MODE SWEep
[CHANnel<n>]:SOURce[:VOLTage]:SWEep:SPACing LOGarithmic
[CHANnel<n>]:SOURce[:VOLTage]:SWEep:STARt <voltage>|MINimum|MAXimum
[CHANnel<n>]:SOURce[:VOLTage]:SWEep:STOP <voltage>|MINimum|MAXimum
[CHANnel<n>]:SOURce[:VOLTage]:SWEep:POINts <integer>|MINimum|MAXimum
[CHANnel<n>]:SOURce[:CURRent]:SWEep:SPACing LOGarithmic
[CHANnel<n>]:SOURce[:CURRent]:SWEep:STARt <current>|MINimum|MAXimum
[CHANnel<n>]:SOURce[:CURRent]:SWEep:STOP <current>|MINimum|MAXimum
[CHANnel<n>]:SOURce[:CURRent]:SWEep:POINts <integer>|MINimum|MAXimum
```

6.3 Setting the Programmable Sweep

Procedure

1. Press **SWEEP** to display the SWEEP menu.

2. Press the **Mode** soft key to display the Sweep Mode menu.

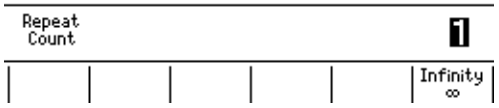


Selecting the Programmable Sweep Mode

3. Press the **Program** soft key to display the Program Sweep menu.

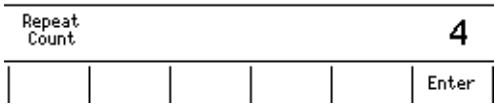
Setting the Repeat Count

4. Press the **Repeat** soft key to display the Repeat Count menu.



5. Use the **rotary knob** or **numeric keys&< >** to set the repeat count. Press the **Infinity** soft key to set infinity (∞).

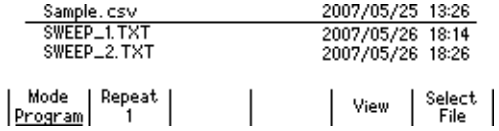
   If you use the numeric keys, press the **Enter** soft key to confirm the setting.



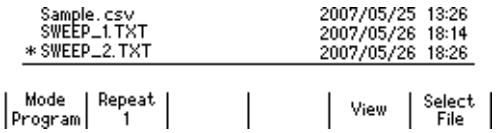
Selecting the Program File

6. Use the **rotary knob** and **< >** to move the cursor (underline) vertically and select the program file to be used for the pattern.

   Pressing the **View** soft key allows you to view the contents of the selected file.



7. Press the **Select File** soft key to confirm the selection.
An asterisk is placed by the confirmed file.



Explanation

Repeat Count

Set a value between 1 and 1000 or infinity (∞). If the repeat count is set to infinity (∞), the GS820 repeats the sweep operation until you turn the sweep operation or output OFF.

Program File

For the notation used in program files, see “Programmable Sweep” on page 2-20.

Note

The maximum number of steps in a program pattern is 100000.If a pattern whose step count exceeds 100000 is selected, the first 100000 points are loaded.

<<Corresponding Command Mnemonic>>

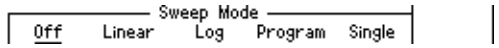
```
[CHANnel<n>]:SOURce:MODE LIST
[CHANnel<n>]:SOURce:LIST:SELect <character string>|NONE
[CHANnel<n>]:SOURce:LIST:CATalog?
[CHANnel<n>]:SOURce:LIST:DELete <character string>
[CHANnel<n>]:SOURce:LIST:LOAD <character string>
[CHANnel<n>]:SWEep:COUNt <integer>|MINimum|MAXimum
```

6.4 Setting the Single-Step Sweep

Procedure

1. Press **SWEEP** to display the SWEEP menu.

2. Press the **Mode** soft key to display the Sweep Mode menu.



Selecting the Single-Sweep Mode

3. Press the **Single** soft key.

Explanation

This function holds the changed settings and applies them when a trigger is received afterwards.
The following setup items are held.

- Source function
- Source level
- Source range
- Pulse base
- Pulse width
- Limiter level
- Measurement function
- Measurement range
- Measurement delay
- Response Mode
- Wiring system

<<Corresponding Command Mnemonic>>

```
[CHANnel<n>]:SOURce:MODE SINGle
```

6.5 Starting the Sweep Operation

Procedure

The sweep operation starts when a sweep start source is applied or when you press **START**.

Explanation

Starting the Liner Sweep, Log Sweep, or Programmable Sweep

The initial state is Waiting for Sweep Start. The GS820 will be able to receive the source trigger once the sweep operation is started from the Waiting for Sweep Start state. After receiving the source trigger the number of times equal to sweep count × repeat count, the sweep operation stops, and the GS820 returns to the Waiting for Sweep Start state.

Note

- Source triggers that are received during the Waiting for Sweep Start state are discarded.
- If a new sweep start occurs while the sweep operation is in progress, the on-going sweep operation is aborted, and an sampling error occurs.

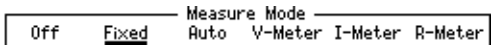
<<Corresponding Command Mnemonic>>

`:STARt`

7.1 Selecting the Measurement Mode

Procedure

1. Press **SHIFT+V/I(MODE)** in the MEASURE section of the front panel to display the Measure Mode menu.



2. Press the soft key corresponding to the desired measurement mode.

Explanation

Select from the modes below.

- **Off**
  Measurement OFF: Does not perform measurements.
- **Fixed**
  Fixed function mode: Select a measurement function (see section 7.2, “Selecting the Measurement Function”) and perform the measurement.
- **Auto**
  Auto function mode: When the source function is switched, the measurement function automatically switches so that it is not the same function as the source function. However, if the limiter is activated, the GS820 measures the same function as the source function.
- **V-Meter**
  Voltmeter mode: Generates 0 nA and measures the voltage.
- **I-Meter**
  Ammeter mode: Generates 0 mV and measures the current.
- **R-Meter**
  Resistance meter mode: Generates a fixed current at each resistance range, measures the voltage, and calculates the resistance as a result.

<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SENSe[:STATe] 1|0|ON|OFF
[:CHANnel<n>]:SENSe:MODE FIXed|AUTO|VMETer|IMETer|RMETer
```

7.2 Selecting the Measurement Function

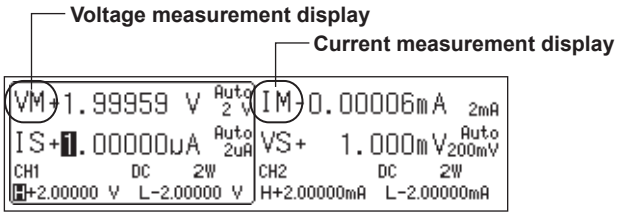
Procedure

1. Press **V/I** in the MEASURE section of the front panel.

Voltage measurement (VM) and current measurement (IM) switch alternately each time you press this key.

Explanation

Display Example of Measurement Function



You can switch the measurement function using the V/I key only when the measurement mode is set to fixed function mode (see section 7.1, “Selecting the Measurement Mode”). If another mode is selected, the measurement function is automatically selected, and you cannot change the function directly.

<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SENSe:FUNCtion VOLTage|CURRent
```

7.3 Setting the Measurement Range and Turning Auto Range ON/OFF

Procedure

There are two measurement ranges: fixed range and auto range.

Changing the Fixed Range

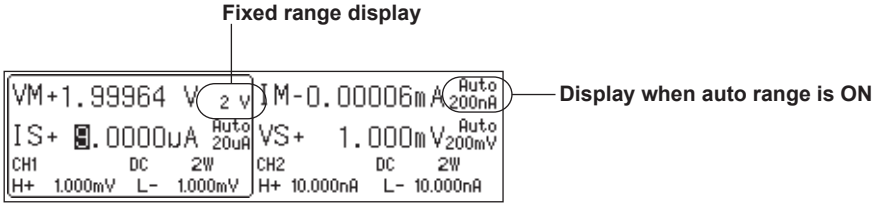
1. Press the △ or ▽ key under **RANGE** in the MEASURE section of the front panel to change the measurement range.

Turning Auto Range ON/OFF

1. Press **SHIFT+▽ (AUTO)** in the MEASURE section of the front panel. The auto range function turns ON and Auto appears in the display.
   If you press **SHIFT+▽ (AUTO)** again or if you press △ or ▽ to change the range when auto range is ON, auto range turns OFF and fixed range is enabled.

Explanation

Display Example of Measurement Range



Fixed Range

- **Voltage Measurement Range**

Measurement Range	Range Measured	Resolution
200 mV	±210.000 mV	1 μV
2 V	±2.10000 V	10 μV
7 V	±7.1000 V	100 μV
18 V	±18.0000 V	100 μV

- **Current Measurement Range**

Measurement Range	Range Measured	Resolution
200 nA	±210.000 nA	1 pA
2 μA	±2.10000 μA	10 pA
20 μA	±21.5000 μA	100 pA
200 μA	±210.000 μA	1 nA
2 mA	±2.10000 mA	10 nA
20 mA	±21.0000 mA	100 nA
200 mA	±210.000 mA	1 μA
1 A	±1.30000 A	10 μA
3 A	±3.20000 A	10 μA

Note

- If the source function and measurement function are the same (voltage source and voltage measurement or current source and current measurement), the measurement range is set to the same range as the source range.
- If the source function and the measurement function are different (current source and voltage measurement or voltage source and current measurement), you can select a measurement range that is greater than the limiter range, but the measured values will be limited by the limit values. Because the limit value affects the response time, set the limit value greater than the anticipated maximum measured value.

Auto Range

If turned ON, the GS820 automatically selects and measures at the best suited resolution. However, the time needed to make the measurement will be longer than when fixed range is used.

Note

Auto range cannot be selected if the source range and the measurement range are the same (voltage source and voltage measurement or current source and current measurement). The measurement range is always set to the same range as the source range.

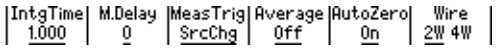
<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SENSe[:VOLTage]:RANGe <voltage>|MINimum|MAXimum|UP|DOWN
[:CHANnel<n>]:SENSe[:VOLTage]:RANGe:AUTO 1|0|ON|OFF
[:CHANnel<n>]:SENSe[:CURRent]:RANGe <current>|MINimum|MAXimum|UP|DOWN
[:CHANnel<n>]:SENSe[:CURRent]:RANGe:AUTO 1|0|ON|OFF
[:CHANnel<n>]:SENSe[:RESistance]:RANGe
 <resistance>|MINimum|MAXimum|UP|DOWN
[:CHANnel<n>]:SENSe[:RESistance]:RANGe:AUTO 1|0|ON|OFF
```

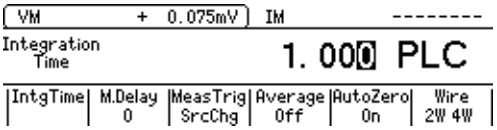
7.4 Setting the Integration Time

Procedure

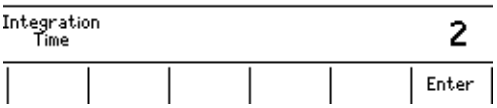
1. Press **CONFIG** in the MEASURE section of the front panel to display the CONFIG menu.



2. Press the **IntgTime** soft key to display the integration time setup screen.



3. Use the **rotary knob** or **numeric keys&< >** to set the integration time.
   If you use the numeric keys, press the **Enter** soft key to confirm the setting.



Explanation

Integration Time

The stability of measured values increases as the integration time is set longer. However, the measurement time will be longer. If the integration time is set to an integer multiple of the power line cycle (nPLC), it has an effect of eliminating the line frequency noise. To perform a highly accurate measurement, set an integer value. For the procedure to set the line frequency, see section 3.6, “Line Frequency.”

Selectable Range

0.001 PLC to 25 PLC (Power Line Cycles or 1 line cycle)

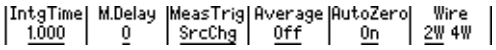
<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SENSe:NPLC <real number>|MINimum|MAXimum
[:CHANnel<n>]:SENSe:ITIMe <time>|MINimum|MAXimum
```

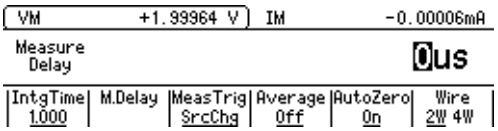
7.5 Setting the Measurement Delay

Procedure

1. Press **CONFIG** in the MEASURE section of the front panel to display the CONFIG menu.



2. Press the **M.Delay** soft key to display the measurement delay setup screen.



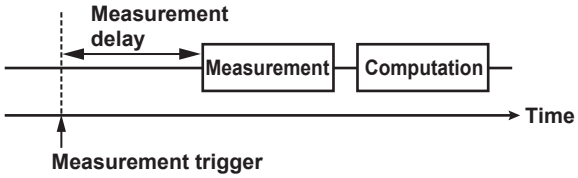
3. Use the **rotary knob** or **numeric keys&< >** to set the measurement delay.

   If you use the numeric keys, press the soft key for the desired unit to apply the setting.

Explanation

Measurement Delay

A wait time from when the measurement trigger is generated until the measurement is actually started. Set this delay if you want to insert a wait time after the source level is changed until the measurement is actually started to allow the DUT to stabilize.



Selectable Range

0 μS to 3600.000000 s

Note

The time from when the source trigger is applied to when the source level stabilizes varies depending on the load, source range, and limiter level. Keep these in mind in addition to the time needed for the DUT to stabilize after the source level is applied to adjust the length of the measurement delay.

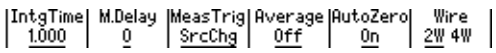
<<Corresponding Command Mnemonic>>

`[:CHANnel<n>]:SENSe:DELay <time>|MINimum|MAXimum`

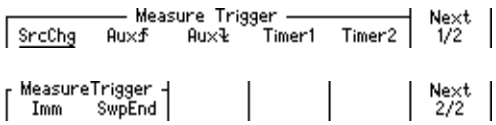
7.6 Selecting the Measurement Trigger

Procedure

1. Press **CONFIG** in the MEASURE section of the front panel to display the CONFIG menu.



2. Press the **MeasTrig** soft key to display the Measure Trigger menu.
   Press the **Next 1/2** soft key to see the next page of available choices.



3. Press the soft key corresponding to the desired measurement trigger.

Explanation

The measurement trigger is a signal source used to start the measurement. Select from the items below.

SrcChg: Source level change
Aux↑: Auxiliary trigger (rising edge)
Aux↓: Auxiliary trigger (falling edge)
Timer1
Timer2
Imm: Immediate
SwpEnd: At sweep end

Note

A sampling error occurs if a new measurement trigger is generated while a measurement is in progress.

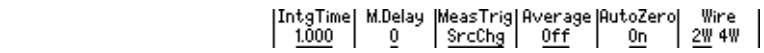
<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SENSe:TRIGger SOURce|AUXiliary|TIMer1|TIMer2|IMMediate|SWEep
[:CHANnel<n>]:SENSe:TRIGger:AUXiliary:POLarity NORMal|INVerted
```

7.7 Auto Zero Function

Procedure

1. Press **CONFIG** in the MEASURE section of the front panel to display the CONFIG menu.



2. Press the **AutoZero** soft key to display the AutoZero menu.

Turning the Auto Zero Function ON/OFF

3. Press the **AutoZero** soft key to select On or Off.

Retrieving the Zero Calibration Value

4. Press the **ZeroCal Exec** soft key to retrieve the zero calibration value.
   The **ZeroCalExec** indicator in the display is highlighted while the zero calibration value is being retrieved.

Explanation

Auto Zero Function

- **On**
  Enables the auto zero function. The GS820 measures the internal zero point for each measurement. The measured result is obtained by subtracting this value from the measured value canceling the A/D offset drift of the measurement circuit in the GS820. However, the measurement takes approximately twice as long as when the auto zero function is OFF, because the GS820 measures twice.

- **Off**
  Disables the auto zero function.

Retrieving the Zero Calibration Value

Use this function to execute the zero reference measurement at a desired timing. When a zero calibration value is retrieved, the zero reference is remeasured on all measurement ranges by disconnecting the voltage measurement circuit from the Hi and Lo terminals and shorting the terminals in voltage measurement and disconnecting the current measurement circuit from the Hi and Lo terminals and opening the terminals in current measurement. Then, the new zero reference is applied to the subsequent measurements. The new zero reference remains effective even if the measurement function or measurement range is changed. When zero reference measurement is executed, the source and measurement operations are interrupted for few seconds.

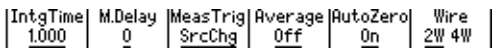
<<Corresponding Command Mnemonic>>

```
[:CHANnel<n>]:SENSe:ZERo:AUTO 1|0|ON|OFF
[:CHANnel<n>]:SENSe:ZERo:EXECute
```

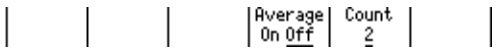
8.1 Averaging

Procedure

1. Press **CONFIG** in the MEASURE section of the front panel to display the CONFIG menu.



2. Press the **Average** soft key to display the Average menu.

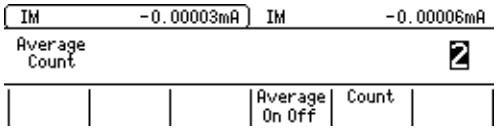


Turning Averaging Mode ON/OFF

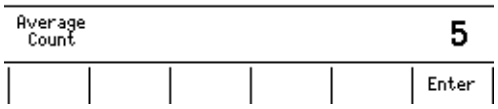
3. Press **Average** soft key to select ON or OFF.

Setting the Average Count

4. Press the **Count** soft key.



5. Use the **rotary knob** or **numeric keys&< >** to set the average count.
   If you use the numeric keys, press the **Enter** soft key to confirm the setting.



Explanation

Setting the Average Count

Set a value in the range from 2 to 256.

<<Corresponding Command Mnemonic>>

```
[CHANnel<n>]:SENSe:AVERage[:STATe] 1|0|ON|OFF
[CHANnel<n>]:SENSe:AVERage:COUNt <integer>|MINimum|MAXimum
```

8.2 NULL Computation

Procedure

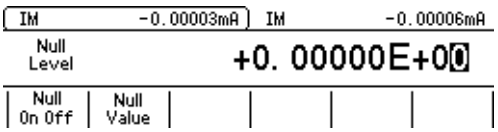
Turning the NULL Computation ON/OFF

1. Press **SHIFT+CONFIG (NULL)** in the MEASURE section of the front panel to display the NULL menu.

2. Press **NULL** soft key to select ON or OFF.

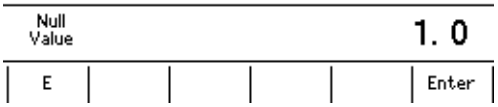
Setting the NULL Value

3. Press the **NullValue** soft key to display the NULL value setup screen.



4. Use the **rotary knob** or **numeric keys&< >** to set the NULL value.

   If you use the numeric keys, press a unit soft key or the **Enter** soft key to confirm the setting.



Explanation

NULL Computation

When the NULL computation is switched from OFF to ON, the current measured value becomes the NULL value. If you change the NULL value when the NULL computation is OFF, it is automatically turned ON. While the NULL computation is ON, the measurement result is the value obtained by subtracting the NULL value from the measured value.

Selectable Range of NULL Value

–9.99999E±24 to +9.99999E±24

<<Corresponding Command Mnemonic>>

```
[CHANnel<n>]:CALCulate:NULL[:STATe] 1|0|ON|OFF
[CHANnel<n>]:CALCulate:NULL:OFFSet <real number>
```

8.3 Equation Computation

Procedure

Turning the Computation ON/OFF

1. Press **MATH** to display the MATH menu.

Selecting the Computation Definition

2. Use the **rotary knob** and **< >** to move the cursor (underline) vertically and select a computation definition file.

3. Press the **Select File** soft key to confirm the computation definition file.
An asterisk is placed by the confirmed computation definition file.

Note

An error occurs if the notation used in the computation definition file is not correct.

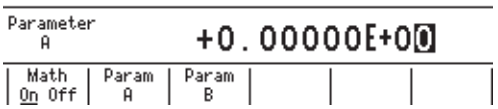
4. Press **Math** soft key to select ON or OFF. If parameters A to C is used in the selected computation definition file, the corresponding soft keys are displayed.

Note

If you select ON without selecting a computation definition file, an error occurs.

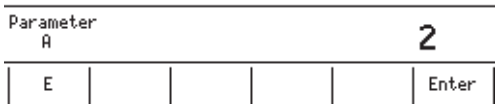
Setting Parameters

5. Press the **Param A**, **Param B**, or **Param C** soft key.



6. Use the **rotary knob** or **numeric keys&< >** to set the parameter.

7. If you use the numeric keys, press the Enter **soft key to confirm the setting.**



Viewing the Computation Definition

8. Press the **View** soft key to display the contents of the selected computation definition.

```
   FILE : Scaling.txt
ML=A*ML+B
```

Explanation

The measured results can be used to perform various computations. The computation definition file can be any of the built-in computation files or a user-defined computation file that you create. For a description of how to write a user-defined computation file, see section 8.5, “User-Defined Computation.”

Built-in Computation Files

The following five equations are built in.

- **Decibel (dB.txt)**
  ML = A*log(ML/B): Computes the decibel value of the measured value with respect to B.
- **Percent (Percent.txt)**
  ML = (ML/A)*100: Computes the percentage of the measured value with respect to A.
- **Scaling (Scaling.txt)**
  ML = A*ML+B: Scales the measured value.
- **Power (Power.txt)**
  ML = V*I: Calculates the power. However, the power cannot be calculated correctly if the source function and measurement function are the same or when the GS820 is in voltmeter, ammeter, or resistance meter mode. Set the GS820 to voltage source and current measurement modes or current source and voltage measurement modes.
- **Resistance (Resistance.txt)**
  ML = V/I: Calculates the resistance. However, the resistance cannot be calculated correctly if the source function and measurement function are the same or when the GS820 is in voltmeter, ammeter, or resistance meter mode. Set the GS820 to voltage source and current measurement modes or current source and voltage measurement modes.

Selectable Range of Parameters

–9.99999E+24 to +9.99999E+24

Viewing the Computation Definition

The contents of the computation definition files stored in the MATH directory of GS820ROM can be viewed.

<<Corresponding Command Mnemonic>>

```
[CHANnel<n>]:CALCulate:MATH[:STATe] 1|0|ON|OFF
[CHANnel<n>]:CALCulate:MATH:SELect <string character>|NONE
[CHANnel<n>]:CALCulate:MATH:CATalog?
[CHANnel<n>]:CALCulate:MATH:DELete <string character>
[CHANnel<n>]:CALCulate:MATH:PARameter:A or B or C <real number>
```

8.4 Comparison Operation

Procedure

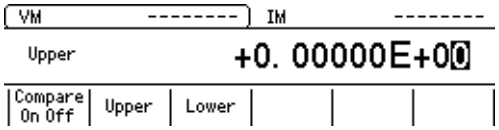
Turning the Comparison Operation ON/OFF

1. Press **SHIFT+MATH (COMPARE)** to display the COMPARE menu.

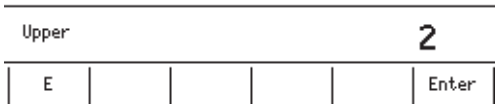
2. Press **Compare** soft key to select On or Off.

Setting the Reference Values

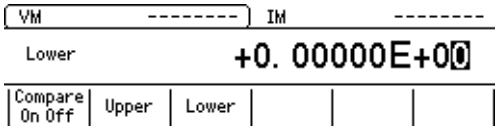
3. Press the **Upper** soft key to display the Upper setup screen.



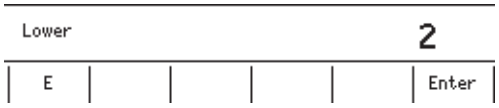
4. Use the **rotary knob** or **numeric keys&< >** to set the upper reference.
If you use the numeric keys, press the **Enter** soft key to confirm the setting.



5. Press the **Lower** soft key to display the Lower setup screen.



6. Use the **rotary knob** or **numeric keys&< >** to set the lower reference.
If you use the numeric keys, press the **Enter** soft key to confirm the setting.



Explanation

Comparison Operation

Determines the magnitude relation between the displayed value and the reference values (upper and lower) and displays the result.

The results of the comparison are displayed as follows:

Displayed Value	Comparison Result Shown on the Display	Signal That is Activated in the External Output
+ oL	High	HI
Displayed value > Upper	High	HI
Upper ≥ Displayed value ≥ Lower	In	IN
Lower > Displayed value	Low	LO
- oL	Low	LO

Setting the Reference Values

Set the reference values so that Upper is greater or equal to than Lower.

Note

If Upper is set to a value greater than Lower, an error message is displayed. If this happens, comparison operation will not be executed.

Selectable Range

–9.99999E+24 to +9.99999E+24

<<Corresponding Command Mnemonic>>

```
[CHANnel<n>]:CALCulate:LIMit[:STATe] 1|0|ON|OFF
[CHANnel<n>]:CALCulate:LIMit:UPPer <real number>
[CHANnel<n>]:CALCulate:LIMit:LOWer <real number>
```

8.5 User-Defined Computation

In addition to the built-in computation files, users can define their own equations. User-defined computations can be carried out similarly to built-in computations by creating definition files using a text editor or the like on your PC and placing the files in the MATH directory on the GS820ROM disk.

Notation Used in User-Defined Computation

Definition files are text files. They are written using statements that are similar to those used in the programming language BASIC.
For example, to perform a computation that multiplies the measured value by 1.25 and subtracts 0.75, we write the following statement in the file.

```
ML = ML * 1.25 - 0.75
```

ML is a built-in variable that represents the measured value. By substituting a value in this variable, you can manipulate the measured value. In addition to built-in variables, there are variables that can be used freely. These variables allow past measured values in computations.
For example, statements that determine the average of the last two measured values can be written in a file as follows:

```
Y  = (X + ML)/2   // Substitute the result of summing the previous value (variable X)
and the present value and dividing by 2 into variable Y
X  = ML           // Substitute the measured value into variable X
ML = Y            // Substitute variable Y into the measured value
```

X and Y are variables that users can use freely. Variables are held until the GS820 is turned OFF. As shown above, statements written in multiple lines are evaluated in order from the top. In the above example, the initial value of variable X is undefined causing the first result to be a undefined value. To prevent this from happening, we will show an example in which NAN (Not A Number) is substituted in the initial value of variable X.

```
if (J==0) then X = NAN        // If first time, substitute NAN into variable X
Y  = (X + ML)/2               //Substitute the result of summing the previous value
                                (variable X) and the present value and dividing by 2
                                into variable Y
X  = ML                       // Substitute the measured value into variable X
ML = Y                        // Substitute variable Y into the measured value
```

Here, J is a built-in variable that represents a counter whose initial value is zero when the output is turned ON and incremented by 1 each time a measurement is completed. This built-in variable J is used to evaluate if the computation is being performed for the first time. The statement is written so that if it is the first time, NAN is substituted into variable X.
As can be seen from the above example, an if statement can be written in an statement. An if statement evaluates true or false based on the following logic.

```
True:   Not 0
False:  0
```

The equality operator (==) used in the statement returns 1 if the right side is equal to the left side and 0 if not. In addition, there are two types of if statements.

if conditional expression **then** a statement to be executed if true

if conditional expression **then** a statement to be executed if true **else** a statement to be executed if false

To write multiple lines of statements to be executed, write them as follows:

```
if conditional expression then {
A statement to be executed if true
                :
}

if conditional expression then {
A statement to be executed if true
                :
} else {
A statement to be executed if false
                :
}
```

Settings can be changed by substituting values into variables that represent settings such as SL. For example, the following statement will cause the source level to be varied using a sine function with 10-V amplitude.

```
SL = 5 * SIN( 2*PI*TM )
```

Here, SL is a built-in variable that represents the source level, SIN() is the sine function, PI is a built-in variable that represents the ratio of circumference to diameter, and TM is a built-in variable that represents the timestamp. The above statement will generate a 1-Hz sine wave with ±5-V amplitude.

Specifications

Built-in Variables

<Variable>	Meaning		<Reference>	<Substitution>
TM	A real number that represents the elapsed seconds from 00:00:00 at January 1, 1970 in 1-μs resolution.		Yes	No
SF	Source function	0: voltage, 1: current	Yes	Yes (setting changed immediately)
SR	Source range	0: 200-mV range to 3: 18-V range 0: 200-nA range to 8: 3-A range	Yes	Yes (setting changed immediately)
SL	Source level		Yes	Yes (setting changed immediately)
SD	Source delay		Yes	Yes (setting changed immediately)
PW	Pulse width		Yes	Yes (setting changed immediately)
PB	Pulse base		Yes	Yes (setting changed immediately)
MF	Measurement function	0: voltage, 1: current	Yes	Yes (setting changed immediately)
MR	Measurement range	0: 200-mV range to 3: 18-V range 0: 200-nA range to 8: 3-A range	Yes	Yes (setting changed immediately)
ML	Measured value		Yes	Yes (manipulates the measurement result)
MD	Measurement delay		Yes	Yes (setting changed immediately)
HL	High limiter		Yes	Yes (setting changed immediately)
LL	Low limiter		Yes	Yes (setting changed immediately)
LS	Limiter status	-1: Low, 0: Limiter not activated, 1: High	Yes	No
OS	Output state	0: OFF, 1: ON, 2: Zero	Yes	Yes (setting changed immediately)
T1	Timer 1		Yes	Yes (setting changed immediately)
T2	Timer 2		Yes	Yes (setting changed immediately)
DO	Digital output	0 to 65535	Yes	Yes (setting changed immediately)
DI	Digital input	0 to 65535	Yes	No
AT	Auxiliary trigger generation		No	Yes (generates an auxiliary trigger immediately)
V	Source level or measured value in voltage dimension		Yes	No
I	Source level or measured value in current dimension		Yes	No
A to C	Constant. Allows a value to be entered from the panel when used in a statement.		Yes	Yes
J	A counter. Initial value is zero. Incremented each time a measurement is completed.		Yes	No

Built-in Constants

E The base of the natural logarithm 2.7182818...

PI Ratio of circumference to diameter 3.1415926...

NAN Not A Number. Indicates “not measured” if substituted into ML.

INF Infinity. “OVER” display occurs if substituted into ML.

Variables

D, F to H, K to U, and W to Z

Binary Operators

+ Returns the sum of the left and right expressions.

- Returns the difference between the left and right expressions.

* Returns the product of the left and right expressions.

/ Returns the quotient of the left and right expressions.

% Returns the remainder of the quotient of the left and right expressions.

^ Returns the left term to the power of the right expressions.

| Returns the logical OR of the left and right expressions.

& Returns the logical AND of the left and right expressions.

Unary Operators

- Returns the negation of the right expression.

~ Returns the bit inversion of the left expression.

! Returns the logical inversion of the left expression.

Relational Operators

< Returns 1 if the left expression is less than the right expression, otherwise returns 0.
<= Returns 1 if the left expression is less than or equal to the right expression, otherwise returns 0.
== Returns 1 if the left expression is equal to the right expression, otherwise returns 0.
!= Returns 1 if the left expression is not equal to the right expression, otherwise returns 0.
>= Returns 1 if the left expression is greater than or equal to the right expression, otherwise returns 0.
> Returns 1 if the left expression is greater than the right expression, otherwise returns 0.

Assignment Operators

= Substitutes the right expression into the left expression.
+= Substitutes the sum of the left and right expressions into the left expression.
-= Substitutes the difference between the left and right expressions into the left expression.
*= Substitutes the product of the left and right expressions into the left expression.
/= Substitutes the quotient between the left and right expressions into the left expression.
%= Substitutes the remainder of the quotient of the left and right expressions into the left expression.
|= Substitutes the logical OR of the left and right expressions into the left expression.
&= Substitutes the logical AND of the left and right expressions into the left expression.

Functions

ABS(expression)	Returns the absolute value of the expression.
LN(expression)	Returns the natural logarithm of the expression.
LOG(expression)	Returns the common logarithm of the expression.
SQRT(expression)	Returns the square root of the expression.
SIN(expression)	Returns the sine of the expression.
COS(expression)	Returns the cosine of the expression.
TAN(expression)	Returns the tangent of the expression.
ASIN(expression)	Returns the arc sine of the expression.
ACOS(expression)	Returns the arc cosine of the expression.
ATAN(expression)	Returns the arc tangent of the expression.
SINH(expression)	Returns the hyperbolic sine of the expression.
COSH(expression)	Returns the hyperbolic cosine of the expression.
TANH(expression)	Returns the hyperbolic tangent of the expression.
TRUNC(expression)	Returns an integer with the fraction truncated.
FLOOR(expression)	Returns the maximum integer less than the expression.
ISNAN(expression)	Returns 1 if the expression is NAN, otherwise returns 0.
ISINF(expression)	Returns -1 if the expression is -INF, returns 1 if the expression is +INF, otherwise returns 0.
RAND()	Returns a random number between 0 and 1.
EDGE(expression)	Returns 1 if the expression changes from false to true, otherwise returns 0.
NEDGE(expression)	Returns 1 if the expression changes from true to false, otherwise returns 0.

Comments

Text written from // to the end of the line are not evaluated. You can write comments after //.

White Spaces

Any number of spaces or tabs can be inserted between a variable, constant, function, or operator.

Limitations to Expressions

An expression can contain up to 256 elements such as variables, constants, functions, and operators. An error will occur if an expression containing more than 256 elements is selected.

9.1 Storing Measurement Results

Procedure

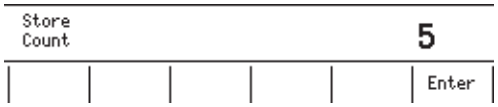
1. Press **SHIFT+STORE(CONFIG)** to display the STORE menu.

Setting the Store Count

2. Press the **Count** soft key to display the store count setup screen.

3. Use the **rotary knob** or **numeric keys&< >** to set the store count.

If you use the numeric keys, press the **Enter** soft key to confirm the setting.



Turning ON/OFF the Result File (Result.csv) Generation Function

4. Press **MakeFile** soft key to select On or Off.

Starting the Storage Operation

5. Press **STORE**. The storage operation starts and the **STORE** key illuminates.

Stopping the Storage Operation

6. Pressing **STORE** again after the storage operation is started stops the operation. The **STORE** key turns OFF.

Explanation

Store Count

The specified number of points of measured results is stored.
Selectable range: 1 to 100000

Turning ON/OFF the Result File (Result.csv) Generation Function

If turned On, the contents in the storage memory will be stored to a result file when the storage operation is completed. The result file (Result.csv) is a text file in CSV format. It is stored on the GS820RAM disk. If the sweep count exceeds 100000 points, the first 100000 points are saved.

Note

GS820RAM is a volatile memory. When the GS820 is turned OFF, the stored files are lost. If you want to save the result files, copy them to a different directory before you turn the GS820 OFF.

Stopping the Storage Operation

After storing the specified number of points, the storage operation automatically stops.

Stopping the Storage Operation

You can stop the storage operation before the specified number of points is reached by pressing STORE. The results until the storage operation was stopped are saved in the result file on the GS820RAM disk.

<<Corresponding Command Mnemonic>>

```
:TRACe[:STATe] 1|0|ON|OFF
:TRACe:FILE:CREate 1|0|ON|OFF
:TRACe:POINts <integer>|MINimum|MAXimum
```

9.2 Recalling Statistical Computation Values

Procedure

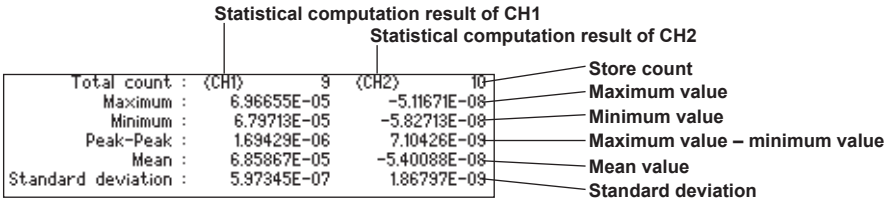
1. Press **SHIFT+STORE(CONFIG)** to display the STORE menu.

2. Press the **Recall** soft key to display the statistical computation values on the measured values of the most recent stored result.

Explanation

Statistical Computation Parameters

The following statistical computation parameters are displayed.CH1 and CH2 are displayed simultaneously.



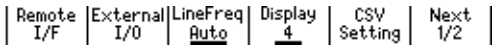
<<Corresponding Command Mnemonic>>

```
:TRACe:CHANnel<n>:ACTual?
:TRACe:CHANnel<n>:DATA:FORMat ASCii|BINary
:TRACe:CHANnel<n>:DATA:ENDian LITTle|BIG
:TRACe:CHANnel<n>:DATA:READ? [TM|DO|DI|SF|SL|MF|ML|LC|HC|CP]
:TRACe:CHANnel<n>:STATistics?
```

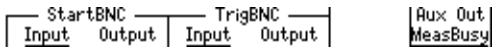
10.1 Setting the BNC I/O Terminal (START IN/OUT, TRIGGER IN/OUT)

Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **External I/O** soft key to display the External I/O menu.



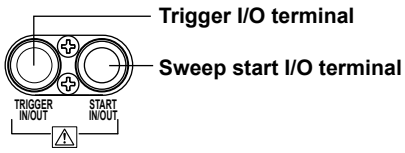
3. Set the signal direction of the sweep start I/O terminal by selecting Input or Output on the StartBNC menu.

4. Set the signal direction of the trigger I/O terminal by selecting Input or Output on the TrigBNC menu.

Explanation

The GS820 can transmit or receive sweep start and trigger through the BNC I/O terminals (TRIGGER IN/OUT and START IN/OUT) on the rear panel. You can assign input or output on each terminal.

BNC I/O Terminals



Signal Direction

StartBNC

- Input
  Receives sweep start. This is the same signal as START IN of the input terminal for synchronous operation (SYNC IN) on the rear panel. The falling edge functions in the same manner as the START key.
- Output
  Transmits the sweep start of the GS820. This is the same signal as START OUT of the output terminal for synchronous operation (SYNC OUT) on the rear panel.

TrigBNC

- Input
  Receives triggers. This is the same signal as TRIG IN of the input terminal for synchronous operation (SYNC IN) on the rear panel. The falling edge functions in the same manner as the TRIG key.
- Output
  Transmits the trigger of the GS820. This is the same signal as TRIG OUT of the output terminal for synchronous operation (SYNC OUT) on the rear panel.

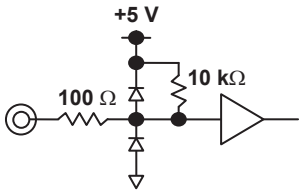
Input Section (TRIGGER IN and START IN)

Input level: TTL level

Input logic: Negative logic, falling edge

Minimum pulse width: 10 μs or greater

- **Input Circuit**



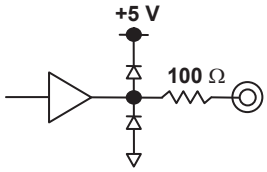
Output Section (TRIGGER OUT and START OUT)

Output level: TTL level

Output logic: Negative logic, falling edge

Minimum pulse width: Approx. 10 μs

- **Output Circuit**



CAUTION

- Do not apply a voltage exceeding the TTL level to the input.
- Do not short or apply external voltage to the output.

<<Corresponding Command Mnemonic>>

```
:ROUTe:BNC:STARt INPut|OUTPut
:ROUTe:BNC:TRIGger INPut|OUTPut
```

10.2 Pin Assignments of the External I/O Connector (EXT I/O)

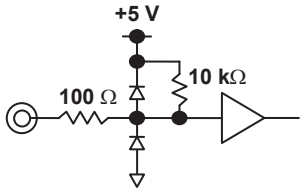
There are no I/O settings for the external I/O connector (EXT I/O) of the rear panel that you specify on the GS820 screen. Make connections according to the pin assignments given below.

Input Section

Input level: TTL level

Input logic: Negative logic (interlock input)

- **Input Circuit**

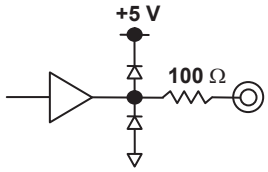


Output Section

Output level: TTL level

Output logic: Negative logic (comparison complete signal and comparison result signal)

- **Output Circuit**

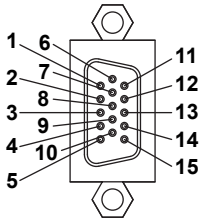


CAUTION

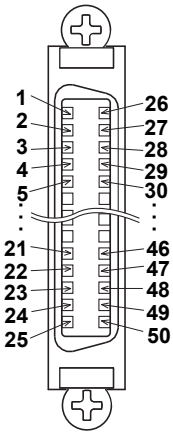
- Do not apply a voltage exceeding the TTL level to the input.
- Do not short or apply external voltage to the output.

Pin Assignments

765601



765602



Signal Names and Functions

Signal Name	Function	Signal Type	Active	Pin No. (765601)[4]	Pin No. (765602)
CH1 END	CH1 comparison complete (low at measurement end, high at the next measurement start)	Pulse	↓	Pin 2	Pin 6
CH1 LOW	CH1 comparison result LOW (measured result < min. value)	Level	Lo	Pin 3	Pin 7
CH1 IN	CH1 comparison result IN (min. value ≤ measured result ≤ max. value)	Level	Lo	Pin 4	Pin 8
CH1 HIGH	CH1 comparison result HIGH (max. value < measured value)	Level	Lo	Pin 5	Pin 9
CH2 END	CH2 comparison complete (low at measurement end, high at the next measurement start)	Pulse	↓	Pin 7	Pin 10
CH2 LOW	CH2 comparison result LOW (measured result < min. value)	Level	Lo	Pin 8	Pin 11
CH2 IN	CH2 comparison result IN (min. value ≤ measured result ≤ max. value)	Level	Lo	Pin 9	Pin 12
CH2 HIGH	CH2 comparison result HIGH (max. value < measured value)	Level	Lo	Pin 10	Pin 13
DO0	Digital output	Level	Lo[3]	Pin 12	Pin 34
DO1	Digital output	Level	Lo[3]	Pin 6	Pin 35
DO2[1]	Digital output	Level	Lo[3]		Pin 36
DO3[1]	Digital output	Level	Lo[3]		Pin 37
DO4[1]	Digital output	Level	Lo[3]		Pin 38
DO5[1]	Digital output	Level	Lo[3]		Pin 39
DO6[1]	Digital output	Level	Lo[3]		Pin 40
DO7[1]	Digital output	Level	Lo[3]		Pin 41
DO8[1]	Digital output	Level	Lo[3]		Pin 43
DO9[1]	Digital output	Level	Lo[3]		Pin 44
DO10[1]	Digital output	Level	Lo[3]		Pin 45
DO11[1]	Digital output	Level	Lo[3]		Pin 46
DO12[1]	Digital output	Level	Lo[3]		Pin 47
DO13[1]	Digital output	Level	Lo[3]		Pin 48
DO14[1]	Digital output	Level	Lo[3]		Pin 49
DO15[1]	Digital output	Level	Lo[3]		Pin 50
DI0	Digital input	Level	Lo[3]	Pin 13	Pin 16
DI1	Digital input	Level	Lo[3]	Pin 11	Pin 17
DI2[1]	Digital input	Level	Lo[3]		Pin 18
DI3[1]	Digital input	Level	Lo[3]		Pin 19
DI4[1]	Digital input	Level	Lo[3]		Pin 20
DI5[1]	Digital input	Level	Lo[3]		Pin 21
DI6[1]	Digital input	Level	Lo[3]		Pin 22
DI7[1]	Digital input	Level	Lo[3]		Pin 23
DI8[1]	Digital input	Level	Lo[3]		Pin 25
DI9[1]	Digital input	Level	Lo[3]		Pin 26
DI10[1]	Digital input	Level	Lo[3]		Pin 27
DI11[1]	Digital input	Level	Lo[3]		Pin 28
DI12[1]	Digital input	Level	Lo[3]		Pin 29
DI13[1]	Digital input	Level	Lo[3]		Pin 30
DI14[1]	Digital input	Level	Lo[3]		Pin 31
DI15[1]	Digital input	Level	Lo[3]		Pin 32
ILOC	Interlock input	Level	Lo	Pin 14	Pin 14
GND	Signal ground			Pin 15	Pin 24
GND	Signal ground				Pin 33
GND	Signal ground				Pin 42
RXD[2]					Pin 1
TXD[2]					Pin 2
232-GND[2]					Pin 3
RTS[2]					Pin 4
CTS[2]					Pin 5

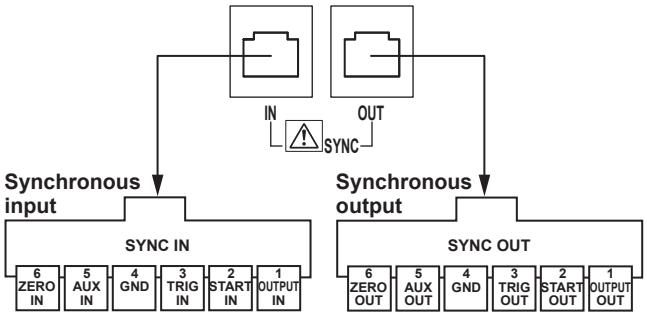
1 Only on the digital input model (765602)
2 RS-232 interface port
3 A digital outputs transmits a low signal if 1 is written in the corresponding bit in a program file. If a low signal is received in a digital input, the corresponding bit will be 1 in the result file.
4 Pin 1 is not used on the 765601.

10.3 Synchronous Operation

The I/O terminals for synchronous operation on the rear panel allow multiple GS820s to be connected and operated in synchronization.

I/O Terminals for Synchronous Operation

There are two RJ-11 connectors, one for input and another for output.



Pin Assignments

Pin No.	SYNC IN (Synchronous Input)	SYNC OUT (Synchronous Output)
1	OUTPUT IN (output control input)	OUTPUT OUT (output control output)
2	START IN (sweep start input)	START OUT (sweep start output)
3	TRIG IN (trigger input)	TRIG OUT (trigger output)
4	GND	GND
5	AUX IN (auxiliary trigger input)	AUX OUT (auxiliary trigger output)
6	ZERO IN (zero source control input)	ZERO OUT (zero source control output)

When two wires are connected
When four wires are connected
When six wires are connected

Connecting the GS820s

A synchronous operation cable (758960, 6-wire) or a commercially sold cable for the RJ-11 connector is used to connect between two GS820s. Synchronous operation becomes possible by connecting the synchronous operation output of a higher level GS820 to the synchronous operation input of a lower level GS820. Note that commercially sold RJ-11 straight cables come in three types: 2-wire, 4-wire, or 6-wire. Depending on the cable that is used, functions that can be synchronized vary as follows:

- When using a 2-wire straight cable: Only the trigger is synchronized.
- When using a 4-wire straight cable: Start, trigger, and auxiliary trigger are synchronized.
- When using a 6-wire straight cable: Start, trigger, auxiliary trigger, and output state are synchronized.

If you use 6-wire straight cables between GS820s and set the highest level GS820 to master and other lower level GS820s to slaves, all channels of the connected GS820s are synchronized. For the procedure to set master and slave, see section 10.4, “Setting the Synchronization Mode between Units.” You can also set synchronous or asynchronous between channels of each GS820. For the procedure to set the inter-channel synchronization, see section 4.3, “Setting the Inter-Channel Synchronization Mode.”

Signal

OUTPUT IN (Output Control Input)
An output control input for CH1. This signal functions in the same way as the OUTPUT key. The output turns ON when a rising edge is applied and turns OFF when a falling edge is applied.

OUTPUT OUT (Output Control Output)
Transmits the output state of CH1. Transmits a high signal if the output is OFF and a low signal if the output or zero source is ON.

START IN (Sweep Start Input)
Generates a sweep start when a rising edge is applied.

START OUT (Sweep Start Output)
Transmits the SwpBusy condition of CH1. Transmits a low signal when a sweep start is generated and a high signal when the sweep operation ends.

TRIG IN (Trigger Input)
Generates a trigger when a rising edge is applied.

TRIG OUT (Trigger Output)
Transmits the SrcBusy condition of CH1. Transmits a low signal when a trigger is generated and a high signal when the source operation ends.

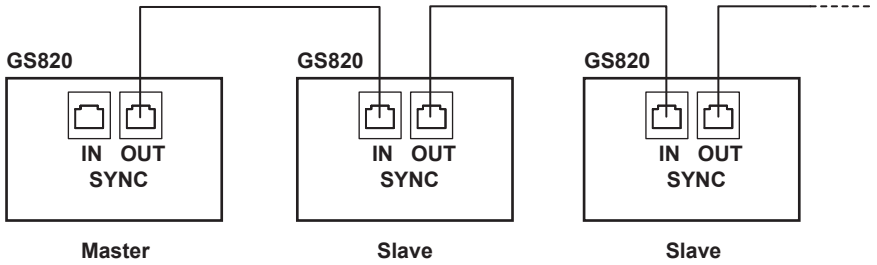
AUX IN (Auxiliary Trigger Input)
An auxiliary trigger input.

AUX OUT (Auxiliary Trigger Output)
An auxiliary trigger output. Select the auxiliary trigger source in advance.
For the procedure to select the auxiliary trigger source, see section 10.5, “Setting the Auxiliary Trigger Signal (AUX OUT).”

ZERO IN (Zero Source Control Input)
A control input for CH1 zero source. This signal functions in the same way as the ZERO key. The zero source turns ON when a rising edge is applied, and the output turns ON when a falling edge is applied.

ZERO OUT (Zero Source Control Output)
Transmits the zero source condition of CH1. Transmits a high signal if the output is OFF or ON and a low signal if the zero source is ON.

Note

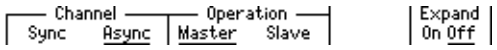


The maximum delay from START IN to START OUT, from TRIG IN to TRIG OUT, and from AUX IN to AUX OUT is less than or equal to 1 μs.
The maximum delay from OUTPUT IN to OUTPUT OUT and from ZERO IN to ZERO OUT is less than or equal to 20 ms.
There is no limitation on the number of slave units that can be connected. However, if you are using the channel expansion function (see section 10.6, “Channel Expansion Function”), the maximum number of slave units is four (10 channels total including the master unit).

10.4 Setting the Synchronous Mode between Units (Master and Slave)

Procedure

1. Press **SYNC** to display the SYNC menu.



2. On the Operation menu, press the Master or Slave soft key.

Explanation

In synchronous operation, the highest level GS820 is set to master and all subsequent GS820s to slave. The master and multiple slave units are synchronized to CH1 of the master unit.

Select the master or slave setting for synchronous operation.

Master: Set to master. Performs sweep start, trigger, and output control

Slave: Set to slave. Follows the sweep start, trigger, and output control that are received through the SYNC IN terminal (see section 10.3, “Synchronous Operation”).

The default setting is Master.

Note

If you want to also synchronize the operation of CH2, enable the inter-channel synchronization mode (see section 4.3, “Setting the Inter-Channel Synchronization Mode”).

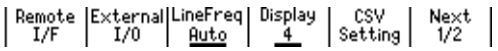
<<Corresponding Command Mnemonic>>

```
:SYNChronize:MODE MASTer|SLAVe
```

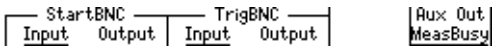
10.5 Setting the Auxiliary Trigger Source (AUX OUT)

Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.

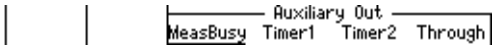


2. Press the **External I/O** soft key to display the External I/O menu.



Setting the Auxiliary Trigger Output Source

3. Press the **Aux Out** soft key to display the Auxiliary Out menu.



4. Press the soft key corresponding to the desired auxiliary trigger signal.

Explanation

Select the auxiliary trigger output source from the four types below. For details on the auxiliary trigger source, see “Block Diagram” in section 2.6, “Triggering” (page 2-25).

- **MeasBusy**
  Indicates measurement-in-progress. Transmits a low signal when the measurement operation starts and a high signal when the measurement operation ends.
- **Timer1**
  Generates a 10-μs low-edge pulse when Timer1 is generated.
- **Timer2**
  Generates a 10-μs low-edge pulse when Timer2 is generated.
- **Through**
  Passes through the auxiliary input signal without any change.

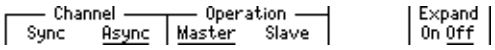
<<Corresponding Command Mnemonic>>

```
:ROUTe:AUXiliary SENSe|TIMer1|TIMer2|THRough
```

10.6 Channel Expansion Function

Procedure

1. Press **SYNC** on the master unit of the synchronous operation to display the SYNC menu.



2. Press **Expand** soft key to select On or Off.

Explanation

Preparations Necessary before Using the Channel Expansion Function

The IP address (see section 13.4, “Viewing the Network Settings”) of slave units must be specified on the master unit that has completed the synchronous operation setting. Create a file named NodeList.txt in the SETUP directory in the GS820ROM disk on the master unit (see “USB Storage Function” on page 2-34) Write the IP address of each slave unit separating each IP address with a line feed (CR+LF) in the NodeList.txt file. Up to five units including the master unit (10 channels) can be connected in this way.

Example of a NodeList.txt file when five units are connected and the number of channels is expanded to 10

192.168.0.55 //CH3, 4
192.168.0.19 //CH5, 6
192.168.0.76 //CH7, 8
192.168.0.87 //CH9, 10

Note

- Be sure to name the file containing the IP addresses to NodeList.txt.
- Check that all GS820s are connected to the network before turning the channel expansion function ON. If any of the slave units is not connected properly, an error occurs when the channel expansion function is turned ON, and the function automatically turns OFF.

Execution of the Channel Expansion Function and Generation of a Result File

If a pattern file containing patterns for up to 10 channels is loaded into the master unit in programmable sweep mode (page 2-20), the master unit automatically distributes and loads the pattern file into each slave unit. After turning ON the storage function of the master unit (see section 9.1, “Storing Measured Results”), start the sweep operation on the master unit (see section 6.5, “Starting the Sweep”). After the storage operation is completed, a result file (Result.csv) containing the data of all expanded channels is generated on the GS820RAM disk of the master unit.

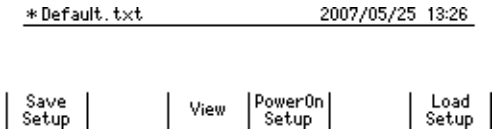
<<Corresponding Command Mnemonic>>

`:SYNChronize:EXPand`

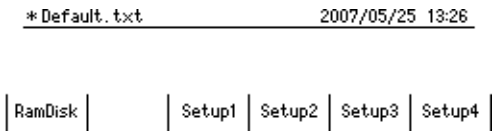
11.1 Saving the Setup Data

Procedure

1. Press **SETUP** to display the saved files and the SETUP menu.



2. Press the **Save Setup** soft key. The menu (RamDisk) for saving to the volatile disk (GS820RAM) and the menu (Setup1 to Setup4) for saving to the non-volatile disk (GS820ROM) are displayed.

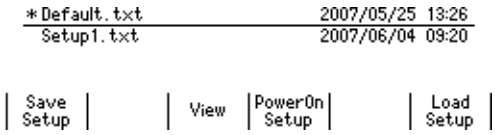


Saving to the Volatile Disk (GS820RAM)

3. Press the **RamDisk** soft key. While saving, the characters of the RamDisk soft key is highlighted.
   When the save operation is completed, the display returns to the SETUP menu.

Saving to the Non-Volatile Disk (GS820ROM)

3. Press any of the **Setup1 to Setup4** soft keys. While saving, the characters of the soft key that you pressed is highlighted.
   When the save operation is completed, the display returns to the SETUP menu.



Explanation

Saving to the Volatile Disk (GS820RAM)

A setup file (Setup.txt) is saved in the GS820RAM. If a setup file already exists, it is overwritten.
This setup file is used to transfer the file to a PC.

Saving to the Non-Volatile Disk (GS820ROM)

A setup file (Setup1 to Setup4.txt) is saved in the SETUP folder in the GS820ROM. If a setup file with the same number already exists, it is overwritten.

Note

- The setup file is a text file containing a sequence of command mnemonics. You can edit the contents on your PC.
- The file stored in the SETUP directory on the GS820ROM can be renamed on your PC. However, do not rename the default setup file (Default.txt).

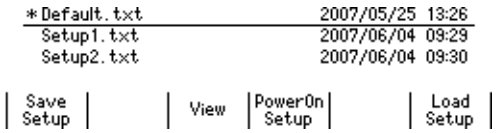
<<Corresponding Command Mnemonic>>

```
:SYSTem:SETup:SAVE <character string>
*SAV 1|2|3|4
```

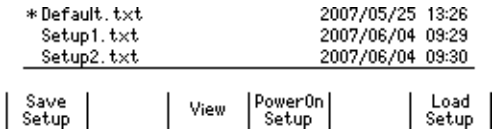
11.2 Loading the Setup Data

Procedure

1. Press **SETUP** to display the SETUP menu.



2. Use the **rotary knob** and **< >** to move the cursor (underline) vertically and select a setup file to be loaded.
   View soft key allows you to view the contents of the selected setup file.



3. Press the **Load Setup** soft key.
   The setup file is loaded, and the display returns to the numeric display.

Explanation

A saved setup file can be loaded to restore the settings.

Note

Loading the Default.txt file sets the GS820 to factory default settings. For details on the Default.txt file, see appendix 18.6, “Contents of the Factory Default Setup File (Default.txt).”

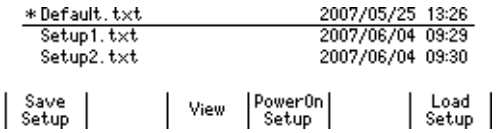
<<Corresponding Command Mnemonic>>

```
:SYSTem:SETup:LOAD <character string>
*RCL 1|2|3|4
*RST
```

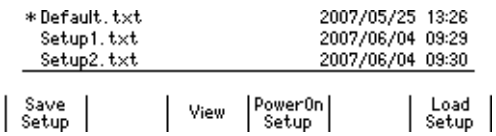
11.3 Selecting the Settings Applied at Power-ON

Procedure

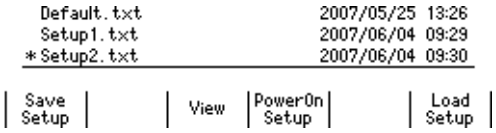
1. Press **SETUP** to display the SETUP menu.



2. Use the **rotary knob** and **< >** to move the cursor (underline) vertically and select a setup file that is applied when the GS820 is turned ON.
View soft key allows you to view the contents of the selected setup file.



3. Press the **PowerOnSetup** soft key.
An asterisk is appears by the selected setup file.



Explanation

The setup files are the files that are saved in section 11.1, “Saving the Setup Data” and the factory default setup file (Default.txt). If Default.txt is selected, the GS820 powers on with the factory default settings.

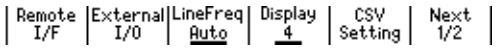
<<Corresponding Command Mnemonic>>

```
:SYSTem:SETup:PON <character string>
```

11.4 Selecting the Display Brightness and Turning the Display OFF

Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **Display** soft key to show the DISPLAY menu.

Selecting the Display Brightness

3. Press the soft key corresponding to the desired brightness.

Turning the Display OFF

3. Press the **Off Exec** soft key. The display is turned OFF, and the SHIFT key blinks until the display is turned ON again. To turn the display back ON, press any key or turn the **rotary knob**.

Explanation

Selecting the Display Brightness

You can select the display brightness in the range of 1 to 4. The darkest setting is 1, and the brightest setting is 4.

Turning the Display OFF

Turning the display OFF extends the life of the display and suppresses the noise that the display generates. In addition, the communication speed improves slightly.

Note

The settings are retained even if the GS820 is turned OFF.

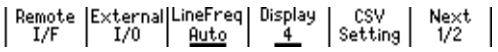
<<Corresponding Command Mnemonic>>

```
:SYSTem:DISPlay[:STATe] 1|0|ON|OFF
:SYSTem:DISPlay:BRIGht <integer>|MINimum|MAXimum|UP|DOWN
```

11.5 Selecting the CSV File Format

Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **CSV Setting** soft key to display a menu for selecting the CSV file format.

3. Press the **DecPoint** or **Separate** soft key to select the CSV file format.
The two soft keys are linked.

Explanation

The following format combinations are available.

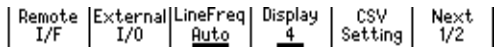
- The decimal point is a period, and the separator is a comma.
- The decimal point is a comma, and the separator is a semicolon.

The default setting is the combination of a period and a comma.

11.6 Turning the Beep Sound ON/OFF

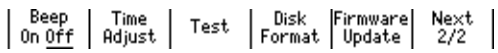
Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **Next 1/2** soft key.

3. Press **Beep** soft key to select On or Off.



Explanation

If the beep sound is turned ON, a beep sound is generated such as when an error occurs during operation.

Note

The setting is retained even if the GS820 is turned OFF.

<<Corresponding Command Mnemonic>>

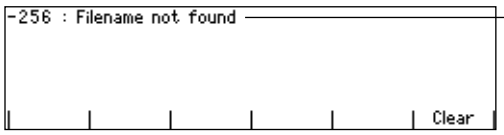
```
:SYSTem:BEEPer 1|0|ON|OFF
```

11.7 Error Log Display

Procedure

Error Log Display

1. Press **ERROR** to display the error log menu.



Clearing the Error Log Display

2. Press the **Clear** soft key to clear the error log.

Explanation

The ERROR key illuminates if an error such as a runtime error or communication command error is stored in the error memory.
The error log displays errors and messages. An error has an associated error number, and a message does not.
A message is displayed in the error log until the problem indicated by the message is resolved. It is not cleared even if the Clear soft key is pressed.
For the meaning and corrective action of errors, see section 17.2, “Error Code Description and Corrective Action.”

Note

- The error memory is also cleared if the error is read using a communication command (“`:SYSTem:ERRor?`”) or if the GS820 is turned OFF. You can also clear the error memory by sending the `*CLS` communication command.
- If the error memory becomes full, “`-350: Queue overflow`” is entered as the last error indicating that any addition errors will be discarded. If the error memory is cleared, the error indicator turns OFF.

<<Corresponding Command Mnemonic>>

```
:SYSTem:ERRor?
*CLS
```

11.8 Key Lock

Procedure

Turning the Key Lock ON

Press **SHIFT** and **+/-(KEY LOCK)**. The key lock turns ON, and the KEY LOCK indicator to the left of the display illuminates. After the key lock is turned ON, all keys are disabled except for the power switch and the **SHIFT** and **+/-(KEY LOCK)** key.

Turning the Key Lock OFF

Press **SHIFT** and **+/-(KEY LOCK)** when key lock is ON. The key lock turns OFF, and the KEY LOCK indicator turns OFF. All keys are enabled.

Explanation

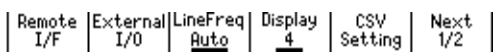
<<Corresponding Command Mnemonic>>

```
:SYSTem:KLOCk 1|0|ON|OFF
```

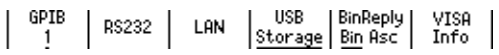
11.9 Selecting the Loading Data Type for the Communication Command

Procedure

1. Press the **SHIFT** + **SETUP(MISC)** keys. The MISC menu appears.



2. Press the **Remote I/F** soft key. The Remote I/F menu appears.



3. Press the **BinReply** soft key, then select Bin or Asc.

Explanation

Normally this setting is not available. With the channel expansion function, if you have a GS820 of firmware revision 1.09 or later as a slave device and a GS820 of firmware revision 1.08 or earlier as the master device, use this setting to specify a data type of ASCII.

Relationship with the :TRACe:CHANnel<n>:DATA:FORMat command (see page 1 of this notice of alterations).

If you use this setting to specify the data type to ASCII, and then use the `:TRACe:CHANnel<n>:DATA:FORMat` command to set the data format to binary and then load stored data, the data is loaded as the text string when text is specified (see page 2 of this notice of alterations). In all other cases, the stored data is loaded in the data format specified with the `:TRACe:CHANnel<n>:DATA:FORMat` command.

Note

- When using the channel expansion function, it is recommended to use the latest firmware version for both the master and slave devices.

<<Supported command mnemonic>>

`:TRACe:BINary:REPLy BINary|ASCii`

12.1 USB Interface Functions and Specifications

USB Interface Functions

USB Storage Function

The two disks, GS820ROM and GS820RAM, can be accessed as external removable disks on your PC (see section 4.6, “USB Storage Function”).

Command Control Function by Way of USB-TMC

The GS820 can be controlled using commands from a VISA (Virtual Instrument Software Architecture) library. A VISA library must be installed in your PC in advance to perform command control by way of USB-TMC.

USB Interface Specifications

Electrical and mechanical specifications: Conforms to USB Rev. 2.0
Connector: Type B connector (receptacle)
Number of ports: 1
Power supply: Self-powered

Connecting to the Network

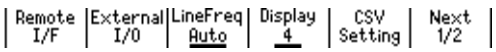
Connection Cable

Use a USB cable for the type B connector (receptacle). For the connection procedure, see section 4.6, “USB Storage Function.”

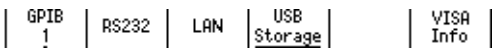
12.2 Selecting the USB Interface Function

Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.

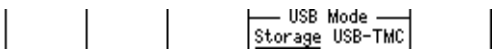


2. Press the **Remote I/F** soft key to display the Remote I/F menu.



Selecting the USB Interface Function

3. Press the **USB** soft key to display the USB menu.



4. Press the soft key corresponding to the desired USB interface function.

Explanation

Selecting the USB Interface Function

Storage

Select this to use the USB storage function (see section 4.6, “USB Storage Function”).

USB-TMC

Select this to perform command control from a VISA library.

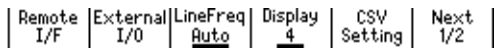
<<Corresponding Command Mnemonic>>

```
:SYSTem:COMMunicate:USB:FUNCtion STORage|TMC
```

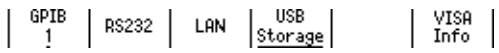
12.3 Viewing the VISA Setup Information

Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **Remote I/F** soft key to display the Remote I/F menu.



Viewing the VISA Information

3. Press the **VISA Info** soft key to display the network setup information that is necessary for communications using a VISA library.

Explanation

VISA information contains the character string that is passed to open a device (viOpen()) using a VISA library.

GPIB: A character string that is passed to viOpen() when using the GP-IB interface.

RS232: A character string that is passed to viOpen() when using the RS232 interface. The x in ASRLx is the COM port number to be used on your PC.

LAN: A character string that is passed to viOpen() when using the VXI-11 protocol of Ethernet.

USB: A character string that is passed to viOpen() when using the USB-TMC protocol.

13.1 Ethernet Interface Functions and Specifications

Ethernet Interface Functions

VXI-11 Server Function

A command mnemonic stream parsing server based on the VXI-11 protocol at port 111 that allows up to five clients to connect.

Command control server function:
A command mnemonic stream parsing server at port 7655 that allows up to five clients to connect.
The terminator (CR, LF, or CR+LF) can be specified.

FTP server function: An anonymous FTP server at port 21 that allows up to five clients to connect.

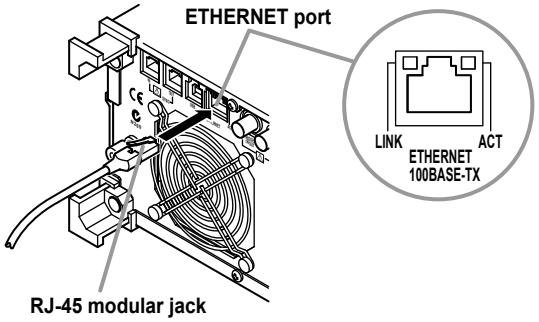
HTTP server function: A function that enables various information to be displayed and performs remote control of the GS820 through port 80 using a Web browser.

Ethernet Interface Specifications

Connector type: RJ-45
Number of ports: 1
Electrical and mechanical specifications:
Conforms to IEEE 802.3
Transmission system: 100BASE-TX/10BASE-T
Maximum data rate: 100 Mbps
Protocol: TCP/IP

13.2 Connecting to the Network

Connect a UTP (Unshielded Twisted-Pair) cable or an STP (Shielded Twisted-Pair) cable that is connected to a hub, for example, to the 100BASE-TX port on the rear panel of the GS820.



ACT indicator
Blinks when packet transmission is in progress.

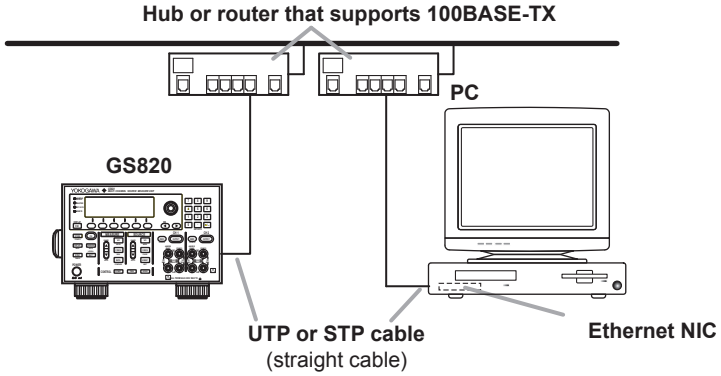
LINK indicator
Illuminates when the link between the port on the GS820 and the connected device is established and communication is mutually possible.

Connection Cable

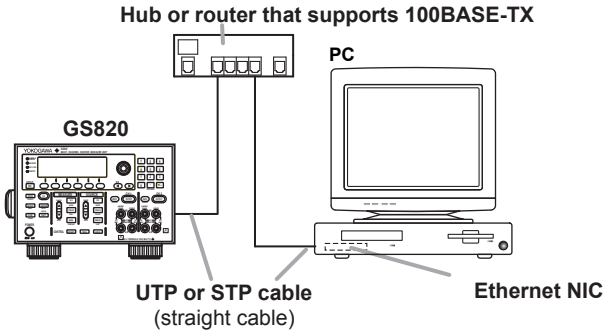
Use either of the following cables to make the connection.

- UTP (Unshielded Twisted-Pair) cable (category 5 or better)
- STP (Shielded Twisted-Pair) cable (category 5 or better)

To Connect to Your PC on a Network



To Make a One-to-One Connection with Your PC



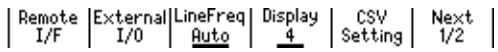
Note

- When using a UTP cable or STP cable (straight cable), be sure to use a category 5 or better cable.
- Avoid connecting your PC directly to the GS820 without going through the hub or router. Operations are not guaranteed for communications using direct connection.

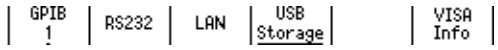
13.3 Setting the Network (TCP/IP)

Procedure

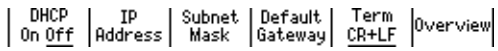
1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **Remote I/F** soft key to display the Remote I/F menu.



3. Press the **LAN** soft key to display the LAN menu.



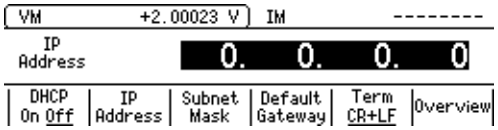
Turning DHCP ON/OFF

4. Press **DHCP** soft key to select On or Off.

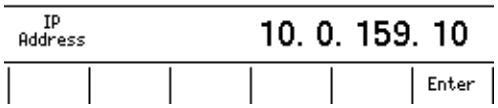
Setting the IP Address

You can set the IP address only if DHCP is OFF.

5. Press the **IP Address** soft key to display the IP address setup screen.



6. Press the **numeric keys** to set the IP address.

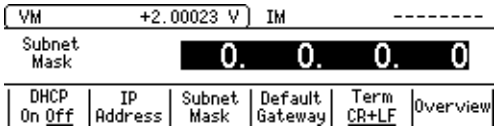


7. Press the **Enter** soft key to confirm the setting.

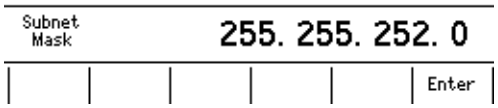
Setting the Subnet Mask

You can set the subnet mask only if DHCP is OFF.

5. Press the **SubNet Mask** soft key to display the subnet mask setup screen.



6. Press the **numeric keys** to set the subnet mask.

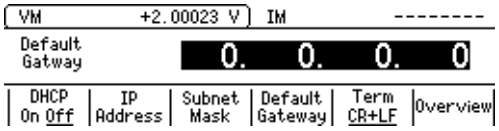


7. Press the **Enter** soft key to confirm the setting.

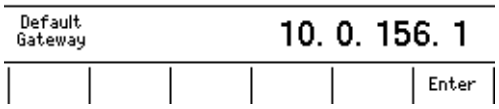
Setting the Default Gateway

You can set the default gateway only if DHCP is OFF.

5. Press the **Default Gateway** soft key to display the default gateway setup screen.



6. Press the **numeric keys** to set the default gateway.



7. Press the **Enter** soft key to confirm the setting.

Setting the Transmission Terminator

You can set the transmission terminator only if DHCP is OFF.

5. Press the **Term** soft key to display the Terminator menu.

6. Press the soft key corresponding to the desired terminator.

Explanation

To use the network function of the GS820, the TCP/IP parameters must be configured.

DHCP (Dynamic Host Configuration Protocol)

DHCP is a protocol that allocates settings that are temporarily needed to PCs connecting to the network. If DHCP is turned ON, the following settings will be automatically assigned.

IP address
Subnet mask
Default gateway

- To use DHCP, the network must have a DHCP server. Consult your network administrator to see if DHCP is available.
- If DHCP is turned ON, different settings may be assigned each time the power is turned ON. When accessing the GS820 from your PC, you must check the GS820 TCP/IP settings such as the IP address each time the power is turned ON.

IP Address (Internet Protocol Address)

- The IP address is a 32-bit value expressed using four octets (each 0 to 255), each separated by a period as in [192.168.111.24].
- Obtain an IP address from your network administrator.
- This parameter is automatically assigned in environments using DHCP.

Subnet Mask

- Consult your network administrator for the subnet mask value. You may not need to set the value.
- This parameter is automatically assigned in environments using DHCP.

Default Gateway

The default gateway setting is necessary to communicate between different subnets.

- Consult your network administrator for the default gateway value. You may not need to set the value.
- This parameter is automatically assigned in environments using DHCP.

Transmission Terminator

You can set the terminator that is used to send data from the command control server at port 7655.

- Select CR, LF, or CR+LF.
- The GS820 handles CR, LF, and CR+LF as a terminator when receiving data.

Note

- If you change the network settings, you may need to power cycle the GS820.
- Network parameters such as the IP address must be specified also on your PC. For details on the setup, check the manual (help) for your PC or consult your network administrator.

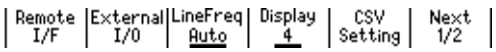
<<Corresponding Command Mnemonic>>

```
:SYSTem:COMMunicate:ETHer:DHCP 1|0|ON|OFF
:SYSTem:COMMunicate:ETHer:IP <character string>
:SYSTem:COMMunicate:ETHer:MASK <character string>
:SYSTem:COMMunicate:ETHer:GATE <character string>
:SYSTem:COMMunicate:ETHer:TERMinator CR|LF|CRLF
```

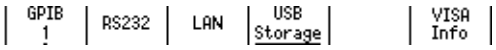
13.4 Viewing the Network Settings

Procedure

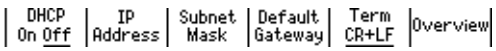
1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **Remote I/F** soft key to display the Remote I/F menu.

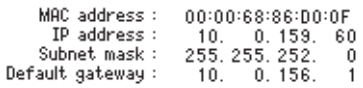


3. Press the **LAN** soft key to display the LAN menu.



Viewing the Network Settings

4. Press the **OverView** soft key to display the currently active network settings. If the settings have been changed after the GS820 was turned ON, the settings before the change are displayed until the power is cycled.



Explanation

You can view the following network settings.

- MAC address
  A unique 48-bit address assigned to the GS820.
- IP address (see section 13.3)
- Subnet mask (see section 13.3)
- Default gateway (see section 13.3)

Note

If DHCP is enabled, “0.0.0.0” will be displayed for the IP address, subnet mask, and default gateway until the addresses are assigned. If the display does not change even after 30 seconds elapses after the power is turned ON, the DHCP address assignment may have failed. If this happens, check that the Ethernet cable is connected correctly and that the LINK indicator of the 100BASE-TX port on the rear panel is illuminated, and power cycle the GS820.

13.5 Web Server Function

The Web server function on the GS820 links the Web browser on your PC to the GS820 and enables the GS820 to be controlled from the Web browser window. The following functions are available.

- **Remote panel function**
  Set or control the GS820 using the keys on the remote panel.
- **Command control function**
  Set or query the GS820 by sending communication commands from the command control screen.
- **Communication environment display**
  View the communication parameters on the status display
- **FTP server function**
  View the files on the GS820 volatile memory (GS820RAM) or non-volatile memory (GS820ROM) and transmit or copy files to your PC.

Environment on the GS820

Connect the GS820 to the network using the Ethernet interface. For the connection procedure, see section 13.2. For details on network settings, see section 13.3.

Preparations on Your PC

Logging into the Web Server (GS820)

1. Start Internet Explorer.
2. Type the IP address name of the GS820 in the Address box, and press ENTER.
   IP address example http://10.0.159.30/
3. If a connection to the GS820 Web server is established, the top page of the GS820 Web Service is displayed.

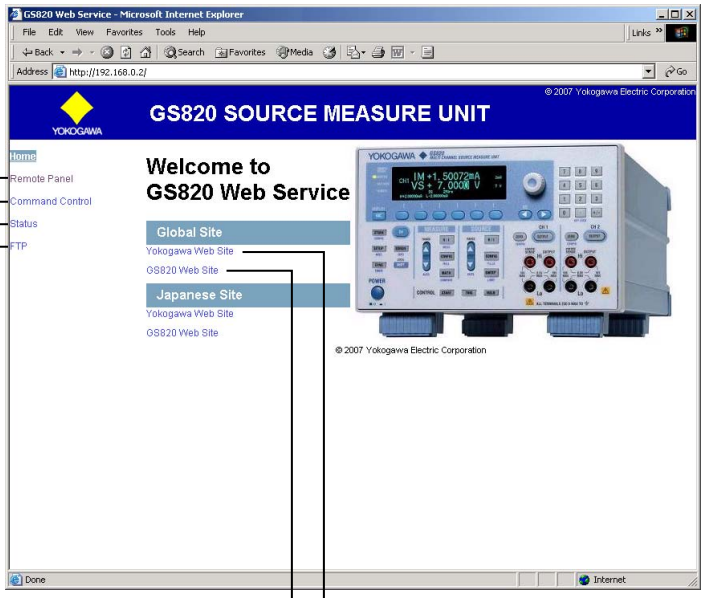
Web Server Window

FTP server function

Communication environment display

Command control function

Remote panel function



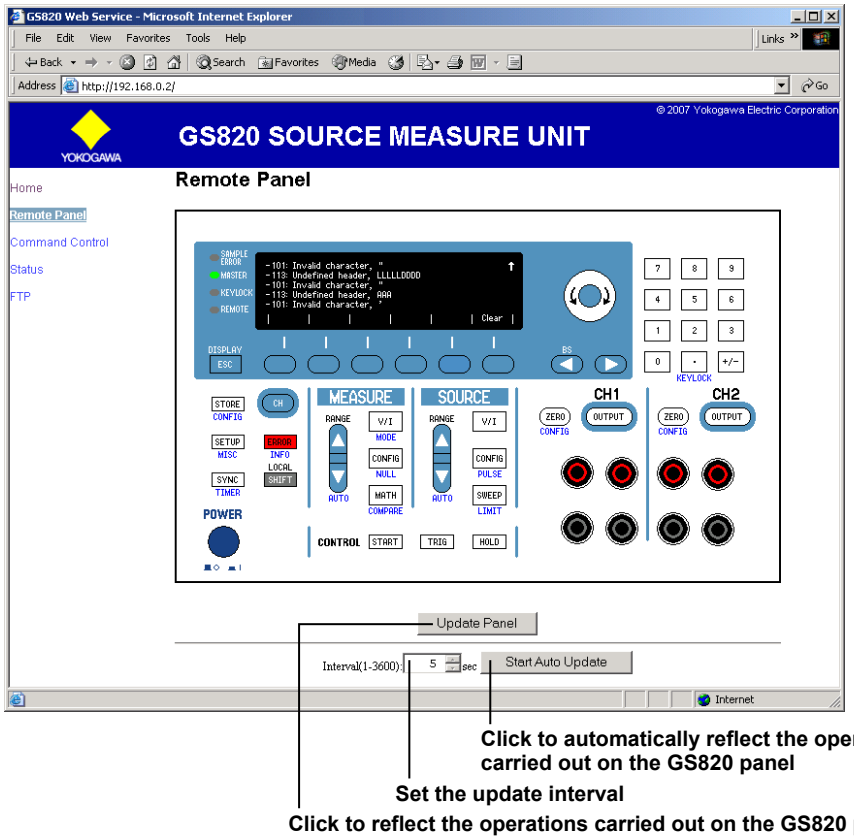
Link to the top page of the YOKOGAWA website

Link to the GS820 page of the YOKOGAWA website

Using the Web Server Function

Remote Panel Function

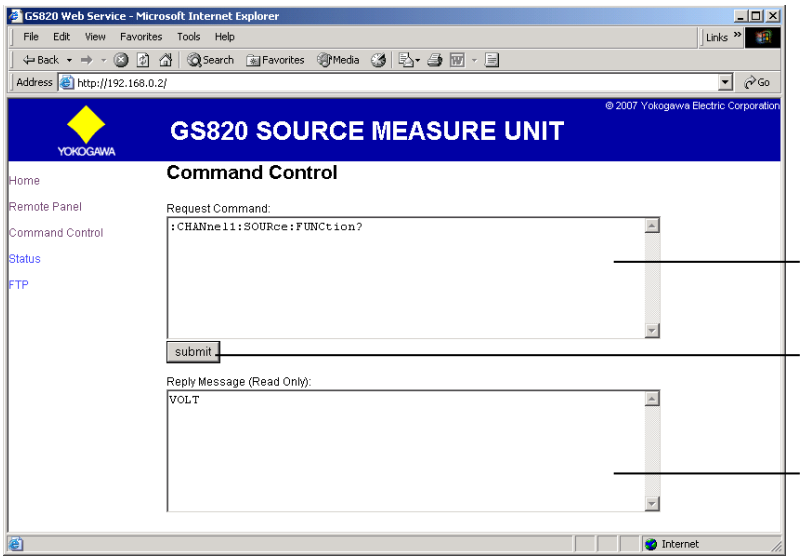
Click the words “Remote Panel” in the Web server window to display a front panel image of the GS820.



The GS820 can be controlled in the same manner as using the actual keys on the GS820. Point the cursor to the desired key and click. The operation on the remote panel is immediately applied to the GS820. To reflect the operations on the GS820 to the remote panel, click Update Panel in the Web server window. Click Start Auto Update to automatically apply the operations on the GS820 to the remote panel at the interval specified in the Interval box.

Command Control Function

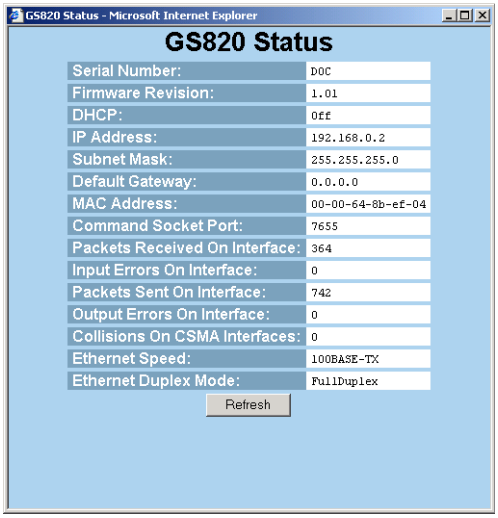
Click the words “Command Control” in the Web server window to display the command control page.



You can send communication commands from the command control window that is displayed in the remote panel to set or query the GS820. Type the communication command in the command transmission area, and click Submit. The response to the transmitted communication command is displayed in the response display area.

Displaying the Communication Environment

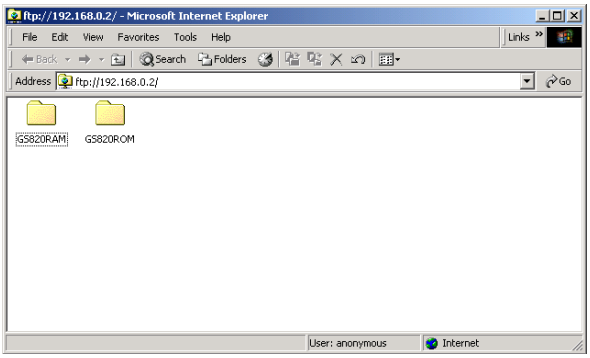
Click the word “Status” in the Web server window to display the communication environment page.



The communication environment of the GS820 is displayed. Press Refresh to update the displayed information.

FTP Server Function

Click the word “FTP” in the Web server window to display the FTP page.



The GS820 RAM folder and GS820ROM folder that are displayed are linked to the volatile memory (GS820RAM) and non-volatile memory (GS820ROM) on the GS820. The files in the GS820 memory can be viewed, duplicated, deleted, or transferred to your PC from the remote panel. For details on the volatile memory (GS820RAM) and non-volatile memory (GS820ROM), see “USB Storage Function” on page 2-34.

14.1 About the IEEE.488.2-1992 Standard

The GP-IB interface of the instrument conforms to the IEEE 488.2-1992 Standard. This standard specifies that the following 23 items be stated in the document. This section describes these items.

(1) Of the IEEE 488.1 interface functions, the subsets that are supported
See "GP-IB Interface Specifications" on page 14-3.

(2) The operation of the device when it is assigned an address outside the 0 to 30 range
The address of this instrument cannot be set to an address outside the 0 to 30 range.

(3) Reaction of the device when the user changes the address
The address change is detected when the address is set on the GP-IB Address menu (see section 14.4). The new address is valid until the next time it is changed.

(4) Device settings at power-up. The commands that can be used at power-up.
The settings selected in section 11.3, "Selecting the Settings Applied at Power ON." If you issue the RST common command, the GS820 always returns to the factory default settings.

(5) Message exchange options

(a) Input buffer size
64 KB.

(b) Queries that return multiple response messages
See the example of the commands given in section 16.2.

(c) Queries that create response data when the command syntax is being analyzed
All queries create response data when the command syntax is analyzed.

(d) Queries that create response data during reception
There are no queries of which the response data are created upon receiving a send request from the controller.

(e) Commands that have parameters that restrict one another
See the example of the commands given in section 16.2.

(6) Items that are included in the functional or composite header elements constituting a command
See sections 16.1 and 16.2.

(7) Buffer sizes that affect block data transmission
The buffer size of block data is 2 MB.

(8) A list of program data elements that can be used in equations and their nesting limitations
Equations cannot be used.

(9) Syntax of the responses to queries
See the example of the commands given in section 16.2.

(10) Communication between devices that do not follow the response syntax
Not supported.

(11) Size of the response data block
2 MB maximum.

(12) A list of supported common commands
See section 16.2.14, "Common Commands."

(13) Device condition after a successful calibration
The settings return to the conditions that existed before the calibration, measurements are terminated, and previous measured data are invalidated.

(14) The maximum length of block data that can be used for the *DDT trigger macro definition
Not supported.

(15) The maximum length of the macro label for defining macros, the maximum length of block data that can be used for the macro definition, and the process when recursion is used in macro definitions
Macro functions are not supported.

(16) Reply to the IDN? query
See section 16.2.14, "Common Commands."

(17) Size of storage area for protected user data for PUD and *PUD?
*PUD and *PUD? are not supported.

(18) The length of the *RDT and *RDT? resource names

*RDT and *RDT? are not supported.

(19) The change in the status due to *RST, *LRN?, *RCL, and *SAV

*RST, *RCL, and *SAV

See section 16.2.14, “Common Commands.”

*LRN?

This common command is not supported.

(20) The extent of the self-test using the *TST? command

Performs a test that is equivalent to the self-test that is executed from the front panel. Returns 0 if successful, otherwise returns an error code.

The self-test consists of the RAM test, ROM test, digital test, CH1 analog test, and CH2 analog test.

(21) The structure of the extended return status

See section 16.3.

(22) Whether each command is processed in an overlapped manner or sequentially

All commands are sequential commands.

(23) The description of the execution of each command

See the functional and procedural explanations given in chapters 1 to 15 and 17.

14.2 GP-IB Interface Functions and Specifications

GP-IB Interface Functions

Listener Capability

- All of the settings that you can set with the panel keys can be set through the GP-IB interface except for power ON/OFF and communication parameters.
- Receives commands from a controller that request the output of setup data, measured data, and the like.
- Also receives status report commands.

Talker Capability

Outputs setup information, measured data, and other information.

Note

Talk-only, listen-only, and controller functions are not available on this instrument.

Switching between Remote and Local Modes

When Switching from Local to Remote Mode

Receiving a REN (Remote Enable) message from the controller when the instrument is in the local mode causes the instrument to switch to the remote mode.

- The REMOTE indicator (see section 1.2) is turned ON.
- All keys other than the LOCAL key are locked.
- Settings entered in local mode are retained even when the GS820 switches to remote mode.

When Switching from Remote to Local Mode

Pressing the LOCAL key when the instrument is in the remote mode causes the instrument to switch to the local mode.

- The REMOTE indicator turns OFF.
- Key operations are enabled.
- Settings entered in remote mode are retained even when the GS820 switches to local mode.

GP-IB Interface Specifications

- **Electrical and Mechanical Specifications**
  Conforms to IEEE St'd 488-1987
- **Mechanical Specifications**
  See the table below.
- **Used Codes**
  ISO (ASCII) codes.
- **Mode**
  Addressable mode.
- **Address Selection**
  Set the address between 0 and 30 in the GP-IB address setting (see section 14.4) in the GP-IB Address menu.
- **Remote Mode Release**
  Clear remote mode by pressing LOCAL. However, key operations are invalid when Local Lockout is enabled by the controller.

Function	Subset Name	Description
Source handshaking	SH1	Full source handshaking capability
Acceptor handshaking	AH1	Full acceptor handshaking capability
Talker	T6	Basic talker capability, serial polling, untalk on MLA (My Listen Address), and no talk-only capability
Listener	L4	Basic listener capability, unlisten on MTA (My Talk Address), and no listen-only capability.
Service request	SR1	Full service request capability
Remote local	RL1	Full remote/local capability
Parallel polling	PP0	No parallel polling capability
Device clear	DC1	Full device clear capability
Device trigger	DT1	Full device trigger capability
Controller	C0	No controller capability
Electrical characteristics	E1	Open collector

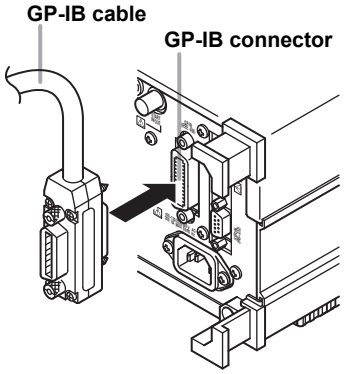
14.3 Connecting the GP-IB Cable

GP-IB cable

The GP-IB available on the GS820 is a 24-pin connector that conforms to the IEEE St'd 488-1987. Use a GP-IB cable that conforms to this standard.

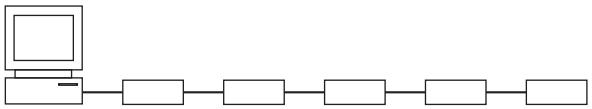
Connection Procedure

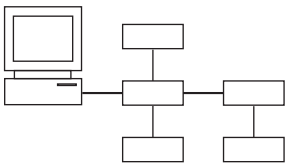
Connect the cable as shown below.



Precautions to Be Taken When Connecting the Cable

- Firmly tighten the screws on the GP-IB cable connector.
- Multiple devices can be connected to a single GP-IB system. However, no more than 15 devices (including the controller) can be connected to a single system.
- When connecting multiple devices, each device must have its own unique address.
- Use a cable of length 2 m or less for connecting the devices.
- Make sure the total length of all cables does not exceed 20 m.
- When communicating, have at least two-thirds of the devices turned ON.
- When connecting multiple devices, connect them in a star or linear configuration (see the figure below). Loop and parallel configurations are not allowed.

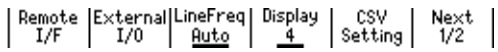




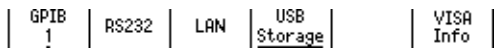
14.4 Setting the GP-IB Address

Procedure

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.

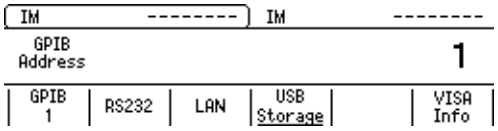


2. Press the **Remote I/F** soft key to display the communication menu.

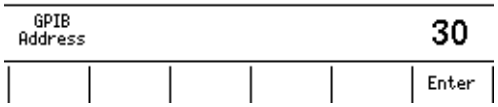


Setting the GP-IB address

3. Press the **GPIB** soft key.



4. Use the **rotary knob** or **numeric keys&< >** to set the GP-IB address.
   If you use the numeric keys, press the **Enter** soft key to confirm the setting.



Explanation

GP-IB Address

Each device that can be connected via GP-IB has a unique address within the GP-IB system. This address is used to distinguish the device from others. If you are connecting the GS820 to a controller such as a PC, select the GP-IB address of the GS820 on the PC side.

Selectable range: 0 to 30

<<Corresponding Command Mnemonic>>

```
:SYSTem:COMMunicate:GPIB:ADDRess <integer>
```

14.5 Responses to Interface Messages

What Are Interface Messages

Interface messages are also referred to as interface commands or bus commands. They are commands that are issued by the controller. They are classified as follows:

Uni-line Messages

A single control line is used to transmit uni-line messages. The following three types are available. IFC (Interface Clear), REN (Remote Enable), and IDY (Identify)

Multi-Line Messages

Eight data lines are used to transmit multi-line messages. The messages are classified as follows:

- **Address Commands**
  These commands are valid when the instrument is designated as a listener or as a talker. The following five commands are available.
  - Commands that are valid on an instrument that is designated as a listener
    GTL (Go To Local), SDC (Selected Device Clear), PPC (Parallel Poll Configure), and GET (Group Execute Trigger)
  - Commands that are valid on an instrument that is designated as a talker
    TCT (Take Control)
- **Universal Commands**
  These commands are valid on all instruments regardless of the listener and talker designations. The following five commands are available.
  LLO (Local Lockout), DCL (Device Clear), PPU (Parallel Poll Unconfigure), SPE (Serial Poll Enable), and SPD (Serial Poll Disable)

Other Interface Messages

Listener address, talker address, and secondary commands are also considered interface messages.

Difference between SDC and DCL

In multi-line messages, SDC messages are those that require talker or listener designation and DCL messages are those that do not require the designation. Therefore, SDC messages are directed at a particular instrument while DCL messages are directed at all instruments on the bus.

Responses to Interface Messages

Responses to Uni-Line Messages

- **IFC**
  Clears the talker and listener functions. Stops output if data is being output.
- **REN**
  Switches between the remote and local modes.
- **IDY**
  Not supported.

Responses to Multi-Line Messages (Address Commands)

- **GTL**
  Switches to the local mode.
- **SDC**
  - Clears the program message (command) being received and the output queue (see section 16.3.6).
  - The COMMunicate:WAIT command is immediately terminated.
- **GET**
  Same operation as the *TRG command.
- **PPC and TCT**
  Not supported.

Responses to Multi-Line Messages (Universal Commands)

- **LLO**
  Disables the LOCAL key on the front panel to prohibit switching to the local mode.
- **DCL**
  Same operation as the SDC message.
- **SPE**
  Sets the talker function on all devices on the bus to serial polling mode. The controller polls the devices in order.
- **SPD**
  Clears the serial polling mode of the talker function on all devices on the bus.
- **PPU**
  Not supported.

15.1 RS-232 Interface Functions and Specifications

Reception Function

You can specify the same settings as those specified by front panel key operations.
Receives output requests for measured and computed data, setup data of the panel, and error codes.

Transmission Function

Transmits measured and computed data.
Transmits panel setup data and the status byte.
Transmits error codes that have occurred.

RS-232 Interface Specifications

Electrical characteristics: Conforms to the EIA-574 standard (for the 9-pin interface of the EIA-232 (RS-232) standard)

Connection:	Point-to-point
Transmission mode:	Full duplex
Synchronization:	Start-stop synchronization
Baud rate:	9600, 14400, 19200, 38400, 57600, 115200
Start bit:	Fixed to 1 bit
Data length:	7 or 8 bits
Parity:	Even, odd, or no parity
Stop bits:	1 or 2 bits
Connector:	DELC-J9PAF-13L6 (JAE or equivalent)

Hardware handshaking: CTS and RTS signals can be used to control both transmission and reception.

Software handshaking: X-ON and X-OFF signals can be used to control both transmission and reception.
X-ON (ASCII 11H) and X-OFF (ASCII 13H)

Received buffer size: 64 KB

Switching between Remote and Local Modes

- **When Switching from Local to Remote Mode**
  If the GS820 receives a ":SYSTem:REMote" command from the PC when it is in the local mode, it switches to the remote mode.
  - The REMOTE indicator to the left of the display illuminates.
  - All keys except the **LOCAL** key are disabled.
  - Settings entered in local mode are retained even when the GS820 switches to remote mode.

- **When Switching from Remote to Local Mode**
  Pressing the **LOCAL** key when the instrument is in the remote mode causes the instrument to switch to the local mode. The GS820 switches to local mode when it receives a :SYSTem:LOCal command from your PC.
  - The REMOTE indicator to the left of the display turns OFF.
  - Key operations are enabled.
  - Settings entered in remote mode are retained even when the GS820 switches to local mode.

Handling of Break Signals

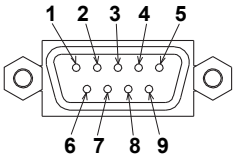
When a break signal is transmitted from your PC, the GS820 behaves in the same way as when a GP-IB device clear is received.

15.2 Connection via the RS-232 Interface

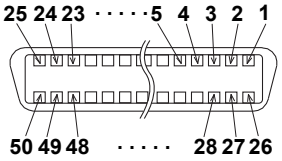
If you connect the GS820 to your PC, you will need to set the GS820 so that the handshaking method, baud rate, data format, and other parameters match with those on your PC.
For details on the settings, see the following pages. In addition, use an interface cable that meets the specifications of the GS820.

Connector and Signal Names

765601



765602



DELC-J9PAF-13L6 or equivalent

765601	765602		
2	1	RD (Received Data):	Received data from your PC. Signal direction: Input
3	2	SD (Send Data):	Transmitted data to your PC. Signal direction: Output
5	3	SG (Signal Ground):	Signal ground.
7	4	RS (Request to Send):	Handshaking used to receive data from your PC. Signal direction: Output
8	5	CS (Clear to Send):	Handshaking used to send data to your PC. Signal direction: Input

* Pins 1, 4, 6, and 9 are not used on the 765601. Only pins 1 through 5 are used on the 765602.

RS-232 Standard Signals and Their JIS and CCITT Abbreviations

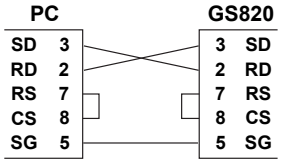
Signal Table

Pin No. (9-pin connector)	Abbreviation			Name
	RS-232	CCITT	JIS	
5	AB(GND)	102	SG	Signal ground
3	BA(TXD)	103	SD	Send data
2	BB(RXD)	104	RD	Receive data
7	CA(RTS)	105	RS	Request to send
8	CB(CTS)	106	CS	Clear to send

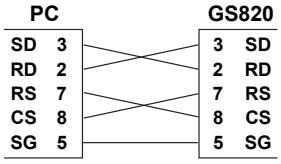
Signal Wiring Example

The pin numbers are for the 9-pin connector.

In general, use a cross cable.



CTS/RTS handshaking is not possible



CTS/RTS handshaking is possible

15.3 Handshaking

When using the serial (RS-232) interface for transferring data, it is necessary to synchronize the equipment so that data is not transmitted in excess of the receive buffer on the receiving end (overrun). This procedure is called handshaking. The GS320 can use any of the three methods below. Match the setting with your PC.

No Handshaking

If the entire command sequence fits in the receive buffer (64 K on the GS820) or if a query command is included in the middle of the command sequence, overrun will not occur.
Select no handshaking if you are transmitting data in this manner.

Hardware Handshaking (CTS/RTS)

Hardware handshaking stops the transmission by setting CTS to false before the receive buffer becomes full and resumes the transmission by setting CTS to true when there is enough free space in the receive buffer.

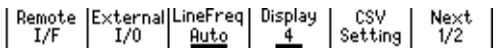
Software Handshaking (XON-XOFF)

Software handshaking stops the transmission by sending an XOFF code (0X13) before the receive buffer becomes full and resumes transmission by sending an XON code (0X11) when there is enough free space in the receive buffer.
Software handshaking can be used by wiring only the data line, but binary data that includes XON (0X11) or XOFF (0X13) cannot be transmitted.

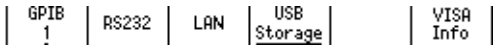
15.4 Setting the RS-232 Interface

Procedure

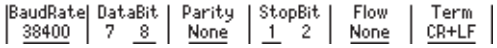
1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **Remote I/F** soft key to display the remote menu.

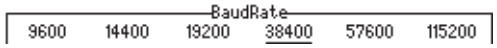


3. Press the **RS232** soft key to display the RS-232 interface menu.



Selecting the Baud Rate

4. Press the **BaudRate** soft key to display the baud rate menu.



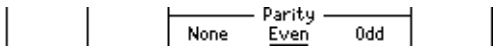
5. Press the soft key corresponding to the desired baud rate.

Selecting the Data Length

4. Press the **DataBit** soft key to select the data length.

Selecting the Parity Bit

4. Press the **Parity** soft key to display the parity menu.



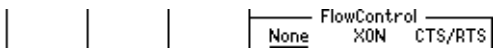
5. Press the soft key corresponding to the desired parity.

Selecting the Stop Bits

4. Press the **StopBit** soft key to select the stop bits.

Selecting the Handshaking Method

4. Press the **Flow** soft key to display the handshaking menu.



5. Press the soft key corresponding to the desired handshaking method.

Selecting the Transmission Terminator

4. Press the **Term** soft key.

5. Press the soft key corresponding to the desired terminator.

Explanation

Specify the following settings if you want to use a controller to set information that can be set using the front panel keys on the GS820 or if you want to transmit the setup data or output waveform data to the controller.

Selecting the Baud Rate

Select from the values below.
9600, 14400, 19200, 38400, 57600, 115200

Selecting the Data Length

Select the data length from below.
8 bits or 7 bits

Selecting the Parity Bit

Select the parity bit from the following:
None (no parity), Even, or Odd

Selecting the Stop Bits

Select the stop bits from the following:
1 bit or 2 bits

Selecting the Handshaking Method

Select the transmit data control and receive data control from the following:
None, XON, or CTS-RTS

Selecting the Terminator

On the GS820 menu, select the terminator that is used when transmitting data from the GS820 from the following:
CR, LF, or CR+LF
The GS820 handles any of the characters CR, LF, and CR+LF as a terminator when receiving data.

<<Corresponding Command Mnemonic>>

```
:SYSTem:COMMunicate:RS232:BAUDrate 9600|14400|19200|38400|57600|115200
:SYSTem:COMMunicate:RS232:DELNgth 7|8
:SYSTem:COMMunicate:RS232:PARity NONE|EVEN|ODD
:SYSTem:COMMunicate:RS232:SBITs 1|2
:SYSTem:COMMunicate:RS232:PACE NONE|XON|HARDware
```

16.1 Program Format

16.1.1 Symbols Used in the Syntax

The following table indicates symbols that are used in the syntax mainly in section 16.2. For details on the data, see pages 16-5 and 16-6.

Symbol	Meaning	Example
|	Exclusive OR	`SOURce:FUNCtion VOLTage|CURRent`
		Example `SOURce:FUNCTION VOLTage`
[]	Can be omitted	`OUTPut[:STATe]`
•••	Can be repeated	

16.1.2 Messages

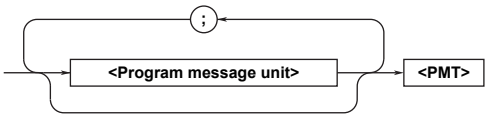
Messages

Messages are used to exchange information between the controller and the instrument. Messages that are sent from the controller to the instrument are called program messages and messages that are sent back from the instrument to the controller are called response messages.

If a program message contains a message unit that requests a response (a query), the instrument returns a response message upon receiving the program message. A single response message is always returned in response to a single program message.

Program Messages

Data that is sent from the controller to the instrument is called a program message. The program message format is shown below.



<Program Message Unit>

A program message consists of one or more program message units; each unit corresponds to one command. The instrument executes the received commands in order.

Each program message unit is separated by a semicolon (;).

For details regarding the format of the program message unit, see the next section.

Example

`:MEASURE:FUNCTION DTOC;SPEED 1.0<PMT>`

Unit Unit

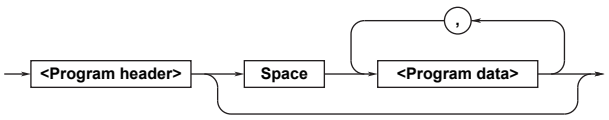
<PMT>

<PMT> is a program message terminator. The following three types are available.

- **NL (New Line)**
  Same as LF (Line Feed). ASCII code “0AH”
- **^END**
  The END message (EOI signal) as defined in the IEEE488.1. (The data byte that is sent with the END message is the last data of the program message.)
- **NL^END**
  NL with an END message attached. (NL is not included in the program message.)

Program Message Unit Format

The program message unit format is shown below.



<Program Header>

The program header indicates the command type. For details, see page 16-3.

<Program Data>

If certain conditions are required in executing a command, program data are added. A space (ASCII code 20H) separates the program data from the header. If there are multiple sets of program data, they are separated by commas (,).
For details, see page 16-5.

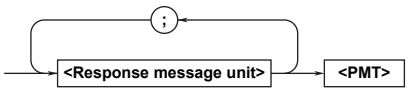
Example

```
:SAMPLE:GATE:MODE TIME<PMT>
```

Header Data

Response Messages

Data that are sent from the instrument to the controller are called response messages. The response message format is shown below.



<Response Message Unit>

A response message consists of one or more response message units; each response message unit corresponds to one response.
Response message units are separated by a semicolon (;).
For details regarding the format of the response message unit, see the next section.

Example

```
:SAMPLE:INHIBIT:STATE 1;POLARITY POSITIVE<PMT>
```

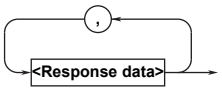
Unit Unit

<RMT>

<RMT> is a response message terminator. It is NL^END.

Response Message Unit Format

The response message unit format is shown below.



<Response Header>

A response header sometimes precedes the response data. A space separates the data from the header. For details, see page 16-5.

<Response Data>

Response data contain the content of the response. If there are multiple sets of response data, they are separated by commas (,).

Example
50.0E-3<RMT>
1,256<RMT>
VOLT<RMT>

If there are multiple queries in a program message, responses are made in the same order as the queries. In most cases, a single query returns a single response message unit, but there are a few queries that return multiple units. The first response message unit always corresponds to the first query, but the n^{th} response unit may not necessarily correspond to the n^{th} query. Therefore, if you want to make sure that every response is retrieved, divide the program messages into individual messages.

Precautions to Be Taken when Transferring Messages

- If a program message that does not contain a query is sent, the next program message can be sent at any time.
- If a program message that contains a query is sent, a response message must be received before the next program message can be sent. If the next program message is sent before the response message is received in its entirety, an error occurs. The response message that was not received is discarded.
- If the controller tries to receive a response message when there is none, an error occurs. If the controller tries to receive a response message before the transmission of the program message is complete, an error occurs.
- If a program message containing multiple message units is sent, and the message contains incomplete units, the instrument attempts to execute the ones that are believed to be complete. However, these attempts may not always be successful. In addition, if the message contains queries, the responses may not be returned.

Deadlock

The instrument can store at least 64 KB of messages in its transmission and reception buffers (the number of available bytes varies depending on the operating conditions). If both the transmit and receive buffers become full at the same time, the instrument will no longer be able to operate. This state is called a deadlock. In this case, operation can be resumed by discarding response messages.
Deadlock will not occur if the program message (including the <PMT>) is kept below 64 KB. Furthermore, deadlock never occurs if a program message does not contain a query.

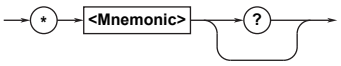
16.1.3 Commands

Commands

There are three types of commands (program headers) that are sent from the controller to the instrument. They differ in their program header formats.

Common Command Header

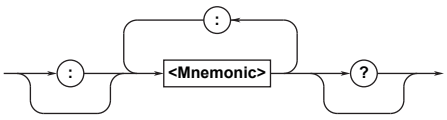
Commands that are defined in the IEEE 488.2-1987 are called common commands. The header format of a common command is shown below. An asterisk (*) is always placed in the beginning of a command.



An example of a common command: `*CLS`

Compound Header

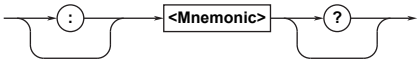
Dedicated commands used by the instrument are classified and arranged in a hierarchy according to their functions. The format of a compound header is shown below. A colon (:) must be used to specify a lower hierarchy.



Example of a compound header:`MEASURE:FUNCTION`

Simple Header

These commands are functionally independent and do not have a hierarchy. The format of a simple header is shown below.



Example of a simple header:`START`

Note

A <mnemonic> is a character string made up of alphanumeric characters.

When Concatenating Commands

Command Group

A command group is a group of commands that have common compound headers arranged in a hierarchy. A command group may contain sub-groups.

Example Group of commands related to sampling

```
SAMPLE?
SAMPLE:ARMING
SAMPLE:ARMING:DELAY:TIME
SAMPLE:ARMING:SLOPE
SAMPLE:ARMING:SOURCE
SAMPLE:GATE?
SAMPLE:GATE:TIME
SAMPLE:INHIBIT?
SAMPLE:INHIBIT:POLARITY
SAMPLE:INHIBIT:STATE
```

When Concatenating Commands of the Same Group

The instrument stores the hierarchical level of the command that is currently being executed, and performs analysis on the assumption that the next command sent will also belong to the same level. Therefore, common header sections can be omitted for commands belonging to the same group.

Example

```
INPUT:DATA:TRIG:MODE MAN;
LEVEL 1.000V<PMT>
```

When Concatenating Commands of Different Groups

If the following command does not belong to the same group, a colon (:) is placed in front of the header.

Example

```
MEASURE:FUNCTION DTOC;:DISPLAY:
SCALE R10<PMT>
```

When Concatenating Simple Headers

If a simple header follows another command, a colon (:) is placed in front of the simple header.

Example

```
MEASURE:FUNCTION DTOC;:START<PMT>
```

When Concatenating Common Commands

Common commands that are defined in the IEEE 488.2-1992 are independent of hierarchy. A colon is not needed before a common command.

Example

```
MEASURE:FUNCTION DTOC;*CLS<PMT>
```

When Separating Commands with <PMT>

If a terminator is used to separate two commands, each command is a separate message. Therefore, the common header must be specified for each command even when commands belonging to the same command group are being concatenated.

Example

```
MEASURE:FUNCTION DTOC<PMT>MEASURE:
SPEED 1.0<PMT>
```

Header Interpretation Rules

The instrument interprets the header that is received according to the rules below.

- Mnemonics are not case sensitive.
  Example `MEASure` can also be written as `measure` or `Measure`.
- The lower-case section of the mnemonic can be omitted.
  Example `MEASure` can also be written as `measure` or `meas`.
- The question mark at the end of a header indicates that it is a query. However, the question mark cannot be omitted.
  Example The shortest abbreviation for `MEASure?` is `MEAS?`.
- If the <x> (value) at the end of a mnemonic is omitted, it is interpreted as a 1.
  Example If `FILT` is specified for `FILTer<x>`, it means `FILTer1`.
- The section enclosed by brackets can be omitted.
  Example `INPut:PLL[:MODE] 1` can be written as `INPut:PLL`.
  However, the last section enclosed by brackets cannot be omitted in an upper-level query.

16.1.4 Response

When the controller sends a message unit that has a question mark in its program header (query), the instrument returns a response message to the query.

16.1.5 Data

Data

Data contain conditions and values that are written after the header. A space is used to separate the header and data. Data is classified as follows:

Notation	Meaning Example
<Integer>	- 125 –1
<Fixed-point number>	- 125.0 –.90
<Floating-point number>*	- 125.0E+0 –9E–1
<Value>	<Integer>, <Fixed-point number>, or <Floating-point number>
<Voltage>	<Value> to which a voltage unit (V) can be attached. -1.25mV
<Current>	A <Value> to which a current unit (A) can be attached. -75.1E-2A
<Time>	A <Value> to which a time unit (S) can be attached. 360S
<Resistance>	A <Value> to which a resistance unit (ohm) can be attached. 4.7kohm
<Binary/Octal/Hexadecimal>	A binary number following #B, an octal number following #Q, or an hexadecimal number following #H. #B1101 #Q706 #H9F3C
<Character string>	Character string enclosed by double or single quotation marks. "Hello"

* In <Floating-point number>, the + sign after E can be omitted.

<Block Data>

<Block data> is data containing 8-bit arbitrary values. It is only used in response messages on the GS820. The syntax is as follows:

Syntax Example

#N<N-digit decimal number><data byte sequence>

#800000010ABCDEFGHIJ

- #N
  Indicates that the data is <Block data>. “N” indicates the number of succeeding data bytes (digits) in ASCII code characters.
- <N-digit decimal number>
  Indicates the number of bytes of data (example: 00000010 = 10 bytes).
- <Data byte sequence>
  Expresses the actual data (example: ABCDEFGHIJ).
- Data is comprised of 8-bit values (0 to 255). This means that the ASCII code “0AH,” which stands for “NL,” can also be a code used for data. Hence, care must be taken when programming the controller.

<Multiplier>

The table below lists the <multipliers> that can be added after a <value>.

Symbol	Word	Multiplier
EX	Exa	10^{18}
PE	Peta	10^{15}
T	Tera	10^{12}
G	Giga	10^{9}
MA	Mega	10^{6}
K	Kilo	10^{3}
M	Milli	10^{-3}
U	Micro	10^{-6}
N	Nano	10^{-9}
P	Pico	10^{-12}
F	Femto	10^{-15}
A	Ato	10^{-18}

16.2 Commands

16.2.1 A List of Commands

Command	Function	Page
Output Commands (OUTPut Group)		
[:CHANnel<n>]		
:OUTPut		
[:STATe]/?	Sets the output state (ON/OFF/Zero) or queries the current setting.	16-13
Sweep Commands (SWEep Group)		
[:CHANnel<n>]		
:SWEep		
:TRIGger/?	Sets the sweep start (external, auxiliary trigger, Timer1 or 2, or measurement end) or queries the current setting.	16-14
:AUXiliary		
:POLarity/?	Sets the auxiliary trigger polarity (normal or inverted) or queries the current setting.	16-14
:COUNt/?	Sets the sweep repeat count or queries current setting.	16-14
Source Commands (SOURce Group)		
[:CHANnel<n>]		
:SOURce:		
:RESPonse/?	Sets the response mode (normal or stable) or queries the current setting.	16-15
:TRIGger/?	Sets the trigger source (external, auxiliary trigger, Timer1 or 2, or measurement end) or queries the current setting.	16-15
:AUXiliary		
:POLarity/?	Sets the auxiliary trigger polarity (normal or inverted) or queries the current setting.	16-15
:FUNCtion/?	Sets the source function (voltage or current) or queries the current setting.	16-15
:SHAPe/?	Sets the source waveform (DC or pulse) or queries the current setting.	16-15
:MODE/?	Sets the source mode (constant, sweep, programmable, or single-step) or queries the current setting.	16-16
:DELay/?	Sets the source delay or queries the current setting.	16-16
:LIST		
:SELect/?	Sets the programmable sweep pattern file or queries the current setting.	16-16
:CATalog?	Queries a list of programmable sweep pattern files.	16-16
:DELete	Deletes a programmable sweep pattern file.	16-16
:LOAD	Loads a programmable sweep pattern data.	16-16
[:VOLTage]		
:RANGe/?	Sets the voltage source range (200 mV, 2 V, 7 V, or 18 V) or queries the current setting.	16-16
:AUTO/?	Turns ON/OFF the auto voltage source range or queries the current setting.	16-17
:LEVel/?	Sets the voltage source level or queries the current setting.	16-17
:PROTection		
[:STATe]/?	Turns ON/OFF the limiter function or queries the current setting.	16-17
:LINKage/?	Turns ON/OFF the limiter tracking function or queries the current setting.	16-17
:LEVel/?	Sets the voltage limit value (for current source mode) or queries the current setting.	16-17
:UPPer/?	Sets the voltage upper limit (for current source mode) or queries the current setting.	16-18
:LOWer/?	Sets the voltage lower limit (for current source mode) or queries the current setting.	16-18

Command	Function	Page
:SWEep		
:SPACing/?	Sets the sweep type (linear or log) or queries the current setting.	16-18
:STARt/?	Sets the voltage sweep start value or queries the current setting.	16-18
:STOP/?	Sets the voltage sweep stop value or queries the current setting.	16-19
:STEP/?	Sets the linear voltage sweep resolution or queries the current setting.	16-19
:POINts/?	Sets the number of divisions of the voltage log sweep or queries the current setting.	16-19
:PULSe		
:WIDTh/?	Sets the pulse width for pulse width mode or queries the current setting.	16-19
:BASE/?	Sets the pulse base value for voltage pulse source mode or queries the current setting.	16-20
:ZERO		
:IMPedance/?	Sets the impedance (high or low) for voltage zero source or queries the current setting.	16-20
[:CURRent]		
:RANGe/?	Sets the current source range (200 nA, 2 μA, 20 μA, 200 μA, 2 mA, 20 mA, 200 mA, 1 A, or 3 A) or queries the current setting.	16-20
:AUTO/?	Turns ON/OFF the auto current source range or queries the current setting.	16-20
:LEVel/?	Sets the current source level or queries the current setting.	16-21
:PROTection		
[:STATe]/?	Turns ON/OFF the limiter function or queries the current setting.	16-21
:LINKage/?	Turns ON/OFF the limiter tracking function or queries the current setting.	16-21
:LEVel/?	Sets the current limit (for voltage source mode) or queries the current setting.	16-21
:UPPer/?	Sets the current upper limit (for voltage source mode) or queries the current setting.	16-22
:LOWer/?	Sets the current lower limit (for voltage source mode) or queries the current setting.	16-22
:SWEep		
:SPACing/?	Sets the sweep type (linear or log) or queries the current setting.	16-22
:STARt/?	Sets the current sweep start value or queries the current setting.	16-22
:STOP/?	Sets the current sweep stop value or queries the current setting.	16-23
:STEP/?	Sets the linear current sweep resolution or queries the current setting.	16-23
:POINts/?	Sets the number of divisions of the current log sweep or queries the current setting.	16-23
:PULSe		
:WIDTh/?	Sets the pulse width for pulse width mode or queries the current setting.	16-23
:BASE/?	Sets the pulse base value for current pulse source mode or queries the current setting.	16-24
:ZERO		
:IMPedance/?	Sets the impedance (high or low) for current zero source or queries the current setting.	16-24

Measurement Commands (SENSe Group)

[:CHANnel<n>]		
:SENSe		
[:STATe]/?	Turns ON/OFF the measurement function or queries the current setting.	16-25
:MODE/?	Sets the measurement mode (fixed function, auto function, voltmeter, ammeter, or resistance meter) or queries the current setting.	16-25
:TRIGger/?	Sets the measurement trigger source (source change, sweep end, auxiliary trigger, Timer1 or 2, or immediate) or queries the current setting.	16-25
:AUXiliary		
:POLarity/?	Sets the auxiliary trigger polarity (normal or inverted) or queries the current setting.	16-25

Command	Function	Page
:FUNCtion/?	Sets the measurement function (voltage or current) or queries the current setting.	16-26
[:VOLTage]		
:RANGe/?	Sets the voltage measurement range (200 mV, 2 V, 7 V, or 18 V) or queries the current setting.	16-26
:AUTO/?	Turns ON/OFF the auto measurement range or queries the current setting.	16-26
[:CURRent]		
:RANGe/?	Sets the current measurement range (200 nA, 2 μA, 20 μA, 200 μA, 2 mA, 20 mA, 200 mA, 1 A, or 3 A) or queries the current setting.	16-26
:AUTO/?	Turns ON/OFF the auto measurement range or queries the current setting.	16-27
[:RESistance]		
:RANGe/?	Sets the resistance measurement range (200 mΩ, 2 Ω, 20 Ω to 200 MΩ) for resistance meter mode or queries the current setting.	16-27
:AUTO/?	Turns ON/OFF the auto measurement range or queries the current setting.	16-27
:NPLC/?	Sets the measurement integration time or queries the current setting (PLC conversion).	16-27
:ITIMe/?	Sets the measurement integration time or queries the current setting (time conversion).	16-28
:DELay/?	Sets the measurement delay or queries the current setting.	16-28
:AVERage		
[:STATe]/?	Turns ON/OFF the average function or queries the current setting.	16-28
:COUNt/?	Sets the average count or queries the current setting.	16-28
:ZERO		
:AUTO/?	Turns ON/OFF the auto zero function or queries the current setting.	16-28
:EXECute	Executes zero calibration.	16-28
:REMote/?	Sets the wiring system (ON = 4W and OFF = 2W) or queries the current setting.	16-28

Computation Commands (CALCulate Group)

[:CHANnel<n>]		
:CALCulate		
:NULL		
[:STATe]/?	Turns ON/OFF the NULL computation function or queries the current setting.	16-29
:OFFSet/?	Sets the NULL computation offset value or queries the current setting.	16-29
:MATH		
[:STATe]/?	Turns ON/OFF the equation computation function or queries the current setting.	16-29
:SELect/?	Sets the equation definition file or queries the current setting.	16-29
:CATalog?	Queries the list of equation definition files.	16-29
:DELete	Deletes an equation definition file.	16-29
:PARameter		
:A/?	Sets equation parameter A or queries the current setting.	16-29
:B/?	Sets equation parameter B or queries the current setting.	16-30
:C/?	Sets equation parameter C or queries the current setting.	16-30
:LIMit		
[:STATe]/?	Turns ON/OFF the comparison operation function or queries the current setting.	16-30
:UPPer/?	Sets the upper limit for comparison or queries the current setting.	16-30
:LOWer/?	Sets the lower limit for comparison or queries the current setting.	16-30

Command	Function	Page
Measured Value Read Commands (INITiate, FETCh, READ, and MEASure Groups)		
[:CHANnel<n>]		
:INITiate	Clears the measured result.	16-31
:FETCh?	Queries the measured result.	16-31
:READ?	Clears the measured result and queries the measured result.	16-31
:MEASure?	Clears the measured result, generates a trigger, and queries the measured result.	16-31
Trigger Commands (STARt and TRIGger Groups)		
:STARt	Generates sweep start.	16-32
:TRIGger	Generates a trigger (equivalent to TRG).	16-32
:AUXiliary	Generates an auxiliary trigger.	16-32
:HOLD/?	Turns ON/OFF the trigger hold or queries the current setting.	16-32
:TIMer<n>/?	Sets the period of Timer1 or 2 or queries the current setting.	16-32
:TSYNc	Aligns the phases between Timer1 and 2.	16-32
Store/Recall Commands (TRACe Group)		
:TRACe		
[:STATe]/?	Turns ON/OFF the storage state or queries the current setting.	16-33
BINary		
:REPLy/?	Sets the type of stored data or queries the current setting.	16-33
:FILE		
:CREate/?	Turns ON/OFF the result file generation function or queries the current setting.	16-33
:POINts/?	Sets the store count or queries the current setting.	16-33
:CHANnel<n>		
:ACTual?	Queries the actual number of stored points.	16-33
:DATA		
:FORMat/?	Sets the read data format (ASCII or binary) for the stored data or queries the current setting.	16-33
:ENDian/?	Sets the stored result read byte order (Big or Little) for binary format or queries the current setting.	16-33
:READ?	Reads the stored data.	16-34
:STATistics?	Queries the statistics of the stored result.	16-34
Synchronization Commands (SYNChronize Group)		
:SYNChronize		
:MODE/?	Sets the synchronization mode (master or slave) between units or queries the current setting.	16-35
:CHANnel/?	Turns ON/OFF the inter-channel synchronization mode or queries the current setting.	16-35
:EXPand/?	Turns ON/OFF the channel expansion function or queries the current setting.	16-35
External I/O Commands (ROUTe Group)		
:ROUTe		
:BNC		
:STARt/?	Sets the signal direction (input or output) of the start BNC or queries the current setting.	16-36
:TRIGger/?	Sets the signal direction (input or output) of the trigger BNC or queries the current setting.	16-36
:AUXiliary/?	Sets the auxiliary trigger output source (CH1 measuring, Timer 1, 2, or Through) or queries the current setting.	16-36

System Commands (SYSTem Group)

Command	Function	Page
:SYSTem		
:DISPlay		
[:STATe]/?	Turns ON/OFF the display or queries the current setting.	16-37
:BRIGht/?	Sets the display brightness or queries the current setting.	16-37
:TEXT/?	Sets and displays the user message or queries the current setting.	16-37
:CLEar	Clears the user message display.	16-37
:CHANnel	Switches the display (CH1 display, CH2 display, or both CH display).	16-37
:ERRor	Displays the error log screen.	16-37
:CLOCk		
:TZONe/?	Sets the time zone or queries the current setting.	16-37
:DATE/?	Sets the date or queries the current setting.	16-37
:TIME/?	Sets the time or queries the current setting.	16-38
:ADJust	Executes the ±30-s correction.	16-38
:SETup		
:SAVE	Saves the setup data.	16-38
:LOAD	Loads the setup data.	16-38
:CATalog?	Queries the list of setup data files.	16-38
:DELete	Deletes a setup data file.	16-38
:PON/?	Sets the setup at power-on or queries the current setting.	16-38
:ERROR?	Queries the error code and description.	16-38
:LOCal	Switches to local mode.	16-38
:REMote	Switches to remote mode.	16-38
:KLOCk/?	Turns ON/OFF the key lock or queries the current setting.	16-38
:BEEPer/?	Turns ON/OFF the beep sound for error occurrences or queries the current setting.	16-39
:LFRequency/?	Sets the line frequency (50 Hz or 60 Hz) or queries the current setting.	16-39
:AUTO/?	Turns ON/OFF the line frequency auto selection function or queries the current setting.	16-39
:COMMunicate		
:GPIB		
:ADDRess/?	Sets the GP-IB address or queries the current setting.	16-39
:RS232		
:BAUDrate/?	Sets the RS-232 baud rate (9600 bps to 115200 bps) or queries the current setting.	16-39
:DLENgth/?	Sets the RS-232 data length (7 bits or 8 bits) or queries the current setting.	16-39
:PARity/?	Sets the RS-232 parity (none, even, or odd) or queries the current setting.	16-39
:SBITs/?	Sets the RS-232 stop bits (1 bit or 2 bits) or queries the current setting.	16-40
:PACE/?	Sets the RS-232 flow control (non, XON-OFF, or CTS-RTS) or queries the current setting.	16-40
:TERMinator/?	Sets the RS-232 terminator (CR, LF, or CR+LF) or queries the current setting.	16-40
:Ether		
:MAC?	Queries the Ethernet MAC address.	16-40
:PORT?	Queries the command socket port number of Ethernet.	16-40
:DHCP/?	Turns ON/OFF the DHCP function of Ethernet or queries the current setting.	16-40
:IP/?	Sets the Ethernet IP address or queries the current setting.	16-40
:MASK/?	Sets the Ethernet subnet mask or queries the current setting.	16-40
:GATE/?	Sets the Ethernet default gateway or queries the current setting.	16-41
:TERMinator/?	Sets the Ethernet command socket terminator (CR, LF, or CR+LF) or queries the current setting.	16-41

Command	Function	Page
:USB		
:FUNCtion/?	Selects the USB function (storage or USB-TMC) or queries the current setting.	16-41

Status Commands (STATus Group)

:STATus		
:SOURce		
:CONDition?	Queries the source event condition register.	16-42
:EVENt?	Queries the source event register and clears the register.	16-42
:ENABle/?	Sets the source event enable register or queries the current setting.	16-42
:SENSe		
:CONDition?	Queries the measurement event condition register.	16-42
:EVENt?	Queries the measurement event register and clears the register.	16-42
:ENABle/?	Sets the measurement event enable register or queries the current setting.	16-42

Common Commands

*IDN?	Queries the device information.	16-43
*OPT?	Queries the option information.	16-43
*TRG	Generates a trigger (equivalent to :TRIGger).	16-43
*CAL?	Executes the source offset calibration of both channels and queries the result.	16-43
*TST?	Performs a self-test and queries the result.	16-43
*RST	Initializes the settings (to factory default values).	16-43
*SAV	Saves the setup data.	16-43
*RCL	Loads the setup data.	16-43
*CLS	Clears the event register and error queue.	16-43
*STB?	Queries the status byte and clears the SRQ.	16-43
*SRE/?	Sets the service request enable register or queries the current setting.	16-43
*ESR?	Queries the standard event register.	16-43
*ESE/?	Sets the standard event enable register or queries the current setting.	16-43
*OPC	Generates a standard event OPC when the execution of all previous commands is completed.	16-44
*OPC?	Generates a response when the execution of all previous commands is completed.	16-44
*WAI	Waits for a completion of an overlap command.	16-44

16.2.2 Output Commands (OUTPut Group)

[:CHANnel<n>]:OUTPut[:STATe]/?

Function Sets the output state (ON/OFF/Zero) or queries the current setting.

Syntax `[:CHANnel<n>]:OUTPut[:STATe] 1|0|ON|OFF|ZERO`

1 or ON	Turns the output ON.
0 or OFF	Turns the output OFF.
ZERO	Sets the output to zero.

`[:CHANnel<n>]:OUTPut[:STATe]?`

→ 1	The output is ON.
→ 0	The output is OFF.
→ ZERO	The output is zero.

Example
```
:OUTP ON
:CHAN2:OUTP:STAT ZERO
:CHAN1:OUTP:STAT?
```

16.2.3 Sweep Commands (SWEep Group)

[:CHANnel<n>]:SWEep:TRIGger/?

Function Sets the sweep start (external, auxiliary trigger, Timer1 or 2, or measurement end) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SWEep:TRIGger
 EXTernal|AUXiliary|TIMer1|TIMer2|
 SENSe
```

EXTernal	Selects external start.
AUXiliary	Selects auxiliary trigger.
TIMer1	Selects Timer1 (constant period).
TIMer2	Selects Timer2 (constant period).
SENSe:	Selects measurement end.

```
[:CHANnel<n>]:SWEep:TRIGger?
```

→ EXT	Set to external start.
→ AUX	Set to auxiliary trigger.
→ TIM1	Set to Timer1.
→ TIM2	Set to Timer2.
→ SENS	Set to measurement end.

Example
```
:SWE:TRIG EXT
:CHAN2:SWE:TRIG TIM1
:CHAN1:SWE:TRIG?
```

[:CHANnel<n>]:SWEep:TRIGger:AUXiliary:POLarity/?

Function Sets the auxiliary trigger polarity (normal or inverted) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SWEep:TRIGger:
AUXiliary:POLarity NORMal|INVerted
```

NORMal	Selects normal (falling edge).
INVerted	Selects inverted (falling edge).

```
[:CHANnel<n>]:SWEep:TRIGger:
AUXiliary:POLarity?
```

→ NORM	Set to normal (falling edge).
→ INV	Set to inverted (rising edge).

Example
```
:SWE:TRIG:AUX:POL NORM
:CHAN2:SWE:TRIG:AUX:POL INV
:CHAN1:SWE:TRIG:AUX:POL?
```

[:CHANnel<n>]:SWEep:COUNt/?

Function Sets the sweep repeat count or queries current setting.

Syntax
```
[:CHANnel<n>]:SWEep:COUNt
 <integer>|INFinity|MINimum|MAXimum
```

<integer>	Specify any repeat count.
INFinity	Sets the count to infinity.
MINimum	Sets the count to minimum (= 1).
MAXimum	Sets the count to maximum (= 1000).

```
[:CHANnel<n>]:SWEep:COUNt?
```

→ <integer>	Current repeat count
→ INF	Set to infinity.

Example
```
:SWE:COUN 5
:CHAN2:SWE:COUN INF
:CHAN1:SWE:COUN?
```

16.2.4 Source Commands (SOURce Group)

[:CHANnel<n>]:SOURce:RESPonse/?

Function Sets the response mode (normal or stable) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce:RESPonse
 NORMal|STABle
```
NORMal Selects normal.
STABle Selects stable.
```
[:CHANnel<n>]:SOURce:RESPonse?
```
→ NORM Set to normal.
→ STAB Set to stable.

Example
```
:SOUR:RESP NORM
:CHAN2:SOUR:RESP STAB
:CHAN1:SOUR:RESP?
```

[:CHANnel<n>]:SOURce:TRIGger/?

Function Sets the trigger source (external, auxiliary trigger, Timer1 or 2, or measurement end) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce:TRIGger
 EXTernal|AUXiliary|TIMer1|TIMER2|
 SENSe
```
EXTernal Selects external trigger.
AUXiliary Selects auxiliary trigger.
TIMer1 Selects Timer1 (constant period).
TIMER2 Selects Timer2 (constant period).
SENSe Selects measurement end.
```
[:CHANnel<n>]:SOURce:TRIGger?
```
→ EXT Set to external start.
→ AUX Set to auxiliary trigger.
→ TIM1 Set to Timer1.
→ TIM2 Set to Timer2.
→ SENS Set to measurement end.

Example
```
:SOUR:TRIG TIM1
:CHAN2:SOUR:TRIG EXT
:CHAN1:SOUR:TRIG?
```

[:CHANnel<n>]:SOURce:TRIGge:AUXiliary:POLarity/?

Function Sets the auxiliary trigger polarity (normal or inverted) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce:TRIGge:AUXiliary:
 POLarity NORMal|INVerted
```
NORMal Selects normal (falling edge).
INVerted Selects inverted (falling edge).
```
[:CHANnel<n>]:SOURce:TRIGge:
AUXiliary:POLarity?
```
→ NORM Set to normal (falling edge).
→ INV Set to inverted (rising edge).

Example
```
:SOUR:TRIG:AUX:POL NORM
:CHAN2:SOUR:TRIG:AUX:POL INV
:CHAN1:SOUR:TRIG:AUX:POL?
```

[:CHANnel<n>]:SOURce:FUNCtion/?

Function Sets the source function (voltage or current) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce:FUNCtion
 VOLTage|CURRent
```
VOLTage Selects voltage.
CURRent Selects current.
```
[:CHANnel<n>]:SOURce:FUNCtion?
```
→ VOLT Set to voltage.
→ CURR Set to current.

Example
```
:SOUR:FUNC VOLT
:CHAN2:SOUR:FUNC CURR
:CHAN1:SOUR:FUNC?
```

[:CHANnel<n>]:SOURce:SHAPe/?

Function Sets the source waveform (DC or pulse) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce:SHAPe DC|PULSe
```
DC Selects DC.
PULSe Selects pulse.
```
[:CHANnel<n>]:SOURce:SHAPe?
```
→ DC Set to DC.
→ PULS Set to pulse.

Example
```
:SOUR:SHAP DC
:CHAN2:SOUR:SHAP PULS
:CHAN1:SOUR:SHAP?
```

[:CHANnel<n>]:SOURce:MODE/?

Function Sets the source mode (constant, sweep, programmable, or single-step) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce:MODE
 FIXed|SWEep|LIST|SINGle
```
FIXed	Selects fixed value (sweep off).
SWEep	Selects linear or log sweep.
LIST	Selects programmable sweep.
SINGle	Selects single-step sweep.

```
[:CHANnel<n>]:SOURce:MODE?
```
→ FIX	Set to fixed value (sweep value)
→ SWE	Set to linear or log sweep.
→ LIST	Set to programmable sweep.
→ SING	Set to single-step sweep.

Example
```
:SOUR:MODE LIST
:CHAN2:SOUR:MODE FIX
:CHAN1:SOUR:MODE?
```

[:CHANnel<n>]:SOURce:DELay/?

Function Sets the source delay or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce:DELay
 <time>|MINimum|MAXimum
```
<time>	Specify any source delay value.
MINimum	Sets the minimum value (= 15 μs).
MAXimum	Sets the maximum value (= 3600 s).

```
[:CHANnel<n>]:SOURce:DELay?
```
→ <time>	The present source delay time

Example
```
:SOUR:DEL 2.5E-3
:CHAN2:SOUR:DEL MIN
:CHAN1:SOUR:DEL 1.25ms
:CHAN1:SOUR:DEL?
```

[:CHANnel<n>]:SOURce:LIST:SELect/?

Function Sets the programmable sweep pattern file or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce:LIST:SELect
 <character string>|NONE
```
<character string>	Specify a pattern file name.
NONE	Pattern file not selected condition.

```
[:CHANnel<n>]:SOURce:LIST:SELect?
```
→ <character string>	The present pattern file name
→ NONE	Pattern file not selected.

Example
```
:SOUR:LIST:SEL "Test1.csv"
:CHAN2:SOUR:LIST:SEL "Test2.csv"
:CHAN1:SOUR:LIST:SEL?
```

[:CHANnel<n>]:SOURce:LIST:CATalog?

Function Queries the list of programmable sweep pattern files.

Syntax
```
[:CHANnel<n>]:SOURce:LIST:CATalog?
```
→ <character string>,... Pattern file name list

Example
```
:SOUR:LIST:CAT?
```

[:CHANnel<n>]:SOURce:LIST:DELete

Function Deletes a programmable sweep pattern file.

Syntax
```
[:CHANnel<n>]:SOURce:LIST:DELete
 <character string>
```
<character string>	The name of the pattern file to be deleted.

Example
```
:SOUR:LIST:DEL "Test1.csv"
```

[:CHANnel<n>]:SOURce:LIST:LOAD

Function Loads the pattern data of a programmable sweep.

Syntax
```
[:CHANnel<n>]:SOURce:LIST:LOAD
 <character string>|<block data>
```
<character string>	Pattern data character string to be loaded.
<block data>	Block data expression of the pattern data to be loaded.

Example
```
:SOUR:LIST:LOAD #40062...
:CHAN2:SOUR:LIST:LOAD #500128...
```

[:CHANnel<n>]:SOURce[:VOLTage]:RANGe/?

Function Sets the voltage source range (200 mV, 2 V, 7 V, or 18 V) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:RANGe
 <voltage>|MINimum|MAXimum|UP|DOWN
```
<voltage>	Specify any voltage range. The smallest range that includes the specified voltage will be selected.
MINimum	Sets the minimum value (= 200 mV).
MAXimum	Sets the maximum value (= 18 V).
UP	Increases the range by one level.
DOWN	Decreases the range by one level.

```
[:CHANnel<n>]:SOURce[:VOLTage]:RANGe?
```
→ 200E-3	Set to 200 mV range.
→ 2E+0	Set to 2 V range.
→ 7E+0	Set to 7 V range.
→ 18E+0	Set to 18 V range.

Example
```
:SOUR:VOLT:RANG 2E+0
:CHAN2:SOUR:VOLT:RANG 7V
:CHAN1:SOUR:VOLT:RANG MAX
:CHAn1:SOUR:VOLT:RANG?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:RANGe:AUTO/?

Function Turns ON/OFF the auto voltage source range or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:RANGe:AUTO 1|0|ON|OFF
```
1 or ON Enables auto range.
0 or OFF Enables fixed range.
```
[:CHANnel<n>]:SOURce[:VOLTage]:RANGe:AUTO?
```
→ 1 Set to auto range.
→ 0 Set to fixed range.

Example
```
:SOUR:VOLT:RANG:AUTO ON
:CHAN2:SOUR:VOLT:RANG:AUTO 0
:CHAN1:SOUR:VOLT:RANG:AUTO?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:LEVel/?

Function Sets the voltage source level or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:LEVel <voltage>|MINimum|MAXimum
```
<voltage> Specify any voltage level.
MINimum Sets the minimum value.
In fixed range mode, it is set to the minimum value within the range.
In auto range mode, it is set to –18 V.
MAXimum Sets the maximum value.
In fixed range mode, it is set to the maximum value within the range.
In auto range mode, it is set to 18 V.
```
[:CHANnel<n>]:SOURce[:VOLTage]:LEVel?
```
→ <voltage> The present voltage level.

Example
```
:SOUR:VOLT:LEV 3.5
:CHAN2:SOUR:VOLT:LEV -1.5V
:CHAn1:SOUR:VOLT:LEV?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:PROTection[:STATe]/?

Function Turns ON/OFF the limiter function or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection[:STATe] 1|0|ON|OFF
```
1 or ON Turns the limiter function ON.
0 or OFF Turns the limiter function OFF.
```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection[:STATe]?
```
→ 1 The limiter function is ON.
→ 0 The limiter function is OFF.

Example
```
:SOUR:VOLT:PROT ON
:CHAN2:SOUR:VOLT:PROT:STAT 0
:CHAN1:SOUR:VOLT:PROT:STAT?
```

Description If VOLTage is omitted, the GS820 assumes that the present limit function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LINKage/?

Function Turns ON/OFF the limiter tracking function or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LINKage 1|0|ON|OFF
```
1 or ON Turns the tracking function ON.
0 or OFF Turns the tracking function OFF.
```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LINKage?
```
→ 1 The tracking function is ON.
→ 0 The tracking function is OFF.

Example
```
:SOUR:VOLT:PROT:LINK ON
:CHAN2:SOUR:VOLT:PROT:LINK 0
:CHAN1:SOUR:VOLT:PROT:LINK?
```

Description If VOLTage is omitted, the GS820 assumes that the present limit function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LEVel/?

Function Sets the voltage limit value (for current source mode) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LEVel <voltage>|MINimum|MAXimum
```
<voltage> Specify any level for the positive and negative voltage limits.
MINimum Sets the minimum value (= 1 mV).
MAXimum Sets the maximum value (= 18 V).
```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LEVel?
```
→ <voltage> The present voltage limit.

Example
```
:SOUR:VOLT:PROT:LEV 2.0
:CHAN2:SOUR:VOLT:PROT:LEV 2.5V
:CHAN1:SOUR:VOLT:PROT:LEV?
```

Description If VOLTage is omitted, the GS820 assumes that the present limit function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:UPPer/?

Function Sets the voltage upper limit (for current source mode) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:UPPer <voltage>|MINimum|MAXimum
```
<voltage> Specify any level for the upper voltage limit.
MINimum Sets the minimum value (= 1 mV).
MAXimum Sets the maximum value (= 18 V).
```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:UPPer?
```
→ <voltage> The present voltage upper limit.

Example
```
:SOUR:VOLT:PROT:UPP 2.0
:CHAN2:SOUR:VOLT:PROT:UPP 2.5V
:CHAN1:SOUR:VOLT:PROT:UPP?
```

Description If VOLTage is omitted, the GS820 assumes that the present limit function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LOWer/?

Function Sets the voltage lower limit (for current source mode) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LOWer <voltage>|MINimum|MAXimum
```
<voltage> Specify any level for the lower voltage limit.
MINimum Sets the maximum value (= –18 V).
MAXimum Sets the maximum value (= –1 mV).
```
[:CHANnel<n>]:SOURce[:VOLTage]:PROTection:LOWer?
```
→ <voltage> The present voltage lower limit.

Example
```
:SOUR:VOLT:PROT:LOW -2.0
:CHAN2:SOUR:VOLT:PROT:LOW -2.5V
:CHAN1:SOUR:VOLT:PROT:LOW?
```

Description If VOLTage is omitted, the GS820 assumes that the present limit function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:SPACing/?

Function Sets the sweep type (linear or log) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:SPACing LINear|LOGarithmic
```
LINear Selects linear sweep.
LOGarithmic Selects log sweep.
```
[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:SPACing?
```
vvvv → LIN Set to linear sweep.
→ LOG Set to log sweep.

Example
```
:SOUR:VOLTR:SWE:SPAC LOG
:CHAN2:SOUR:VOLT:SWE:SPAC LIN
:CHAN1:SOUR:VOLT:SWE:SPAC?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:STARt/?

Function Sets the voltage sweep start value or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:STARt <voltage>|MINiumum|MAXimum
```
<voltage> Specify any voltage sweep start value.
MINimum Sets the maximum value (= –18 V).
MAXimum Sets the maximum value (= 18 V).
```
[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:STARt?
```
→ <voltage> The present voltage sweep start value.

Example
```
:SOUR:VOLT:SWE:STAR -10.0
:CHAN2:SOUR:VOLT:SWE:STAR -9.5V
:CHAn1:SOUR:VOLT:SWE:STAR?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:STOP/?

Function Sets the voltage sweep stop value or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:STOP <voltage>|MINimum|MAXimum
```
<voltage> Specify any voltage sweep stop value.
MINimum Sets the maximum value (= –18 V).
MAXimum Sets the maximum value (= 18 V).
```
[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:STOP?
```
→ <voltage> The present voltage sweep end value

Example
```
:SOUR:VOLT:SWE:STOP 10.0
:CHAN2:SOUR:VOLT:SWE:STOP 9.5V
:CHAN1:SOUR:VOLT:SWE:STOP?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:STEP/?

Function Sets the linear voltage sweep resolution or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:STEP <voltage>|MINimum|MAXimum
```
<voltage> Specify any linear voltage sweep resolution.
MINimum Sets the minimum value.
MAXimum Sets the maximum value.
```
[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:STEP?
```
→ <voltage> The present linear voltage sweep resolution.

Example
```
:SOUR:VOLT:SWE:STEP 0.1
:CHAN2:SOUR:VOLT:SWE:STEP 125mV
:CHAN1:SOUR:VOLT:SWE:STEP?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:POINts/?

Function Sets the number of divisions of the voltage log sweep or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:POINts <integer>|MINimum|MAXimum
```
<integer> Specify any number of divisions of the voltage log sweep.
MINimum Sets the minimum value (= 2).
MAXimum Sets the maximum value (= 10000).
```
[:CHANnel<n>]:SOURce[:VOLTage]:SWEep:POINts?
```
→ <integer> The present number of divisions of the voltage log sweep.

Example
```
:SOUR:VOLT:SWE:POIN 100
:CHAN2:SOUR:VOLT:SWE:POIN MAX
:CHAN1:SOUR:VOLT:SWE:POIN?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:PULSe:WIDTh/?

Function Sets the pulse width for pulse width mode or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:VOLTage]:PULSe:WIDTh <time>|MINimum|MAXimum
```
<time> Specify any pulse width.
MINimum Sets the minimum value (= 50 μs).
MAXimum Sets the maximum value (= 3600 s).
```
[:CHANnel<n>]:SOURce[:VOLTage]:PULSe:WIDTh?
```
→ <integer> The present pulse width.

Example
```
:SOUR:VOLT:PULS:WIDT 250E-3
:CHAN2:SOUR:VOLT:PULS:WIDT 500ms
:CHAn1:SOUR:VOLT:PULS:WIDT?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:PULSe:BASE/?

Function Sets the pulse base value for voltage pulse source mode or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:VOLTage]:PULSe:BASE <voltage>|MINimum|MAXimum`

<voltage>	Specify any voltage pulse base value.
MINimum	Sets the minimum value. In fixed range mode, it is set to the minimum value within the range. In auto range mode, it is set to –18 V.
MAXimum	Sets the maximum value. In fixed range mode, it is set to the maximum value within the range. In auto range mode, it is set to 18 V.

`[:CHANnel<n>]:SOURce[:VOLTage]:PULSe:BASE?`

→ <voltage>	The present voltage pulse base value.

Example
```
:SOUR:VOLT:PULS:BASE -1.0E+2
:CHAN2:SOUR:VOLT:PULS:BASE -250mV
:CHAN1:SOUR:VOLT:PULS:BASE?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:VOLTage]:ZERO:IMPedance/?

Function Sets the impedance (high or low) for voltage zero source or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:VOLTage]:ZERO:IMPedance HIGH|LOW`

HIGH	Sets to high impedance.
LOW	Sets to low impedance.

`[:CHANnel<n>]:SOURce[:VOLTage]:ZERO:IMPedance?`

→ HIGH	The voltage zero source is set to high impedance.
→ LOW	The voltage zero source is set to low impedance.

Example
```
:SOUR:VOLT:ZERO:IMP HIGH
:CHAN2:SOUR:VOLT:ZERO:IMP LOW
:CHAN1:SOUR:VOLT:ZERO:IMP?
```

Description If VOLTage is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:RANGe/?

Function Sets the current source range (200 nA, 2 μA, 20 μA, 200μA, 2 mA, 20 mA, 200 mA, 1 A, or 3 A) or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:RANGe <current>|MINimum|MAXimum|UP|DOWN`

<current>	Specify any current range. The smallest range that includes the specified current will be selected.
MINimum	Sets the minimum value (= 200 nA).
MAXimum	Sets the maximum value (= 3.2 A).
UP	Increases the range by one level.
DOWN	Decreases the range by one level.

`[:CHANnel<n>]:SOURce[:CURRent]:RANGe?`

→ 200E-9	Set to 200 nA range.
→ 2E-6	Set to 2 μA range.
→ 20E-6	Set to 20 μA range.
→ 200E-6	Set to 200 μA range.
→ 2E-3	Set to 2 mA range.
→ 20E-3	Set to 20 mA range.
→ 200E-3	Set to 200 mA range.
→ 1.2E+0	Set to 1 A range.
→ 3.2E+0	Set to 3 A range.

Example
```
:SOUR:CURR:RANG 200E-3
:CHAN2:SOUR:CURR:RANG MAX
:CHAN1:SOUR:CURR:RANG 20uA
:CHAN1:SOUR:CURR:RANG?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:RANGe:AUTO/?

Function Turns ON/OFF the auto current source range or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:RANGe:AUTO 1|0|ON|OFF`

1 or ON	Enables auto range.
0 or OFF	Enables fixed range.

`[:CHANnel<n>]:SOURce[:CURRent]:RANGe:AUTO?`

→ 1	Set to auto range.
→ 0	Set to fixed range.

Example
```
:SOUR:CURR:RANG:AUTO ON
:CHAN2:SOUR:CURR:RANG:AUTO 0
:CHAN1:SOUR:CURR:RANG:AUTO?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:LEVel/?

Function Sets the current source level or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:LEVel <current>|MINimum|MAXimum`

- <current> Specify any current level.
- MINimum Sets the minimum value. In fixed range mode, it is set to the minimum value within the range. In auto range mode, it is set to –3.2 A.
- MAXimum Sets the maximum value. In fixed range mode, it is set to the maximum value within the range. In auto range mode, it is set to 3.2 A.

`[:CHANnel<n>]:SOURce[:CURRent]:LEVel?`

→ <current> The present current level.

Example
```
:SOUR:CURR:LEV -125E-6
:CHAN2:SOUR:CURR:LEV 900mA
:CHAN1:SOUR:CURR:LEV?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:PROTection[:STATe]/?

Function Turns ON/OFF the limiter function or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:PROTection[:STATe] 1|0|ON|OFF`

- 1 or ON Turns the limiter function ON.
- 0 or OFF Turns the limiter function OFF.

`[:CHANnel<n>]:SOURce[:CURRent]:PROTection[:STATe]?`

- → 1 The limiter function is ON.
- → 0 The limiter function is OFF.

Example
```
:SOUR:CURR:PROT ON
:CHAN2:SOUR:CURR:PROT:STAT 0
:CHAN1:SOUR:CURR:PROT:STAT?
```

Description If CURRent is omitted, the GS820 assumes that the present limit function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LINKage/?

Function Turns ON/OFF the limiter tracking function or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LINKage 1|0|ON|OFF`

- 1 or ON Turns the tracking function ON.
- 0 or OFF Turns the tracking function OFF.

`[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LINKage?`

- → 1 The tracking function is ON.
- → 0 The tracking function is OFF.

Example
```
:SOUR:CURR:PROT:LINK ON
:CHAN2:SOUR:CURR:PROT:LINK 0
:CHAN1:SOUR:CURR:PROT:LINK?
```

Description If CURRent is omitted, the GS820 assumes that the present limit function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LEVel/?

Function Sets the current limit value (for voltage source mode) or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LEVel <current>|MINimum|MAXimum`

- <current> Specify any level for the positive and negative current limits.
- MINimum Sets the minimum value (= 10 nA).
- MAXimum Sets the maximum value (= 3.2 A).

`[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LEVel?`

→ <current> The present current limit value.

Example
```
:SOUR:CURR:PROT:LEV 2.5
:CHAN2:SOUR:CURR:PROT:LEV 2.0A
:CHAN1:SOUR:CURR:PROT:LEV?
```

Description If CURRent is omitted, the GS820 assumes that the present limit function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:PROTection:UPPer/?

Function Sets the current upper limit (for voltage source mode) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:CURRent]:PROTection:UPPer <current>|MINimum|MAXimum
```
<current> Specify any level for the upper current limit.
MINimum Sets the minimum value (= 10 nA).
MAXimum Sets the maximum value (= 3.2 A).
```
[:CHANnel<n>]:SOURce[:CURRent]:PROTection:UPPer?
```
→ <current> The present current upper limit.

Example
```
:SOUR:CURR:PROT:UPP 2.5
:CHAN2:SOUR:CURR:PROT:UPP 2.0A
:CHAN1:SOUR:CURR:PROT:UPP?
```

Description If CURRent is omitted, the GS820 assumes that the present limit function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LOWer/?

Function Sets the current lower limit (for voltage source mode) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LOWer <current>|MINimum|MAXimum
```
<current> Specify any level for the lower current limit.
MINimum Sets the minimum value (= –3.2 A).
MAXimum Sets the maximum value (= –10 nA).
```
[:CHANnel<n>]:SOURce[:CURRent]:PROTection:LOWer?
```
→ <current> The present current lower limit.

Example
```
:SOUR:CURR:PROT:LOW -2.0
:CHAN2:SOUR:CURR:PROT:LOW -1.5A
:CHAN1:SOUR:CURR:PROT:LOW?
```

Description If CURRent is omitted, the GS820 assumes that the present limit function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:SWEep:SPACing/?

Function Sets the sweep type (linear or log) or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:CURRent]:SWEep:SPACing LINear|LOGarithmic
```
LINear Selects linear sweep.
LOGarithmic Selects log sweep.
```
[:CHANnel<n>]:SOURce[:CURRent]:SWEep:SPACing?
```
→ LIN Set to linear sweep.
→ LOG Set to log sweep.

Example
```
:SOUR:CURR:SWE:SPAC LOG
:CHAN2:SOUR:CURR:SWE:SPAC LIN
:CHAN1:SOUR:CURR:SWE:SPAC?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:SWEep:STARt/?

Function Sets the current sweep start value or queries the current setting.

Syntax
```
[:CHANnel<n>]:SOURce[:CURRent]:SWEep:STARt <current>|MINimum|MAXimum
```
<current> Specify any current sweep start value.
MINimum Sets the minimum value (= –3.2 A).
MAXimum Sets the maximum value (= 3.2 A).
```
[:CHANnel<n>]:SOURce[:CURRent]:SWEep:STARt?
```
→ <current> The present current sweep start value.

Example
```
:SOUR:CURR:SWE:STOP -2
:CHAN2:SOUR:CURR:SWE:STOP -1.5A
:CHAN1:SOUR:CURR:SWE:STOP?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:SWEep:STOP/?

Function Sets the current sweep stop value or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:SWEep:STOP <current>|MINimum|MAXimum`

<current>	Specify any current sweep stop value.
MINimum	Sets the minimum value (= –3.2 A).
MAXimum	Sets the maximum value (= 3.2 A).

`[:CHANnel<n>]:SOURce[:CURRent]:SWEep:STOP?`

→ <current>	The present current sweep stop value.

Example
```
:SOUR:CURR:SWE:STOP 2.0
:CHAN2:SOUR:CURR:SWE:STOP 1.5A
:CHAN1:SOUR:CURR:SWE:STOP?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:SWEep:STEP/?

Function Sets the linear current sweep resolution or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:SWEep:STEP <current>|MINimum|MAXimum`

<current>	Specify any linear current sweep resolution.
MINimum	Sets the minimum value.
MAXimum	Sets the maximum value.

`[:CHANnel<n>]:SOURce[:CURRent]:SWEep:STEP?`

→ <current>	The present linear current sweep resolution.

Example
```
:SOUR:CURR:SWE:STEP 0.1
:CHAn2:SOUR:CURR:SWE:STEP 125uA
:CHAN1:SOUR:CURR:SWE:STEP?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:SWEep:POINts/?

Function Sets the number of divisions of the current log sweep or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:SWEep:POINts <integer>|MINimum|MAXimum`

<integer>	Specify any number of divisions of the current log sweep.
MINimum	Sets the minimum value (= 2).
MAXimum	Sets the maximum value (= 10000).

`[:CHANnel<n>]:SOURce[:CURRent]:SWEep:POINts?`

→ <integer>	The present number of divisions of the current log sweep.

Example
```
:SOUR:CURR:SWE:POIN 100
:CHAN2:SOUR:CURR:SWE:POIN MAX
:CHAN1:SOUR:CURR:SWE:POIN?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:PULSe:WIDTh/?

Function Sets the pulse width for pulse width mode or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:PULSe:WIDTh <time>|MINimum|MAXimum`

<time>	Specify any pulse width.
MINimum	Sets the minimum value (= 50 μs).
MAXimum	Sets the maximum value (= 3600 s).

`[:CHANnel<n>]:SOURce[:CURRent]:PULSe:WIDTh?`

→ <integer>	The present pulse width.

Example
```
:SOUR:CURR:PULS:WIDT 250E-3
:CHAN2:SOUR:CURR:PULS:WIDT 500ms
:CHAn1:SOUR:CURR:PULS:WIDT?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:PULSe:BASE/?

Function Sets the pulse base value for current pulse source mode or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:PULSe:BASE <current>|MINimum|MAXimum`

<current>	Specify any current pulse base value.
MINimum	Sets the minimum value. In fixed range mode, it is set to the minimum value within the range. In auto range mode, it is set to –3.2 A.
MAXimum	Sets the maximum value. In fixed range mode, it is set to the maximum value within the range. In auto range mode, it is set to 3.2 A.

`[:CHANnel<n>]:SOURce[:CURRent]:PULSe:BASE?`

→ <current>	The present current pulse base value.

Example
```
:SOUR:CURR:PULS:BASE 0.75
:CHAN2:SOUR:CURR:PULS:BASE 5mA
:CHAN1:SOUR:CURR:PULS:BASE?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

[:CHANnel<n>]:SOURce[:CURRent]:ZERO:IMPedance/?

Function Sets the impedance (high or low) for current zero source or queries the current setting.

Syntax `[:CHANnel<n>]:SOURce[:CURRent]:ZERO:IMPedance HIGH|LOW`

HIGH	Sets to high impedance.
LOW	Sets to low impedance.

`[:CHANnel<n>]:SOURce[:CURRent]:ZERO:IMPedance?`

→ HIGH	The current zero source is set to high impedance.
→ LOW	The current zero source is set to low impedance.

Example
```
:SOUR:CURR:ZERO:IMP LOW
:CHAN2:SOUR:CURR:ZERO:IMP HIGH
:CHAN1:SOOR:CURR:ZERO:IMP?
```

Description If CURRent is omitted, the GS820 assumes that the present source function was specified.

16.2.5 Measurement Commands (SENSe Group)

[:CHANnel<n>]:SENSe[:STATe]/?

Function Turns ON/OFF the measurement function or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe[:STATe] 1|0|ON|OFF`

1 or ON	Turns the measurement function ON.
0 or OFF	Turns the measurement function OFF.

`[:CHANnel<n>]:SENSe[:STATe]?`

→ 1	The measurement function is ON.
→ 0	The measurement function is OFF.

Example
```
:SENS ON
:CHAN2:SENS:STAT 0
:CHAN1:SENS:STAT?
```

[:CHANnel<n>]:SENSe:MODE/?

Function Sets the measurement mode (fixed function, auto function, voltmeter, ammeter, or resistance meter) or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:MODE FIXed|AUTO|VMETer|IMETer|RMETer`

FIXed	Selects the fixed function mode.
AUTO	Selects the auto function mode.
VMETer	Selects the ammeter mode.
IMETer	Selects the voltmeter mode.
RMETer	Selects the resistance meter mode.

`[:CHANnel<n>]:SENSe:MODE?`

→ FIX	Set to fixed function.
→ AUTO	Set to auto function.
→ VMET	Set to voltmeter mode.
→ IMET	Set to ammeter mode.
→ RMET	Set to resistance meter mode.

Example
```
:SENS:MODE AUTO
:CHAN2:SENS:MODE RMET
:CHAN1:SENS:MODE?
```

[:CHANnel<n>]:SENSe:TRIGger/?

Function Sets the measurement trigger source (source change, sweep end, auxiliary trigger, Timer1, 2, or immediate) or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:TRIGger SOURce|SWEep|AUXiliary|TIMer1|TIMer2|IMMediate`

SOURce	Selects source change.
SWEep	Selects sweep end.
AUXiliary	Selects auxiliary trigger.
TIMer1	Selects Timer1 (constant period).
TIMer2	Selects Timer2 (constant period).
IMMediate	Selects immediate trigger.

`[:CHANnel<n>]:SENSe:TRIGger?`

→ SOUR	Set to source change.
→ SWE	Set to sweep end.
→ AUX	Set to auxiliary trigger.
→ TIM1	Set to Timer1.
→ TIM2	Set to Timer2.
→ IMM	Set to immediate trigger.

Example
```
:SENS:TRIG AUX
:CHAN2:SENS:TRIG TIM2
:CHAn1:SENS:TRIG?
```

[:CHANnel<n>]:SENSe:TRIGger:AUXiliary:POLarity/?

Function Sets the auxiliary trigger polarity (normal or inverted) or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:TRIGger:AUXiliary:POLarity NORMal|INVerted`

NORMal	Selects normal (falling edge).
INVerted	Selects inverted (falling edge).

`[:CHANnel<n>]:SENSe:TRIGger:AUXiliary:POLarity?`

→ NORM	Set to normal (falling edge).
→ INV	Set to inverted (rising edge).

Example
```
:SENS:TRIG:AUX:POL INV
:CHAN2:SENS:TRIG:AUX:POL NORM
:CHAN1:SENS:TRIG:AUX:POL?
```

[:CHANnel<n>]:SENSe:FUNCtion/?

Function Sets the measurement function (voltage or current) or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:FUNCtion VOLTage|CURRent`

VOLTage	Selects voltage.
CURRent	Selects current.

`[:CHANnel<n>]:SENSe:FUNCtion?`

→ VOLT	Set to voltage.
→ CURR	Set to current.

Example
```
:SENS:FUNC VOLT
:CHAN2:SENS:FUNC CURR
:CHAN1:SENS:FUNC?
```

[:CHANnel<n>]:SENSe:[:VOLTage]:RANGe/?

Function Sets the voltage measurement range (200 mV, 2 V, 7 V, or 18 V) or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:[:VOLTage]:RANGe <voltage>|MINimum|MAXimum|UP|DOWN`

<voltage>	Specify any voltage range. The smallest range that includes the specified voltage will be selected.
MINimum	Sets the minimum value (= 200 mV).
MAXimum	Sets the maximum value (= 18 V).
UP	Increases the range by one level.
DOWN	Decreases the range by one level.

`[:CHANnel<n>]:SENSe:[:VOLTage]:RANGe?`

→ 200E-3	Set to 200 mV range.
→ 2E+0	Set to 2 V range.
→ 7E+0	Set to 7 V range.
→ 18E+0	Set to 18 V range.

Example
```
:SENS:VOLT:RANG 7
:CHAN2:SENS:VOLT:RANG MAX
:CHAN1:SENS:VOLT:RANG 200mV
:CHAN1:SENS:VOLT:RANG?
```

Description If VOLTage is omitted, the GS820 assumes that the present measurement function was specified.

[:CHANnel<n>]:SENSe:[:VOLTage]:RANGe:AUTO/?

Function Turns ON/OFF the auto measurement range or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:[:VOLTage]:RANGe:AUTO 1|0|ON|OFF`

1 or ON	Enables auto range.
0 or OFF	Enables fixed range.

`[:CHANnel<n>]:SENSe:[:VOLTage]:RANGe:AUTO?`

→ 1	Set to auto range.
→ 0	Set to fixed range.

Example
```
:SENS:RANG:AUTO ON
:CHAN2:SENS:VOLT:RANG:AUTO 0
:CHAN1:SENS:VOLT:RANG:AUTO?
```

[:CHANnel<n>]:SENSe:[:CURRent]:RANGe/?

Function Sets the current measurement range (200 nA, 2 μA, 20 μA, 200μA, 2 mA, 20 mA, 200 mA, 1 A, or 3 A) or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:[:CURRent]:RANGe <current>|MINimum|MAXimum|UP|DOWN`

<current>	Specify any current range. The smallest range that includes the specified current will be selected.
MINimum	Sets the minimum value (= 200 nA).
MAXimum	Sets the maximum value (= 3.2 A).
UP	Increases the range by one level.
DOWN	Decreases the range by one level.

`[:CHANnel<n>]:SENSe:[:CURRent]:RANGe?`

→ 200E-9	Set to 200 nA range.
→ 2E-6	Set to 2 μA range.
→ 20E-6	Set to 20 μA range.
→ 200E-6	Set to 200 μA range.
→ 2E-3	Set to 2 mA range.
→ 20E-3	Set to 20 mA range.
→ 200E-3	Set to 200 mA range.
→ 1.2E+0	Set to 1 A range.
→ 3.2E+0	Set to 3 A range.

Example
```
:SENS:CURR:RANG 1.2
:CHAN2:SENS:CURR:RANG MAX
:CHAN2:SENS:CURR:RANG 20mA
:CHAN2:SENS:CURR:RANG?
```

Description If CURRent is omitted, the GS820 assumes that the present measurement function was specified.

[:CHANnel<n>]:SENSe:[:CURRent]:RANGe:AUTO/?

Function Turns ON/OFF the auto measurement range or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:[:CURRent]:RANGe:AUTO 1|0|ON|OFF`

1 or ON	Enables auto range.
0 or OFF	Enables fixed range.

`[:CHANnel<n>]:SENSe:[:CURRent]:RANGe:AUTO?`

→ 1	Set to auto range.
→ 0	Set to fixed range.

Example
```
:SENS:RANG:AUTO ON
:CHAN2:SENS:CURR:RANG:AUTO 0
:CHAN1:SENS:CURR:RANG:AUTO?
```

Description If CURRent is omitted, the GS820 assumes that the present measurement function was specified.

[:CHANnel<n>]:SENSe:[:RESistance]:RANGe/?

Function Sets the resistance measurement range (200 mΩ, 2 Ω, or 20 Ω to 200 MΩ) in resistance meter mode or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:[:RESistance]:RANGe <resistance>|MINimum|MAXimum|UP|DOWN`

<resistance>	Specify any resistance range. The smallest range that includes the specified current will be selected.
MINimum	Sets the minimum value (= 200 mΩ).
MAXimum	Sets the maximum value (= 200 MΩ).
UP	Increases the range by one level.
DOWN	Decreases the range by one level.

`[:CHANnel<n>]:SENSe:[:RESistance]:RANGe?`

→ 200E-3	Set to 200 mΩ range.
→ 2E+0	Set to 2 Ω range.
→ 20E+0	Set to 20 Ω range.
→ 200E+0	Set to 200 Ω range.
→ 2E+3	Set to 2 kΩ range.
→ 20E+3	Set to 20 kΩ range.
→ 200E+3	Set to 200 kΩ range.
→ 2E+6	Set to 2 MΩ range.
→ 20E+6	Set to 20 MΩ range.
→ 200E+6	Set to 200 MΩ range.

Example
```
:SENS:RES:RANG 20E+3
:CHAN2:SENS:RES:RANG MAX
:CHAN1:SENS:RES:RANG 200kohm
:CHAN1:SENS:RES:RANG?
```

Description If RESistance is omitted, the GS820 assumes that the present measurement function was specified.

[:CHANnel<n>]:SENSe:[:RESistance]:RANGe:AUTO/?

Function Turns ON/OFF the auto measurement range or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:[:RESistance]:RANGe:AUTO 1|0|ON|OFF`

1 or ON	Enables auto range.
0 or OFF	Enables fixed range.

`[:CHANnel<n>]:SENSe:[:RESistance]:RANGe:AUTO?`

→ 1	Set to auto range.
→ 0	Set to fixed range.

Example
```
:SENS:RANG:AUTO ON
:CHAN2:SENS:RES:RANG:AUTO 0
:CHAN1:SENS:RES:RANG:AUTO?
```

Description If RESistance is omitted, the GS820 assumes that the present measurement function was specified.

[:CHANnel<n>]:SENSe:NPLC/?

Function Sets the measurement integration time in terms of PLC or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:NPLC <real number>|MINimum|MAXimum`

<real number>	Specify any integration time in terms of PLC.
MINimum	Sets the minimum value (= 0.001).
MAXimum	Sets the maximum value (= 25).

`[:CHANnel<n>]:SENSe:NPLC?`

<real number>	The present integration time in terms of PLC.

Example
```
:SENS:NPLC 5
:CHAN2:SENS:NPLC MIN
:CHAN1:SENS:NPLC 0.01
:CHAN1:SENS:NPLC?
```

[:CHANnel<n>]:SENSe:ITIMe/?

Function Sets the measurement integration time in terms of time or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:ITIMe <time>|MINimum|MAXimum`

<time>	Specify any integration time in terms of time.
MINimum	Sets the minimum value. Set to 20 μs for line frequency of 50Hz and 16.6 μs for 60 Hz.
MAXimum	Sets the maximum value. Set to 500 ms for line frequency of 50 Hz and 416.6 ms for 60 Hz.

`[:CHANnel<n>]:SENSe:ITIMe?`

<time>	The present integration time in terms of time.

Example
```
:SENS:ITIM 20E-3
:CHAN2:SENS:ITIM MIN
:CHAN1:SENS:ITIM 16.666ms
:CHAN1:SENS:ITIM?
```

[:CHANnel<n>]:SENSe:DELay/?

Function Sets the measurement delay or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:DELay <time>|MINimum|MAXimum`

<time>	Specify any measurement delay value.
MINimum	Sets the minimum value (= 0 s).
MAXimum	Sets the maximum value (= 3600 s).

`[:CHANnel<n>]:SENSe:DELay?`

→ <time>	The present measurement delay time

Example
```
:SENS:DEL 2.5E-3
:CHAN2:SENS:DEL MIN
:CHAN1:SENS:DEL 1.25ms
:CHAN1:SENS:DEL?
```

[:CHANnel<n>]:SENSe:AVERage[:STATe]/?

Function Turns ON/OFF the average function or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:AVERage[:STATe] 1|0|ON|OFF`

1 or ON	Turns the average function ON.
0 or OFF	Turns the average function OFF.

`[:CHANnel<n>]:SENSe:AVERage[:STATe]?`

→ 1	The average function is ON.
→ 0	The average function is OFF.

Example
```
:SENS:AVER ON
:CHAN2:SENS:AVER:STAT 0
:CHAN1:SENS:ACER:STAT?
```

[:CHANnel<n>]:SENSe:AVERage:COUNt/?

Function Sets the average count or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:AVERage:COUNt <integer>|MINimum|MAXimum`

<integer>	Specify any average count.
MINimum	Sets the minimum value (= 2).
MAXimum	Sets the maximum value (= 256).

`[:CHANnel<n>]:SENSe:AVERage:COUNt?`

→ <integer>	The present average count.

Example
```
:SENS:AVER:COUN MAX
:CHAN2:SENS:AVER:COUN 5
:CHAN1:SENS:AVER:COUN?
```

[:CHANnel<n>]:SENSe:ZERO:AUTO/?

Function Turns ON/OFF the auto zero function or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:ZERO:AUTO 1|0|ON|OFF`

1 or ON	Turns the auto zero function ON.
0 or OFF	Turns the auto zero function OFF.

`[:CHANnel<n>]:SENSe:ZERO:AUTO?`

→ 1	The auto zero function is ON.
→ 0	The auto zero function is OFF.

Example
```
:SENS:ZERO:AUTO ON
:CHAN2:SENS:ZERO:AUTO 0
:CHAN1:SENS:ZERO:AUTO?
```

[:CHANnel<n>]:SENSe:ZERO:EXECute

Function Executes zero calibration.

Syntax `[:CHANnel<n>]:SENSe:ZERO:EXECute`

Example
```
:SENS:ZERO:EXEC
:CHAN2:SENS:ZERO:EXEC
```

[:CHANnel<n>]:SENSe:REMote/?

Function Turns ON/OFF the wiring system (ON for 4W and OFF for 2W) or queries the current setting.

Syntax `[:CHANnel<n>]:SENSe:REMote 1|0|ON|OFF`

1 or ON	Sets to remote sense (4W).
0 or OFF	Sets to local sense (2W).

`[:CHANnel<n>]:SENSe:REMote?`

→ 1	Set to remote sense (4W).
→ 0	Set to local sense (2W).

Example
```
:SENS:REM ON
:CHAN2:SENS:REM 0
:CHAN1:SENS:REM?
```

16.2.6 Computation Commands (CALCulate Group)

[:CHANnel<n>]:CALCulate:NULL[:STATe]/?

Function Turns ON/OFF the NULL computation function or queries the current setting.

Syntax `[:CHANnel<n>]:CALCulate:NULL[:STATe] 1|0|ON|OFF`

1 or ON	Turns the NULL computation function ON.
0 or OFF	Turns the NULL computation function OFF.

`[:CHANnel<n>]:CALCulate:NULL[:STATe]?`

→ 1	The NULL computation function is ON.
→ 0	The NULL computation function is OFF.

Example
```
:CALC:NULL ON
:CHAN2:CALC:NULL:STAT 0
:CHAN1:CALC:NULL:STAT?
```

[:CHANnel<n>]:CALCulate:NULL:OFFSet/?

Function Sets the NULL computation offset value or queries the current setting.

Syntax `[:CHANnel<n>]:CALCulate:NULL:OFFSet <real number>`

<real number>	Specify any NULL computation offset value.

`[:CHANnel<n>]:CALCulate:NULL:OFFSet?`

→ <real number>	The present NULL computation offset value.

Example
```
:CALC:NULL:OFFS -1.23E-3
:CHAN2:CALC:NULL:OFFS 1.23E-3
:CHAN1:CALC:NULL:OFFS?

:CHAN2:CALC:MATH:STAT 0
:CHAN1:CALC:MATH:STAT?
```

[:CHANnel<n>]:CALCulate:MATH[:STATe]/?

Function Turns ON/OFF the equation computation function or queries the current setting.

Syntax `[:CHANnel<n>]:CALCulate:MATH[:STATe] 1|0|ON|OFF`

1 or ON	Turns the equation computation function ON.
0 or OFF	Turns the equation computation function OFF.

`[:CHANnel<n>]:CALCulate:MATH[:STATe]?`

→ 1	The equation computation function is ON.
→ 0	The equation computation function is OFF.

Example `:CALC:MATH ON`

[:CHANnel<n>]:CALCulate:MATH:SELect/?

Function Sets the equation definition file or queries the current setting.

Syntax `[:CHANnel<n>]:CALCulate:MATH:SELect <character string>`

<character string>	Specify any MATH definition file name.
NONE	MATH definition file not selected condition.

`[:CHANnel<n>]:CALCulate:MATH:SELect?`

→ <character string>	The present MATH definition file name.
→ NONE	The MATH definition file is not selected.

Example
```
:CALC:MATH:SEL "Sinusoid.txt"
:CHAN2:CALC:MATH:SEL?
```

[:CHANnel<n>]:CALCulate:MATH:CATalog?

Function Queries a list of equation definition files.

Syntax `[:CHANnel<n>]:CALCulate:MATH:CATalog?`

→ <character string>,...	A list of MATH definition file names.

Example `:CALC:MATH:CAT?`

[:CHANnel<n>]:CALCulate:MATH:DELete

Function Deletes a equation definition file.

Syntax `[:CHANnel<n>]:CALCulate:MATH:DELete <character string>`

<character string>	The name of the MATH definition file to be deleted.

Example `:CALC:MATH:DEL "Sinusoid.txt"`

[:CHANnel<n>]:CALCulate:MATH:PARameter:A/?

Function Sets equation parameter A or queries the current setting.

Syntax `[:CHANnel<n>]:CALCulate:MATH:PARameter:A <real number>`

<real number>	Specify any parameter A value.

`[:CHANnel<n>]:CALCulate:MATH:PARameter:A?`

→ <real number>	The present parameter A value.

Example
```
:CALC:MATH:PAR:A 1.23E-3
:CHAN2:CALC:MATH:PAR:A -1.23E-3
:CHAN1:CALC:MATH:PAR:A?
```

[:CHANnel<n>]:CALCulate:MATH:PARameter:B/?

Function Sets equation parameter B or queries the current setting.

Syntax
```
[:CHANnel<n>]:CALCulate:MATH:PARameter:B <real number>
```
<real number> Specify any parameter B value.
```
[:CHANnel<n>]:CALCulate:MATH:PARameter:B?
```
→ <real number> The present parameter B value.

Example
```
:CALC:MATH:PAR:B 1.23E-3
:CHAN2:CALC:MATH:PAR:B -1.23E-3
:CHAN1:CALC:MATH:PAR:B?
```

[:CHANnel<n>]:CALCulate:MATH:PARameter:C/?

Function Sets equation parameter C or queries the current setting.

Syntax
```
[:CHANnel<n>]:CALCulate:MATH:PARameter:C <real number>
```
<real number> Specify any parameter C value.
```
[:CHANnel<n>]:CALCulate:MATH:PARameter:C?
```
→ <real number> The present parameter C value.

Example
```
:CALC:MATH:PAR:C 1.23E-3
:CHAN2:CALC:MATH:PAR:C -1.23E-3
:CHAN1:CALC:MATH:PAR:C?
```

[:CHANnel<n>]:CALCulate:MATH:LIMit[:STATe]/?

Function Turns ON/OFF the comparison operation function or queries the current setting.

Syntax
```
[:CHANnel<n>]:CALCulate:MATH:LIMit[:STATe] 1|0|ON|OFF
```
1 or ON Turns the comparison operation function ON.

0 or OFF Turns the comparison operation function OFF.
```
[:CHANnel<n>]:CALCulate:MATH:LIMit[:STATe]?
```
→ 1 The comparison operation function is ON.

→ 0 The comparison operation function is OFF.

Example
```
:CALC:LIM ON
:CHAN2:CALC:LIM:STAT 0
:CHAN1:CALC:LIM:STAT?
```

[:CHANnel<n>]:CALCulate:MATH:LIMIT:UPPer/?

Function Sets the upper limit for comparison or queries the current setting.

Syntax
```
[:CHANnel<n>]:CALCulate:MATH:LIMIT:UPPer <real number>
```
<real number> Specify any upper limit for comparison.
```
[:CHANnel<n>]:CALCulate:MATH:LIMIT:UPPer?
```
→ <real number> The present upper limit for comparison.

Example
```
:CALC:LIM:UPP 1.23E-3
:CHAN2:CALC:LIM:UPP -1.23E-3
:CHAN1:CALC:LIM:UPP?
```

[:CHANnel<n>]:CALCulate:MATH:LIMIT:LOWer/?

Function Sets the lower limit for comparison or queries the current setting.

Syntax
```
[:CHANnel<n>]:CALCulate:MATH:LIMIT:LOWer <real number>
```
<real number> Specify any lower limit for comparison.
```
[:CHANnel<n>]:CALCulate:MATH:LIMIT:LOWer?
```
→ <real number> The present lower limit for comparison.

Example
```
:CALC:LIM:LOW 1.23E-3
:CHAN2:CALC:LIM:LOW -1.23E-3
:CHAN1:CALC:LIM:LOW?
```

16.2.7 Measured Value Read Commands (INITiate, FETCh, READ, MEASure Group)

For the procedure on how to use the measured value read commands, see the sample programs.

[:CHANnel<n>]:INITiate

Function Clears the measured result.

Syntax `[:CHANnel<n>]:INITiate [DUAL]`

DUAL Requests the command on two channels.
If DUAL is not specified, the request is made on a specified channel.

Example
```
:INIT
:CHAN2:INIT
:INIT DUAL
```

[:CHANnel<n>]:FETCh?

Function Queries the measured results.

Syntax `[:CHANnel<n>]:FETCh? [DUAL]`

DUAL Requests the command on two channels.
If DUAL is not specified, the request is made on a specified channel.

→ <real number>
Measured result of CHANNel<n>

→ <real number 1>,<real number 2>
Measured result of CH1, measured result of CH2

Example
```
:FETC?
:CHAN2:FETC?
:FETC? DUAL
```

[:CHANnel<n>]:READ?

Function Clears the measured result and queries the measured result.

Syntax `[:CHANnel<n>]:READ? [DUAL]`

DUAL Requests the command on two channels.
If DUAL is not specified, the request is made on a specified channel.

→ <real number>
Measured result of CHANNel<n>

→ <real number 1>,<real number 2>
Measured result of CH1, measured result of CH2

Example
```
:READ?
:CHAN2:MEAS?
:MEAS? DUAL
```

[:CHANnel<n>]:MEASure?

Function Clears the measured result, generates a trigger, and queries the measured result.

Syntax `[:CHANnel<n>]:MEASure? [DUAL]`

DUAL Requests the command on two channels.
If DUAL is not specified, the request is made on a specified channel.

→ <real number>
Measured result of CHANNel<n>

→ <real number 1>,<real number 2>
Measured result of CH1, measured result of CH2

Example
```
:MEAS?
:CHAN2:MEAS?
:MEAS? DUAL
```

16.2.8 Trigger Commands (STARt and TRIGger Groups)

:STARt

Function Generates a sweep start.
Syntax :STARt
Example :STAR

:TRIGger

Function Generates a trigger (equivalent to TRG).
Syntax :TRIGger
Example :TRIG

:TRIGger:AUXiliary

Function Generates an auxiliary trigger.
Syntax :TRIGger:AUXiliary
Example :TRIG:AUX

:TRIGger:HOLD/?

Function Turns ON/OFF the hold off function or queries the current setting.
Syntax :TRIGger:HOLD 1|0|ON|OFF
1 or ON Enables trigger hold.
0 or OFF Releases trigger hold.
:TRIGger:HOLD?
→ 1 Trigger hold enabled.
→ 0 Trigger hold disabled.
Example :TRIG:HOLD ON
:TRIG:HOLD 0
:TRIG:HOLD?

:TRIGger:TIMer<n>/?

Function Sets the period of Timer1 or 2 or queries the current setting.
Syntax :TRIGger:TIMer<n> <time>|MINimum|MAXimum
<time> Specify any timer period.
MINimum Sets the minimum value (= 100 μs).
MAXimum Sets the maximum value (= 3600 s).
:TRIGger:TIMer<n>?
→ <time> The present timer period.
Example :TRIG:TIM1 250E-6
:TRIG:TIM2 1ms
:TRIG:TIM1?

:TRIGger:TSYNc

Function Executes the phase alignment of Timer1 and 2.
Syntax :TRIGger:TSYNc
Example :TRIG:TSYN

16.2.9 Store/Recall Commands (TRACe Group)

:TRACe[:STATe]/?

Function Turns ON/OFF the storage function or queries the current setting.

Syntax `:TRACe[:STATe] 1|0|ON|OFF`

1 or ON Starts the storage operation.

0 or OFF Stops the storage operation.

`:TRACe[:STATe]?`

→ 1 Storage operation in progress.

→ 0 Storage operation not in progress.

Example
```
:TRAC:STAT ON
:TRAC 0
:TRAC:STAT?
```

:TRACe:BINary:REPLy/?

Function Sets/queries the type of stored data.

Syntax `:TRACe:BINary:REPLy BINary|ASCii`

`BINary` Selects binary.

`ASCii` Selects ASCII.

`:TRACe:BINary:REPLy?`

→`BIN` The current type is binary

→`ASC` The current type is ASCII

Example
```
:TRAC:BIN:REPL BIN
:TRAC:BIN:REPL?
```

Explanation When the data format of stored data is set to binary, and the stored data type is set to binary, the response to the `:TRAC:CHAN<n>:DATA:READ?` command is the data string when in binary format. When the data format of stored data is set to binary, and the stored data type is set to ASCII, the response to the `:TRAC:CHAN<n>:DATA:READ?` command is the text string when TEXT is specified.

:TRACe:FILE:CREate/?

Function Turns ON/OFF the result file generation function or queries the current setting.

Syntax `:TRACe:FILE:CREate 1|0|ON|OFF`

1 or ON Turns the result file generation function ON.

0 or OFF Turns the result file generation function OFF.

`:TRACe:FILE:CREate?`

→ 1 The result file generation function is ON.

→ 0 The result file generation function is OFF.

Example
```
:TRAC:FILE:CRE ON
:TRAC:FILE:CRE 0
:TRAC:FILE:CRE?
```

:TRACe:POINts/?

Function Sets the storage count or queries the current setting.

Syntax `:TRACe:POINts <integer>|MINimum|MAXimum`

<integer> Specify any storage count.

MINimum Sets the minimum value (= 1).

MAXimum Sets the maximum value (= 100000).

`:TRACe:POINts?`

→ <integer> The present storage count.

Example
```
:TRAC:POIN MAX
:TRAC:POIN 1000
:TRAC:POIN?
```

:TRACe:CHANnel<n>:ACTual?

Function Queries the actual number of stored points.

Syntax `:TRACe:CHANnel<n>:ACTual?`

→ <integer> The actual number of stored points.

Example
```
:TRAC:CHAN2:ACT?
```

:TRACe:CHANnel<n>:DATA:FORMat/?

Function Sets the read data format (ASCII or binary) of the stored data or queries the current setting.

Syntax `:TRACe:CHANnel<n>:DATA:FORMat ASCii|BINary`

ASCii ASCII format.

BINary Binary format.

`:TRACe:CHANnel<n>:DATA:FORMat?`

→ ASC Set to ASCII format.

→ BIN Set to binary format.

Example
```
:TRAC:CHAN1:DATA:FORM BIN
:TRAC:CHAN1:DATA:FORM?
```

:TRACe:CHANnel<n>:DATA:ENDian/?

Function Sets the byte order (Little or Big) used to read the stored results for binary format or queries the current setting.

Syntax `:TRACe:CHANnel<n>:DATA:ENDian LITTle|BIG`

LITTle Sets the byte order of the binary format to Little Endian.

BIG Sets the byte order of the binary format to Big Endian.

`:TRACe:CHANnel<n>:DATA:ENDian?`

→ LITTle Set to Little Endian.

→ BIG Set to Big Endian.

Example
```
:TRAC:CHAN1:DATA:END LITT
:TRAC:CHAN1:DATA:END?
```

:TRACe:CHANnel<n>:DATA:READ?

Function Reads the stored data.

Syntax `:TRACe:CHANnel<n>:DATA:READ? [TM|DO|DI|SF|SL|MF|ML|LC|HC|CP]`

- TM — Requests a timestamp sequence. Binary format is double-precision real number.
- DO — Requests a digital output sequence. Binary format is word.
- DI — Requests a digital input sequence. Binary format is word.
- SF — Requests a source function sequence. Binary format is byte.
- SL — Requests a source level sequence. Binary format is double-precision real number.
- MF — Requests a measurement function sequence. Binary format is byte.
- ML — Requests a measurement level sequence. Binary format is double-precision real number.
- LC — Requests a comparison lower limit sequence. Binary format is double-precision real number.
- HC — Requests a comparison upper limit sequence. Binary format is double-precision real number.
- CP — Requests a comparison result sequence. Binary format is byte.

→ <value 1>,<value 2>... Data sequence for ASCII format

→ <block data> Data sequence for binary format data or text sequence when TEXT is specified.

Example `:TRAC:CHAN1:DATA:READ? ML`

:TRACe:CHANnel<n>:STATistics?

Function Retrieves the statistical values of the stored result.

Syntax `:TRACe:CHANnel<n>:STATistics?`

→ <minimum value>,<maximum value>,<average value>,<standard deviation>

Example `:TRAC:CHAN2:STAT?`

16.2.10 Synchronization Commands (SYNChronize Group)

:SYNChronize:MODE/?

Function Sets the synchronization mode between units (master or slave) or queries the current setting.

Syntax `:SYNChronize:MODE MASTer|SLAVe`

MASTer	Specifies master.
SLAVe	Specifies slave.

`:SYNChronize:MODE?`

→ MASTer	Set to master.
→ SLAVe	Set to slave.

Example
```
:SYNC:MODE SLAV
:SYNC:MODE?
```

:SYNChronize:CHANnel/?

Function Turns ON/OFF the inter-channel synchronous operation or queries the current setting.

Syntax `:SYNChronize:CHANnel 1|0|ON|OFF`

1 or ON	Specifies synchronous operation between channels.
0 or OFF	Specifies asynchronous operation between channels.

`:SYNChronize:CHANnel?`

→ 1	Inter-channel synchronous operation enabled.
→ 0	Inter-channel asynchronous operation enabled.

Example
```
:SYNC:CHAN ON
:SYNC:CHAN?
```

:SYNChronize:EXPand/?

Function Turns ON/OFF the channel expansion function or queries the current setting.

Syntax `:SYNChronize:EXPand 1|0|ON|OFF`

1 or ON	Turns the channel expansion function ON.
0 or OFF	Turns the channel expansion function OFF.

`:SYNChronize:EXPand?`

→ 1	The channel expansion function is turned ON.
→ 0	The channel expansion function is turned OFF.

Example
```
:SYNC:EXP ON
:SYNC:EXP?
```

16.2.11 External I/O Commands (ROUTe Group)

:ROUTe:BNC:STARt/?

Function Sets the signal direction (input or output) of the start BNC or queries the current setting.

Syntax `:ROUTe:BNC:STARt INPut|OUTPut`

INPut	Sets the start BNC to input.
OUTPut	Sets the start BNC to output.

`:ROUTe:BNC:STARt?`

→ INP	Set to input.
→ OUTP	Set to output.

Example
```
:ROUT:BNC:STAR OUTP
:ROUT:BNC:STAR?
```

:ROUTe:BNC:TRIGger/?

Function Sets the signal direction (input or output) of the trigger BNC or queries the current setting.

Syntax `:ROUTe:BNC:TRIGger INPut|OUTPut`

INPut	Sets the trigger BNC to input.
OUTPut	Sets the trigger BNC to output.

`:ROUTe:BNC:TRIGger?`

→ INP	Set to input.
→ OUTP	Set to output.

Example
```
:ROUT:BNC:TRIG INP
:ROUT:BNC:TRIG?
```

:ROUTe:AUXiliary/?

Function Sets the auxiliary trigger output source (CH1 measuring, Timer1, 2, or through) or queries the current setting.

Syntax `:ROUTe:AUXiliary SENSe|TIMer1|TIMer2|THRough`

SENSe	Selects CH1 measuring.
TIMer1	Selects Timer1 (constant period).
TIMer2	Selects Timer2 (constant period).
THRough	Selects through.

`:ROUTe:AUXiliary?`

→ SENS	Set to CH1 measuring.
→ TIM1	Set to Timer1.
→ TIM2	Set to Timer2.
→ THR	Set to through.

Example
```
:ROUT:AUX TIM1
:ROUT:AUX?
```

16.2.12 System Commands (SYSTem Group)

:SYSTem:DISPlay[:STATe]/?

Function Turns ON/OFF the display or queries the current setting.

Syntax `:SYSTem:DISPlay[:STATe] 1|0|ON|OFF`

1 or ON	Turns the display ON.
0 or OFF	Turns the display OFF.

`:SYSTem:DISPlay[:STATe]?`

→ 1	The display is ON.
→ 0	The display is OFF.

Example
```
:SYST:DISP 0
:SYST:DISP:STAT ON
:SYST:DISP:STAT?
```

:SYSTem:DISPlay:BRIGht/?

Function Sets the display brightness or queries the current setting.

Syntax `:SYSTem:DISPlay:BRIGht <integer>|MINimum|MAXimum|UP|DOWN`

<integer>	Specify any brightness.
MINimum	Sets the minimum value (= 1).
MAXimum	Sets the maximum value (= 4).
UP	Increases the brightness by one level.
DOWN	Decreases the brightness by one level.

`:SYSTem:DISPlay:BRIGht?`

→ <integer>	The present brightness.

Example
```
:SYST:DISP:BRIG MIN
:SYST:DISP:BRIG 3
:SYST:DISP:BRIG?
```

:SYSTem:DISPlay:TEXT/?

Function Sets and displays the user message or queries the current setting.

Syntax `:SYSTem:DISPlay:TEXT <character string>`

<character string> User message

`:SYSTem:DISPlay:TEXT?`

→ <character string> Displayed user message.

Example
```
:SYST:DISP:TEXT "User Message"
```

:SYSTem:DISPlay:TEXT:CLEar

Function Clears the user message display.

Syntax `:SYSTem:DISPlay:TEXT:CLEar`

Example
```
:SYST:DISP:CLE
```

:SYSTem:DISPlay:CHANnel

Function Switches the display (CH1 display, CH2 display, or both CH display).

Syntax `:SYSTem:DISPlay:CHANnel 1|2|DUAL`

1	Sets to CH1 display.
2	Sets to CH2 display.
DUAL	Sets to dual channel display.

Example
```
:SYST:DISP:CHAN 1
```

:SYSTem:DISPlay:ERRor

Function Displays the error log screen.

Syntax `:SYSTem:DISPlay:ERRor`

Example
```
:SYST:DISP:ERR
```

:SYSTem:CLOCk:TZONe/?

Function Sets the time zone or queries the current setting.

Syntax `:SYSTem:CLOCk:TZONe <character string>`

<character string> Specify the time difference from GMT using a character string in “±hh:mm” format.
hh = Hours (00 to 23)
mm = Minutes (00 to 59)

`:SYSTem:CLOCk:TZONe?`

→ <character string>
Time difference from GMT “±hh:mm”

Example
```
:SYST:CLOC:TZON "+09:00"
:SYST:CLOC:TZON?
```

:SYSTem:CLOCk:DATE/?

Function Sets the date or queries the current setting.

Syntax `:SYSTem:CLOCk:DATE <character string>`

<character string> Specify the date using a character string in “yyyy/mm/dd” format.
yyyy = Year (2001 to 2099)
mm = Month (01 to 12)
dd = Day (01 to 31)

`:SYSTem:CLOCk:DATE?`

→ <character string>
Date “yyyy/mm/dd” format

Example
```
:SYST:CLOC:DATE "2007/07/31"
:SYST:CLOC:DATE?
```

:SYSTem:CLOCk:TIME/?

Function Sets the time or queries the current setting.
Syntax `:SYSTem:CLOCk:TIME <character string>`
<character string> Specify a character string in "hh:mm:ss" format.
hh = Hours (00 to 23)
mm = Minutes (00 to 59)
ss = Seconds (00 to 59)
`:SYSTem:CLOCk:TIME?`
→ <character string>
Time "hh:mm:ss" format
Example `:SYST:CLOC:TIME "17:30:45"`
`:SYST:CLOC:TIME?`

:SYSTem:CLOCk:ADJust

Function Executes the ±30-s correction.
Syntax `:SYSTem:CLOCk:ADJust`
Example `:SYST:CLOC:ADJ`

:SYSTem:SETup:SAVE

Function Saves the setup data.
Syntax `:SYSTem:SETup:SAVE <character string>`
<character string> The name of the setup data file to be saved.
Example `:SYST:SET:SAVE "XY_Test.txt"`

:SYSTem:SETup:LOAD

Function Loads the setup data.
Syntax `:SYSTem:SETup:LOAD <character string>`
<character string> The name of the setup data file to be loaded.
Example `:SYST:SET:LOAD "XY_Test.txt"`

:SYSTem:SETup:CATalog?

Function Queries the list of setup data files.
Syntax `:SYSTem:SETup:CATalog?`
→ <character string>,...
A list of setup data file names.
Example `:SYST:SET:CAT?`

:SYSTem:SETup:DELete

Function Deletes the setup data file.
Syntax `:SYSTem:SETup:DELete <character string>`
<character string> The name of the setup data file to be deleted.
Example `:SYST:SET:DEL "XY_Test.txt"`

:SYSTem:SETup:PON/?

Function Sets the setup at power-on or queries the current setting.
Syntax `:SYSTem:SETup:PON <character string>`
<character string> Name of the setup data file that is used to start up the GS820.
`:SYSTem:SETup:PON?`
Example `:SYST:SET:PON "XY_Test.txt"`

:SYSTem:ERROR?

Function Queries the error code and description.
Syntax `:SYSTem:ERROR?`
→ <integer>,<character string>
Error code and error message.
Example `:SYST:ERR?`

:SYSTem:LOCal

Function Switches to local mode.
Syntax `:SYSTem:LOCal`
Example `:SYST:LOC`

:SYSTem:REMote

Function Switches to remote mode.
Syntax `:SYSTem:REMote`
Example `:SYST:REM`

:SYSTem:KLOCk/?

Function Turns ON/OFF the key lock function or queries the current setting.
Syntax `:SYSTem:KLOCk 1|0|ON|OFF`
1 or ON Enables key lock.
0 or OFF Releases the key lock.
`:SYSTem:KLOCk?`
→ 1 Key lock enabled.
→ 0 Key lock disabled.
Example `:SYST:KLOC ON`
`:SYST:KLOC?`

:SYSTem:BEEPer/?

Function Turns ON/OFF the beep sound for error occurrences or queries the current setting.

Syntax `:SYSTem:BEEPer 1|0|ON|OFF`

1 or ON	Enables the beep sound.
0 or OFF	Disables the beep sound.

`:SYSTem:BEEPer?`

→ 1	Beep sound enabled.
→ 0	Beep sound disabled.

Example
```
:SYST:BEEP ON
:SYST:BEEP?
```

:SYSTem:LFRequency/?

Function Sets the line frequency (50 Hz or 60 Hz) or queries the current setting.

Syntax `:SYSTem:LFRequency 50|60`

50	Selects 50 Hz.
60	Selects 60 Hz.

`:SYSTem:LFRequency?`

→ 50	Set to 50 Hz.
→ 60	Set to 60 Hz.

Example
```
:SYST:LFR 60
:SYST:LFR?
```

:SYSTem:LFRequency:AUTO/?

Function Turns ON/OFF the line frequency auto selection function or queries the current setting.

Syntax `:SYSTem:LFRequency:AUTO 1|0|ON|OFF`

1 or ON	Turns ON the auto selection of the line frequency.
0 or OFF	Turns OFF the auto selection of the line frequency.

`:SYSTem:LFRequency:AUTO?`

→ 1	Line frequency auto selection is ON.
→ 0	Line frequency auto selection is OFF.

Example
```
:SYST:LFR:AUTO ON
:SYST:LFR:AUTO?
```

:SYSTem:COMMunicate:GPIB:ADDRess/?

Function Sets the GP-IB address or queries the current setting.

Syntax `:SYSTem:COMMunicate:GPIB:ADDRess <integer>`

<integer>	Specify any address between 0 and 30.

`:SYSTem:COMMunicate:GPIB:ADDRess?`

→ <integer>	The present address.

Example
```
:SYST:COMM:GPIB:ADDR 15
:SYST:COMM:GPIB:ADDR?
```

:SYSTem:COMMunicate:RS232:BAUDrate/?

Function Sets the RS-232 baud rate (9600 bps to 115200 bps) or queries the current setting.

Syntax `:SYSTem:COMMunicate:RS232:BAUDrate 9600|14400|19200|38400|57600|115200`

9600	Selects 9600 bps.
14400	Selects 14400 bps.
19200	Selects 19200 bps.
38400	Selects 38400 bps.
57600	Selects 57600 bps.
115200	Selects 115200 bps.

`:SYSTem:COMMunicate:RS232:BAUDrate?`

→ 9600	Set to 9600 bps.
→ 14400	Set to 14400 bps.
→ 19200	Set to 19200 bps.
→ 38400	Set to 38400 bps.
→ 57600	Set to 57600 bps.
→ 115200	Set to 115200 bps.

Example
```
:SYST:COMM:RS232:BAUD 115200
:SYST:COMM:RS232:BAUD?
```

:SYSTem:COMMunicate:RS232:DLENgth/?

Function Sets the RS-232 data length (7 bits or 8 bits) or queries the current setting.

Syntax `:SYSTem:COMMunicate:RS232:DLENgth 7|8`

7	Selects 7 bits.
8	Selects 8 bits.

`:SYSTem:COMMunicate:RS232:DLENgth?`

→ 7	Set to 7 bits.
→ 8	Set to 8 bits.

Example
```
:SYST:COMM:RS232:DLEN 8
:SYST:COMM:RS232:DLEN?
```

:SYSTem:COMMunicate:RS232:PARity/?

Function Sets the RS-232 parity (none, even, or odd) or queries the current setting.

Syntax `:SYSTem:COMMunicate:RS232:PARity NONE|EVEV|ODD`

NONE	Selects no parity.
EVEN	Selects even parity.
ODD	Selects odd parity.

`:SYSTem:COMMunicate:RS232:PARity?`

→ NONE	Set to no parity.
→ EVEN	Set to even parity.
→ ODD	Set to odd parity.

Example
```
:SYST:COMM:RS232:PAR EVEN
:SYST:COMM:RS232:PAR?
```

:SYSTem:COMMunicate:RS232:SBITs/?

Function Sets the RS-232 stop bits (1 bit or 2 bits) or queries the current setting.

Syntax `:SYSTem:COMMunicate:RS232:SBITs 1|2`

1 Selects 1 bit.

2 Selects 2 bits.

`:SYSTem:COMMunicate:RS232:SBITs?`

→ 1 Set to 1 bit.

→ 2 Set to 2 bits.

Example
```
:SYST:COMM:RS232:SBIT 1
:SYST:COMM:RS232:SBIT?
```

:SYSTem:COMMunicate:RS232:PACE/?

Function Sets the RS-232 flow control (none, XON-OFF, or CTS-RTS) or queries the current setting.

Syntax `:SYSTem:COMMunicate:RS232:PACE NONE|XON|HARDware`

NONE Selects no flow control.

XON Selects XON-OFF flow control.

HARDware Selects CTS-RTS flow control.

`:SYSTem:COMMunicate:RS232:PACE?`

→ NONE Set to no flow control.

→ XON Set to XON-OFF flow control.

→ HARD Set to CTS-RTS flow control.

Example
```
:SYST:COMM:RS232:PACE NONE
:SYST:COMM:RS232:PACE?
```

:SYSTem:COMMunicate:RS232:TERMinator/?

Function Sets the RS-232 terminator (CR, LF, or CR+LF) or queries the current setting.

Syntax `:SYSTem:COMMunicate:RS232:TERMinator CR|LF|CRLF`

CR Selects CR.

LF Selects LF.

CRLF Selects CR+LF.

`:SYSTem:COMMunicate:RS232:TERMinator?`

→ CR Set to CR.

→ LF Set to LF.

→ CRLF Set to CR+LF.

Example
```
:SYST:COMM:RS232:TERM LF
:SYST:COMM:RS232:TERM?
```

:SYSTem:COMMunicate:Ether:MAC?

Function Queries the Ethernet MAC address.

Syntax `:SYSTem:COMMunicate:Ether:MAC?`

→ <character string> Returns the MAC address in "00:00:00:00:00:00" format.

Example
```
:SYST:COMM:ETH:MAC?
```

:SYSTem:COMMunicate:Ether:PORT?

Function Queries the command socket port number of Ethernet.

Syntax `:SYSTem:COMMunicate:Ether:PORT?`

→ 7655 The port number of the command socket.

Example
```
:SYST:COMM:ETH:PORT?
```

:SYSTem:COMMunicate:Ether:DHCP/?

Function Turns ON/OFF the DHCP function of Ethernet or queries the current setting.

Syntax `:SYSTem:COMMunicate:Ether:DHCP 1|0|ON|OFF`

1 or ON Enables the DHCP function.

0 or OFF Disables the DHCP function.

`:SYSTem:COMMunicate:Ether:DHCP?`

→ 1 DHCP function enabled

→ 0 DHCP function disabled

Example
```
:SYST:COMM:ETH:DHCP ON
:SYST:COMM:ETH:DHCP?
```

:SYSTem:COMMunicate:Ether:IP/?

Function Sets the Ethernet IP address or queries the current setting.

Syntax `:SYSTem:COMMunicate:Ether:IP <character string>`

<character string> Specify the IP address in "0.0.0.0" format.

`:SYSTem:COMMunicate:Ether:IP?`

→ <character string> The present IP address.

Example
```
:SYST:COMM:ETH:IP "192.168.0.17"
:SYST:COMM:ETH:IP?
```

:SYSTem:COMMunicate:Ether:MASK/?

Function Sets the Ethernet subnet mask or queries the current setting.

Syntax `:SYSTem:COMMunicate:Ether:MASK <character string>`

<character string> Specify the subnet mask in "0.0.0.0" format.

`:SYSTem:COMMunicate:Ether:MASK?`

→ <character string> The present subnet mask.

Example
```
:SYST:COMM:ETH:MASK "255.255.254.0"
:SYST:COMM:ETH:MASK?
```

:SYSTem:COMMunicate:Ether:GATE/?

Function Sets the Ethernet default gateway or queries the current setting.

Syntax `:SYSTem:COMMunicate:Ether:GATE <character string>`

<character string> Specify the default gateway in the “0.0.0.0” format.

`:SYSTem:COMMunicate:Ether:GATE?`

→ <character string> The present default gateway.

Example
```
:SYST:COMM:ETH:GATE "192.168.0.255"
:SYST:COMM:ETH:GATE?
```

:SYSTem:COMMunicate:Ether:TERMinator/?

Function Sets the Ethernet command socket terminator (CR, LF, or CR+LF) or queries the current setting.

Syntax `:SYSTem:COMMunicate:Ether:TERMinator CR|LF|CRLF`

CR	Selects CR.
LF	Selects LF.
CRLF	Selects CR+LF.

`:SYSTem:COMMunicate:Ether:TERMinator?`

→ CR	Set to CR.
→ LF	Set to LF.
→ CRLF	Set to CR+LF.

Example
```
:SYST:COMM:ETH:TERM CRLF
:SYST:COMM:ETH:TERM?
```

:SYSTem:COMMunicate:USB:FUNCtion/?

Function Selects the USB function (storage or USB-TMC) or queries the current setting.

Syntax `:SYSTem:COMMunicate:USB:FUNCtion STORage|TMC`

STORage	Selects the storage function.
TMC	Selects the command control function by way of USB-TMC.

`:SYSTem:COMMunicate:USB:FUNCtion?`

→ STOR	Set to storage function.
→ TMC	Set to command control function by way of USB-TMC.

Example
```
:SYST:COMM:USB:FUNC STOR
:SYST:COMM:USB:FUNC?
```

16.2.13 Status Commands (STATus Group)

:STATus:SOURce:CONDition?

Function Queries the source event condition register.

Syntax `:STATus:SOURce:CONDition?`

→ <integer> The present source event condition register value.

Example `:STAT:SOUR:COND?`

:STATus:SOURce:EVENt?

Function Queries the source event register and clears the register.

Syntax `:STATus:SOURce:EVENt?`

→ <integer> The present source event register value.

Example `:STAT:SOUR:EVEN?`

:STATus:SOURce:ENABle/?

Function Sets the source event enable register or queries the current setting.

Syntax `:STATus:SOURce:ENABle <integer>`

<integer> Specify any value between 0 to 65535.

`:STATus:SOURce:ENABle?`

→ <integer> The present source event enable register value.

Example
```
:STAT:SOUR:ENAB 16385
:STAT:SOUR:ENAB #H4001
:STAT:SOUR:ENAB?
```

:STATus:SENSe:CONDition?

Function Queries the measurement event condition register.

Syntax `:STATus:SENSe:CONDition?`

→ <integer> The present measurement event condition register value.

Example `:STAT:SENS:COND?`

:STATus:SENSe:EVENt?

Function Queries the measurement event register and clears the register.

Syntax `:STATus:SENSe:EVENt?`

→ <integer> The present measurement event register value.

Example `:STAT:SENS:EVEN?`

:STATus:SENSe:ENABle/?

Function Sets the measurement event enable register or queries the current setting.

Syntax `:STATus:SENSe:ENABle <integer>`

<integer> Specify any value between 0 to 65535.

`:STATus:SENSe:ENABle?`

→ <integer> The present source event enable register value.

Example
```
:STAT:SOUR:ENAB 16385
:STAT:SENS:ENAB #H4001
:STAT:SENS:ENAB?
```

16.2.14 Common Commands

*IDN?

Function Queries the device information.
Syntax *IDN?
→ "YOKOGAWA, 765601, serial number, firmware version"
Example *IDN?

*OPT?

Function Queries the option information.
Syntax *OPT?
→ NONE
Example *OPT?

*TRG

Function Generates a trigger (equivalent to :TRIGger).
Syntax *TRG
Example *TRG

*CAL?

Function Executes the source offset calibration of both channels and queries the result.
Syntax *CAL?
Example *CAL?

*TST?

Function Performs a self-test and queries the result.
Syntax *TST?
→ 0 Normal completion.
→ Non-zero integer Test failed.
Example *TST?

*RST

Function Initializes the settings to factory default values.
Syntax *RST
Example *RST

*SAV

Function Saves the setup data.
Syntax *SAV 1|2|3|4
1 Saves setup data to Setup1.txt.
2 Saves setup data to Setup2.txt.
3 Saves setup data to Setup3.txt.
4 Saves setup data to Setup4.txt.
Example *SAV 2

*RCL

Function Loads the setup data.
Syntax *RCL 1|2|3|4
1 Loads setup data from Setup1.txt.
2 Loads setup data from Setup2.txt.
3 Loads setup data from Setup3.txt.
4 Loads setup data from Setup4.txt.
Example *RCL 2

*CLS

Function Clears the event register and error queue.
Syntax *CLS
Example *CLS

*STB?

Function Queries the status byte and clears the SRQ.
Syntax *STB?
→ <integer> The present status byte value.
Example *STB?

*SRE/?

Function Sets the service request enable register or queries the current setting.
Syntax *SRE <integer>
<integer> Specify any value between 0 to 255.
*SRE?
→ <integer> The present service request enable register value.
Example *SRE 3
*SRE?

*ESR?

Function Queries the standard event register.
Syntax *ESR
*ESR?
→ <integer> The present status byte value.
Example *ESR 25
*ESR?

*ESE/?

Function Sets the standard event enable register or queries the current setting.
Syntax *ESE <integer>
<integer> Specify any value between 0 to 255.
*ESE?
→ <integer> The present standard event enable register value.
Example *ESE 6
*ESE?

***OPC**

Function Generates a standard event OPC when the execution of all previous commands is completed.
Syntax `*OPC`
Example `*OPC`

***OPC?**

Function Generates a response when the execution of all previous commands is completed.
Syntax `*OPC?`
→ 1 Execution of all commands completed.
Example

***WAI**

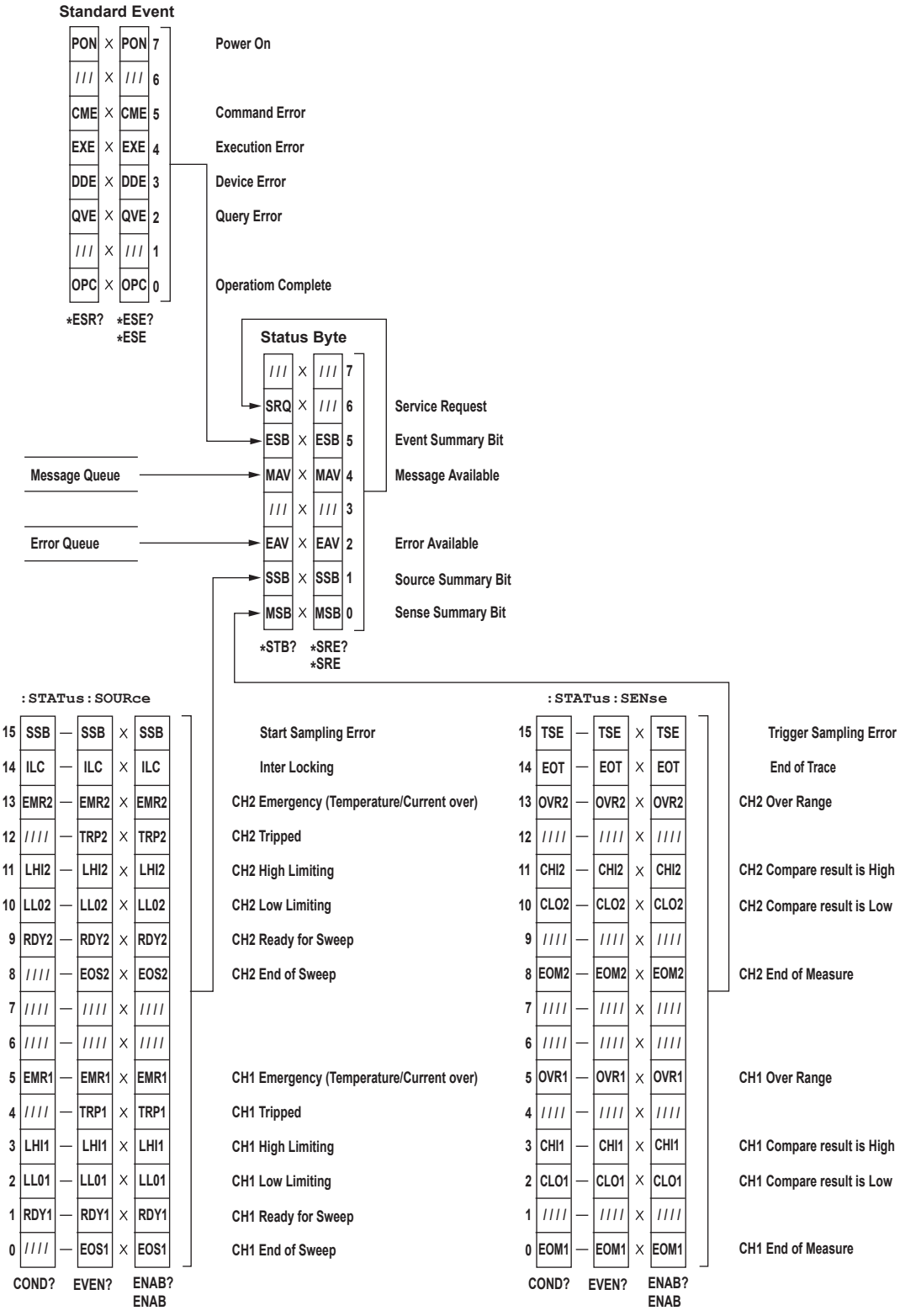
Function Waits for the completion of the overlap command.
Syntax `*WAI`
Example `*WAI`

16.3 Status Reports

16.3.1 Status Reports

Status Reports

The figure below shows the status report that is read by serial polling. This status report is an extended version of the status report defined in IEEE 488.2-1992.



Registers and Queues That Affect the Status Byte

Registers that affect the bits of the status byte are shown below.

- Standard event register: Sets bit 5 (ESB) of the status byte to 1 or 0.
- Output queue: Sets bit 4 (MAV) of the status byte to 1 or 0.
- Source event register: Sets bit 1 (SSB) of the status byte to 1 or 0.
- Measure event register: Sets bit 0 (MSB) of the status byte to 1 or 0.
- Error queue: Sets bit 2 (EAV) of the status byte to 1 or 0.

Enable Registers

Registers that are used to mask a bit so that the bit will not affect the status byte even when it is set to 1, are shown below.

- Status byte: Mask the bits using the service request enable register.
- Standard event register: Mask the bits using the standard event enable register.
- Source event register: Mask the bits using the source event enable register.
- Measurement event register: Mask the bits using the measurement event enable register.

Reading and Writing to the Registers

For example, the *ESE command is used to set the bits in the standard event enable register to 1's or 0's. The *ESE? command is used to query whether the bits in the standard event enable register are 1's or 0's. For details regarding these commands, see section 16.2.14.

16.3.2 Status Byte

Status Byte

	SRQ						
7	6	ESB	MAV	3	EAV	SSB	MSB

Bits 3 and 7

Not used (always 0)

Bit 0 MSB (Measure Event Summary Bit)

Set to 1 when the logical product of each bit of the measure event register and each bit of the corresponding enable register is 1. See the page 16-49.

Bit 1 SSB (Source Event Summary Bit)

Set to 1 when the logical product of each bit of the source event register and each bit of the corresponding enable register is 1. See the page 16-47.

Bit 2 EAV (Error Available)

Set to 1 when the error queue is not empty. In other words, this bit is set to 1 when an error occurs. See the page 16-50.

Bit 4 MAV (Message Available)

Set to 1 when the output queue is not empty. In other words, this bit is set to 1 when there is data to be transmitted. See the page 16-50.

Bit 5 ESB (Event Summary Bit)

Set to 1 when the logical product of the standard event register and the corresponding event register is 1. See the page 16-45.

Bit 6 RQS (Request Service)/MSS (Master Status Summary)

Set to 1 when the logical AND of the status byte excluding Bit 6 and the service request enable register is 1. In other words, this bit is set to 1 when the instrument is requesting service from the controller. RQS is set to 1 when the MSS bit changes from 0 to 1, and cleared when serial polling is carried out or when the MSS bit changes to 0.

Bit Masking

To mask a bit in the status byte so that it does not cause an SRQ, set the corresponding bit of the service request enable register to 0.

For example, to mask bit 2 (EAV) so that service is not requested when an error occurs, set bit 2 of the service request enable register to 0. This can be done using the *SRE command. To query whether each bit of the service request enable register is 1 or 0, use *SRE?. For details on the *SRE command, see section 16.2.14.

Status Byte Operation

A service request is issued when bit 6 of the status byte becomes 1. Bit 6 is set to 1 when any of the other bits becomes a 1 (when the corresponding bit of the service request enable register is also set to 1).
For example, if an event occurs and the logical AND of the standard event register and the corresponding enable register becomes a 1, then bit 5 (ESB) is set to 1. In this case, if bit 5 of the service request enable register is 1, bit 6 (MSS) is set to 1, thus requesting service from the controller.
In addition, you can also check what type of event occurred by reading the contents of the status byte.

Reading the Status Byte

The following two ways to read the contents of the status byte:

Inquiry using the *STB? query

A *STB? query causes bit 6 to be a MSS bit. This causes the MSS to be read. After completion of the read-out, none of the bits in the status byte will be cleared.

Serial Polling

Serial polling causes bit 6 to be a RQS bit. This causes RQS to be read. After completion of the read-out, only RQS is cleared. MSS cannot be read using serial polling.

Clearing the Status Byte

There are no ways to clear all the bits of the status byte. The bits that are cleared for each operation are shown below.

When a query is made using the *STB? command

None of the bits are cleared.

When serial polling is executed

Only the RQS bit is cleared.

When a *CLS command is received.

Receiving the *CLS command will not clear the status byte itself, but the contents of the standard event register that affect the status byte. As a result, the corresponding bits in the status byte are cleared, except bit 4 (MAV), since the output queue cannot be emptied by the *CLS command. However, the output queue will also be cleared if the *CLS command is received just after a program message terminator.

16.3.3 Standard Event Register

Standard Event Register

7	6	5	4	3	2	1	0
PON	URQ	CME	EXE	DDE	QVE	RQC	OPC

Bit 7 PON (Power ON)

Set to 1 when the instrument is turned ON.

Bit 6 URQ (User Request)

Not used (always 0)

Bit 5 CME (Command Error)

Set to 1 when there is an error in the command syntax.

Example Incorrectly spelled command name; “9” used in octal data.

Bit 4 EXE (Execution Error)

Set to 1 when the command syntax is correct, but the command cannot be executed in the current state of the instrument.

Example Parameters are outside the range.

Bit 3 DDE (Device Error)

Set to 1 when a command cannot be executed for internal reasons other than a command syntax error and command execution error.

Bit 2 QVE (Query Error)

Set to 1 when a query command is transmitted, but the error queue is empty or the data are lost.

Example No response data; data is lost due to an overflow in the output queue.

Bit 1 RQC (Request Control)

Not used (always 0)

Bit 0 OPC (Operation Complete)

Set to 1 when the operation designated by the *OPC command (see section 16.2.14) is completed.

Bit Masking

To mask a certain bit of the standard event register so that it does not cause bit 5 (ESB) of the status byte to change, set the corresponding bit of the standard event enable register to 0.
For example, to mask bit 2 (QYE) so that ESB will not be set to 1 even if a query error occurs, set bit 2 of the standard event enable register to 0. This can be done using the *ESE command. To inquire whether each bit of the standard event enable register is 1 or 0, use the *ESE?. For details on the *ESE command, see section 16.2.14.

Standard Event Register Operation

The standard event register is a register for the eight types of events that occur inside the instrument. Bit 5 (ESB) of the status byte is set to 1 when any of the bits in this register becomes 1 (or when the corresponding bit of the standard event enable register becomes 1).
Example

1. A query error occurs.
2. Bit 2 (QYE) is set to 1.
3. Bit 5 (ESB) of the status byte is set to 1 if bit 2 of the standard event enable register is 1.

In addition, you can also check what type of event occurred in the instrument by reading the contents of the standard event register.

Reading the Standard Event Register

The *ESR? command can be used to read the contents of the standard event register. After the register is read, it is cleared.

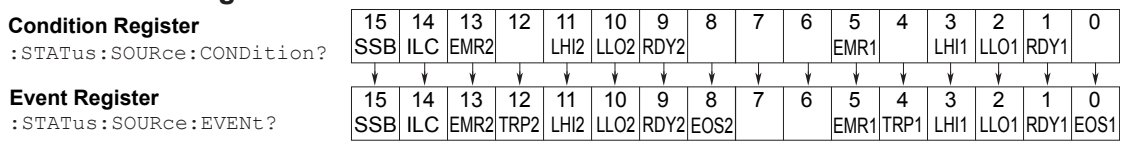
Clearing the Standard Event Register

The standard event register is cleared in the following three cases.

- When the contents of the standard event register are read using the *ESR command.
- When a *CLS command is received.
- When the instrument is power cycled.

16.3.4 Source Event Register

Source Event Register



Bit 15 SSB (Start Sampling Error)
The bit in the condition register temporarily set to 1 if an overlapped sweep start is applied before the sweep operation is completed and a sampling error occurs. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 14 ILC (Inter Locking)
The bit in the condition register is set to 1 during interlock. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 13 EMR2 (CH2 Emergency)
The bit in the condition register is set to 1 if the temperature error or overcurrent protection of CH2 is activated and the GS820 needs to be turned OFF. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 12 TRP2 (CH2 Tripped)
The bit in the event register is set to 1 if a trip occurs on CH2 and the output is turned OFF.

Bit 11 LHI2 (CH2 High Limiting)
The bit in the condition register is set to 1 if the high limiter of CH2 is activated. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 10 LLO2 (CH2 Low Limiting)
The bit in the condition register is set to 1 if the low limiter of CH2 is activated. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 9 RDY (Ready for Sweep)
The bit in the condition register is set to 1 if the CH2 is ready to sweep and 0 if the sweep operation is in progress. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 8 EOS (End of Sweep) on CH2
The bit in the condition register is set to 1 if the CH2 sweep operation is completed.

Bit 7
Not used (always 0)

Bit 6
Not used (always 0)

Bit 5 EMR1 (CH1 Emergency)
The bit in the condition register is set to 1 if the temperature error or overcurrent protection of CH1 is activated and the GS820 needs to be turned OFF. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 4 TRP1 (CH1 Tripped)
The bit in the event register is set to 1 if a trip occurs on CH1 and the output is turned OFF.

Bit 3 LHI1 (CH1 High Limiting)
The bit in the condition register is set to 1 if the high limiter of CH1 is activated. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 2 LLO1 (CH1 Low Limiting)
The bit in the condition register is set to 1 if the low limiter of CH1 is activated. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 1 RDY (Ready for Sweep)
The bit in the condition register is set to 1 if the CH1 is ready to sweep and 0 if the sweep operation is in progress. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 0 EOS (End of Sweep) on CH1
The bit in the condition register is set to 1 if the CH1 sweep operation is completed.

Bit Masking

To mask a bit in the source event register so that it does not cause bit 1 (SSB) of the status byte to change, set the corresponding bit in the source event enable register to 0. Use the :STATus:SOURce:ENABle command for this purpose.

Reading the Source Event Register

The contents of the source event register can be read by the :STATus:SOURce:EVENt? command. After the register is read, it is cleared. The contents of the source condition register can be read by the :STATus:SOURce:CONDition? command. Reading the register does not change the contents of the register.

Clearing the Source Event Register

The source event register is cleared in the following three cases.

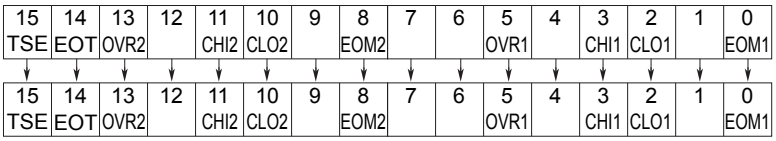
- When the contents of the source event register is read by the :STATus:SOURce:EVENt? command.
- When a *CLS command is received.
- When the instrument is power cycled.

16.3.5 Measurement Event Register

Measure Event Register

Condition Register
:STATus:SENSe:CONDition?

Event Register
:STATus:SENSe:EVENt?



Bit 15 TSE (Trigger Sampling Error)
The bit in the condition register temporarily set to 1 if an overlapped trigger is applied while sourcing or measuring is in progress and a sampling error occurs. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 14 EOT (End of Trace) Storage Complete
The bit in the condition register is set to 1 when storage is not in progress and 0 when storage is in progress. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 13 OVR2 (CH2 Over Range)
The bit in the condition register is set to 1 if the measured result of CH2 is over range. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 12
Not used (always 0)

Bit 11 CHI2 (CH2 Compare High)
The bit in the condition register is set to 1 if the measurement comparison result of CH2 is high. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 10 CLO2 (CH2 Compare Low)
The bit in the condition register is set to 1 if the measurement comparison result of CH2 is low. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 9
Not used (always 0)

Bit 8 EOM2 (CH2 End of Measure)
The bit in the condition register is set to 0 if the measurement is in progress on CH2 and 1 if not. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 7
Not used (always 0)

Bit 6
Not used (always 0)

Bit 5 OVR12 (CH1 Over Range)
The bit in the condition register is set to 1 if the measured result of CH1 is over range. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 4
Not used (always 0)

Bit 3 CHI1 (CH1 Compare High)
The bit in the condition register is set to 1 if the measurement comparison result of CH1 is high. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 2 CLO2 (CH2 Compare Low)
The bit in the condition register is set to 1 if the measurement comparison result of CH1 is low. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit 1
Not used (always 0)

Bit 0 EOM1 (CH1 End of Measure)
The bit in the condition register is set to 0 if the measurement is in progress on CH1 and 1 if not. The bit in the event register is set to 1 when the condition register bit changes from 0 to 1.

Bit Masking

To mask a bit in the measurement event register so that it does not cause bit 1 (MSB) of the status byte to change, set the corresponding bit in the measurement event enable register to 0. Use the :STATus:SENSe:ENABle command for this purpose.

Reading the Measurement Event Register

The contents of the measurement event register can be read by the :STATus:SENSe:EVENt? command. After the register is read, it is cleared. The contents of the measurement condition register can be read by the :STATus:SENSe:CONDition? command. Reading the register does not change the contents of the register.

Clearing the Measurement Event Register

The measurement event register is cleared in the following three cases.

- When the contents of the source event register is read by the :STATus:SENSe:EVENt? command.
- When a *CLS command is received.
- When the instrument is power cycled.

16.3.6 Output Queue and Error Queue

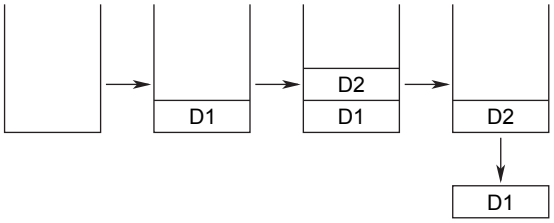
Output Queue

The output queue stores response messages for the queries.

The example below shows that data is stored record by record in the output queue, and is read out oldest item first. The output queue is emptied in the following cases (in addition to when read-out is performed).

- When a new message is received from the controller.
- When a deadlock occurs (see page 16-3).
- When a device clear command (DCL or SDC) is received.
- When the instrument is power cycled.

The *CLS command cannot be used to clear the output queue. To see whether the output queue is empty or not, check bit 4 (MAV) of the status byte.



Error Queue

The error queue stores the error number and message when an error occurs. For example, if the controller sends an incorrect program message, the error number and message “–113, “Undefined header”” are stored in the error queue when the error is displayed.

The SYSTem:ERRor? query can be used to read the contents of the error queue. As with the output queue, the messages are read from the oldest ones first.

When the error queue overflows, the last message is replaced by the following message: “–350, “Queue overflow.””

The error queue is also cleared for the following cases.

- When a *CLS command is received.
- When the instrument is power cycled.

Bit 2 (EAV) of the status byte can be used to check whether the error queue is empty.

16.4 Sample Programs

Notes on Using the Sample Programs

Yokogawa Electric Corporation assumes no liability for any problems that may occur as a result of using the sample programs.

16.4.1 Before Programming

Platform and Language

Target machine: Windows PC
Language: Visual Basic Version 5.0 Professional Edition or higher.
GPIB board: AT-GPIB/TNT IEEE-488.2 by National Instruments.

Settings on Visual Basic

Standard modules used: Niglobal.bas
Vbib-32.bas

GS820 Settings

GP-IB

The sample programs given in this chapter use a GP-IB address of 1 for the GS820.
Set the GP-IB address to 1 according to the procedures described in section 14.4.
Or, change the ADDRESS definition in GpibLib.bas.

16.4.2 Interface Access Function

```
Attribute VB_Name = "CommLib"
'
' Interface Access Function
'
' Used modules:        VISA interface by National Instruments  visa32.bas and vpptype.bas
'


'
' RS232 settings (match with the settings on the GS820)
'
Const RS232_BAUD = 115200             ' Baud rate for RS232     9600/14400/19200/38400/57600/115200
Const RS232_DBIT = 8                  ' Data length for RS232   7/8
Const RS232_SBIT = VI_ASRL_STOP_ONE   ' Stop bits for RS232 VI_ASRL_STOP_ONE/VI_ASRL_STOP_TWO
Const RS232_PARI = VI_ASRL_PAR_NONE   ' Parity for RS232    VI_ASRL_PAR_NONE/VI_ASRL_PAR_EVEN/VI_ASRL_PAR_ODD
Const RS232_FLOW = VI_ASRL_FLOW_NONE  ' Flow control for RS232VI_  VI_ASRL_FLOW_NONE/ASRL_FLOW_XON_XOFF/
                                      '                            VI_ASRL_FLOW_RTS_CTS

' Open function
Function CommOpen(ByVal rsrc, ByVal name As String) As Long
  Dim ret, vi As Long
  ret = viOpen(rsrc, name, 0, 0, vi)
  If (ret < 0) Then
    CommOpen = ret
  Else
    CommOpen = vi
    Call viSetAttribute(vi, VI_ATTR_ASRL_BAUD, RS232_BAUD)
    Call viSetAttribute(vi, VI_ATTR_ASRL_DATA_BITS, RS232_DBIT)
    Call viSetAttribute(vi, VI_ATTR_ASRL_STOP_BITS, RS232_SBIT)
    Call viSetAttribute(vi, VI_ATTR_ASRL_PARITY, RS232_PARI)
    Call viSetAttribute(vi, VI_ATTR_ASRL_FLOW_CTRL, RS232_FLOW)
    Call viSetAttribute(vi, VI_ATTR_ASRL_END_IN, VI_ASRL_END_TERMCHAR)
    Call viSetAttribute(vi, VI_ATTR_ASRL_END_OUT, VI_ASRL_END_TERMCHAR)
  End If
End Function

' Close function
Function CommClose(ByVal vi) As Long
  CommClose = viClose(vi)
End Function
```

```
' Transmission function
Function CommSend(ByVal vi As Long, ByVal msg As String) As Long
  Dim act, ret As Long
  ret = viWrite(vi, msg + Chr(10), Len(msg) + 1, act)       ' Add LF to the character string and send
  If (ret < 0) Then Call viClear(vi)                        ' Clear device if transmission error
  CommSend = ret
End Function

' Reception function
Function CommRecv(ByVal vi As Long, ByRef msg As String) As Long
  Dim act, ret As Long
  ret = viRead(vi, msg, Len(msg), act)                      ' Receive in the string buffer
  If (ret < 0) Then                                         ' If reception error
    Call viClear(vi)                                        ' Clear device
    CommRecv = ret
  Else                                                      ' If reception successful
    If (Mid(msg, act, 1) = Chr(10)) Then act = act - 1      ' If last byte is LF, subtract 1 from the number
                                                            ' of received characters
    CommRecv = act
  End If
End Function

' Character string reception function
Function CommRecvString(ByVal vi As Long) As String
  Dim buf As String * 256
  Dim ret As Integer
  ret = CommRecv(vi, buf)               ' Receive in the 256-byte receive buffer
  If (ret < 0) Then                     ' If reception error
    CommRecvString = ""                 '   Received string = NULL string
  Else                                  ' If reception successful
    CommRecvString = Left(buf, ret)     '   Received string = section of the string up to the received bytes
  End If
End Function

' Device clear function
Function CommClear(ByVal vi As Long) As Long
  CommClear = viClear(vi)
End Function

' Serial polling function
Function CommPoll(ByVal vi As Long) As Integer
  Dim ret As Long
  Dim stb As Integer
  ret = viReadSTB(vi, stb)
  If (ret < 0) Then CommPoll = ret Else CommPoll = stb
End Function
```

16.4.3 Sample 1 (Example of Reading the Measured Results during Free Run Using Constant Period Trigger)

```
Attribute VB_Name = "Sample1"
'================================================================
'
'  Sample 1 (Example of Reading the Measured Results during Free Run Using Constant Period Trigger)
'
'  CALL SampleSequence1()
'
'================================================================


'----------------------------------------------------------------
'
'  Setup 1
'
'  <CH1 source settings>
'  Source function:            Current
'  Source range:               1 A
'  Limiter:                    ±250 mV
'  Source level:               0.33333 A
'  Source trigger:             Timer1
'  Source delay:               Minimum (= 15 us)
'
'  <CH1 measurement settings>
'  Measurement:                ON
'  Measurement function:       Voltage
'  Integration time:           1 PLC
'  Auto zero:                  ON
'  Measurement trigger         Source change
'  Source delay:               Minimum (= 0 us)
'
'  Timer1 period:              100 ms
'
'  Output:                     ON
'
'----------------------------------------------------------------


Function Setup1(ByVal dev As Long)

  Call CommSend(dev, "*RST")                                    ' Reset to factory default settings

  Call CommSend(dev, ":CHAN1:SOUR:FUNC CURR")                   ' Source function  Current
  Call CommSend(dev, ":CHAN1:SOUR:RANG 1A")                     ' Source range  1 A
  Call CommSend(dev, ":CHAN1:SOUR:PROT:LINK ON")                ' Limiter tracking  ON
  Call CommSend(dev, ":CHAN1:SOUR:PROT:LEV 250mV")              ' Limiter  250 mV
  Call CommSend(dev, ":CHAN1:SOUR:PROT:STAT ON")                ' Limiter  ON
  Call CommSend(dev, ":CHAN1:SOUR:LEV 0.33333A")                ' Source level  0.33333 A
  Call CommSend(dev, ":CHAN1:SOUR:TRIG TIM1")                   ' Source trigger  Timer1
  Call CommSend(dev, ":CHAN1:SOUR:DEL MIN")                     ' Source delay  Minimum
```

```
  Call CommSend(dev, ":CHAN1:SENS:MODE FIX")              ' Measurement mode fixed function
  Call CommSend(dev, ":CHAN1:SENS ON")                    ' Measurement  ON
  Call CommSend(dev, ":CHAN1:SENS:NPLC 1")                ' Integration time  1 PLC
  Call CommSend(dev, ":CHAN1:SENS:ZERO:AUTO ON")          ' Auto zero  ON
  Call CommSend(dev, ":CHAN1:SENS:TRIG SOUR")             ' Measurement trigger  Source change
  Call CommSend(dev, ":CHAN1:SENS:DEL MIN")               ' Measurement delay  Minimum

  Call CommSend(dev, ":TRIG:TIM1 100ms")                  ' Timer1 period 100 ms

  Call CommSend(dev, ":CHAN1:OUTP ON")                    ' Output  ON

  Call CommSend(dev, "*OPC?")                             ' Wait for the setting to complete
  Call CommRecvString(dev)

End Function

Function SampleSequence1(ByVal dname As String, ByVal rm As Long)

  Dim i, dev As Long
  Dim result(9) As Double

  dev = CommOpen(rm, dname)                               ' Open the device

  Call Setup1(dev)                                        ' To Setup 1

  For i = 0 To 9                                          ' Loop 10 times
    Call CommSend(dev, ":CHAN1:READ?")                    ' Query the new measured result
    result(i) = Val(CommRecvString(dev))                  ' Read the result and substitute into an array
  Next i

  Call CommSend(dev, ":OUTP OFF")                         ' Output OFF

  Call CommClose(dev)                                     ' Close the device

End Function
```

16.4.4 Sample 2 (Example of Generating a Trigger from the PC and Reading the Measured Results)

```
Attribute VB_Name = "Sample2"
'================================================================
'
'  Sample 2 (Example of Generating a Trigger from the PC and Reading the Measured Results)
'
'  CALL SampleSequence2()
'
'================================================================


'----------------------------------------------------------------
'
'  Setup 2
'
'  <CH2 source settings>
'  Source function:            Voltage
'  Source range:               20 V
'  Limiter:                    ±50 mA
'  Source level:               -17.5 V
'  Source trigger:             External trigger
'  Source delay:               Minimum (= 15 us)
'
'  <CH2 measurement settings>
'  Measurement:                ON
'  Measurement function:       Current
'  Integration time:           Minimum (= 250 us)
'  Auto zero:                  OFF
'  Measurement trigger         Source change
'  Measurement delay:          1 ms
'
'  Output:                     ON
'
'----------------------------------------------------------------


Function Setup2(ByVal dev As Long)

  Call CommSend(dev, "*RST")                                    ' Reset to factory default settings

  Call CommSend(dev, ":CHAN2:SOUR:FUNC VOLT")                   ' Source function  Voltage
  Call CommSend(dev, ":CHAN2:SOUR:RANG 20V")                    ' Source range  20 V
  Call CommSend(dev, ":CHAN2:SOUR:PROT:LINK ON")                ' Limiter tracking  ON
  Call CommSend(dev, ":CHAN2:SOUR:PROT:LEV 50mA")               ' Limiter  50 mA
  Call CommSend(dev, ":CHAN2:SOUR:PROT ON")                     ' Limiter  ON
  Call CommSend(dev, ":CHAN2:SOUR:LEV -17.5V")                  ' Source level  -17.5 V
  Call CommSend(dev, ":CHAN2:SOUR:TRIG EXT")                    ' Source trigger  External trigger
  Call CommSend(dev, ":CHAN2:SOUR:DEL MIN")                     ' Source delay  Minimum
```

```
  Call CommSend(dev, ":CHAN2:SENS:MODE FIX")                    ' Measurement mode  Fixed function
  Call CommSend(dev, ":CHAN2:SENS ON")                          ' Measurement ON
  Call CommSend(dev, ":CHAN2:SENS:FUNC CURR")                   ' Measurement function  Current
  Call CommSend(dev, ":CHAN2:SENS:NPLC MIN")                    ' Integration time  Minimum
  Call CommSend(dev, ":CHAN2:SENS:ZERO:AUTO OFF")               ' Auto zero  OFF
  Call CommSend(dev, ":CHAN2:SENS:TRIG SOUR")                   ' Measurement trigger  Source change
  Call CommSend(dev, ":CHAN2:SENS:DEL 1ms")                     ' Measurement delay  1 ms

  Call CommSend(dev, ":CHAN2:OUTP:STAT ON")                     ' Output  ON

  Call CommSend(dev, "*OPC?")                                   ' Wait for the setting to complete
  Call CommRecvString(dev)

End Function

Function SampleSequence2(ByVal dname As String, ByVal rm As Long)

  Dim dev As Long
  Dim result(4) As Double

  dev = CommOpen(rm, dname)                                     ' Open the device

  Call Setup2(dev)                                              ' To Setup 2

  Call CommSend(dev, ":CHAN2:SOUR:LEV 2.8")                     ' Set the level to 2.8 V
  Call CommSend(dev, ":CHAN2:MEAS?")                            ' Generate a trigger and read the result
  result(0) = Val(CommRecvString(dev))

  Call CommSend(dev, ":CHAN2:SOUR:LEV 2.9")                     ' Set the level to 2.9 V
  Call CommSend(dev, ":CHAN2:MEAS?")                            ' Generate a trigger and read the result
  result(1) = Val(CommRecvString(dev))

  Call CommSend(dev, ":CHAN2:SOUR:LEV 3.0")                     ' Set the level to 3.0 V
  Call CommSend(dev, ":CHAN2:MEAS?")                            ' Generate a trigger and read the result
  result(2) = Val(CommRecvString(dev))

  Call CommSend(dev, ":CHAN2:SOUR:LEV 3.1")                     ' Set the level to 3.1 V
  Call CommSend(dev, ":CHAN2:MEAS?")                            ' Generate a trigger and read the result
  result(3) = Val(CommRecvString(dev))

  Call CommSend(dev, ":CHAN2:SOUR:LEV 3.2")                     ' Set the level to 3.2 V
  Call CommSend(dev, ":CHAN2:MEAS?")                            ' Generate a trigger and read the result
  result(4) = Val(CommRecvString(dev))

  Call CommSend(dev, ":CHAN2:OUTP OFF")                         ' Output OFF

  Call CommClose(dev)                                           ' Close the device

End Function
```

16.4.5 Sample 3 (Example of Changing and Measuring Simultaneously on Two Channels Using Single-Step Sweep)

```
Attribute VB_Name = "Sample3"
'================================================================
'
'  Sample 3 (Example of Changing and Measuring Simultaneously on
'                Two Channels Using Single-Step Sweep)
'
'  CALL SampleSequence3()
'
'================================================================

'----------------------------------------------------------------
'
'  Setup 3
'
'  Channel synchronization     ON
'
'  <CH1 settings>
'  Source trigger:             External trigger
'  Source delay:               Minimum (= 15 us)
'  Source function:            Voltage
'  Measurement function:       Current
'  Source delay:               Minimum (= 15 us)
'  Measurement trigger:        Source change
'  Measurement delay:          250 us
'  Sweep mode:                 Single-step sweep
'  Output:                     ON
'
'  <CH2 settings>
'  Source delay:               Minimum (= 15 us)
'  Source function:            Current
'  Measurement function:       Voltage
'  Measurement trigger:        Source change
'  Measurement delay:          250 us
'  Sweep mode:                 Single-step sweep
'  Output:                     ON
'
'----------------------------------------------------------------

Function Setup3(ByVal dev As Long)

  Call CommSend(dev, "*RST")                                    ' Reset to factory default settings

  Call CommSend(dev, "SYNC:CHAN ON")                            ' Inter-channel synchronization ON

  Call CommSend(dev, ":CHAN1:SOUR:TRIG EXT")                    ' CH1 Source trigger  External trigger
```

```
  Call CommSend(dev, ":CHAN1:SOUR:PROT OFF")                    ' CH1 Limiter  OFF
  Call CommSend(dev, ":CHAN1:SOUR:DEL MIN")                     ' CH1 Source delay  Minimum
  Call CommSend(dev, ":CHAN1:SOUR:FUNC VOLT")                   ' CH1 Source function  Voltage
  Call CommSend(dev, ":CHAN1:SENS:FUNC CURR")                   ' CH1 Measurement function  Current
  Call CommSend(dev, ":CHAN1:SENS:TRIG SOUR")                   ' CH1 Measurement trigger  Source change
  Call CommSend(dev, ":CHAN1:SENS:DEL 250us")                   ' CH1 Measurement delay  250 us
  Call CommSend(dev, ":CHAN1:SOUR:MODE SING")                   ' CH1 Single-step sweep

  Call CommSend(dev, ":CHAN2:SOUR:PROT OFF")                    ' CH2 Limiter  OFF
  Call CommSend(dev, ":CHAN2:SOUR:DEL MIN")                     ' CH2 Source delay  Minimum
  Call CommSend(dev, ":CHAN2:SOUR:FUNC CURR")                   ' CH2 Source function  Current
  Call CommSend(dev, ":CHAN2:SENS:FUNC VOLT")                   ' CH2 Measurement function  Voltage
  Call CommSend(dev, ":CHAN2:SENS:TRIG SOUR")                   ' CH2 Measurement trigger  Source change
  Call CommSend(dev, ":CHAN2:SENS:DEL 250us")                   ' CH2 Measurement delay  250 us
  Call CommSend(dev, ":CHAN2:SOUR:MODE SING")                   ' CH2 Single-step sweep

  Call CommSend(dev, ":OUTP ON")

  Call CommSend(dev, "*OPC?")                                   ' Wait for the setting to complete
  Call CommRecvString(dev)

End Function

Function SampleSequence3(ByVal dname As String, ByVal rm As Long)

  Dim dev As Long
  Dim result(3, 1) As Double

  dev = CommOpen(rm, dname)                    ' Open the device

  Call Setup3(dev)                             ' To Setup 3

  Call CommSend(dev, ":CHAN1:SOUR:LEV 0.1V")   ' CH1 Source level 0.1 V  (The actual output has not changed.
                                               ' Will change on a subsequent trigger.)
  Call CommSend(dev, ":CHAN2:SOUR:LEV -2mA")   ' CH2 Source level -2 mA (The actual output has not changed.
                                               ' Will change on a subsequent trigger.)
  Call CommSend(dev, ":CHAN1:INIT")            ' CH1 New measurement
  Call CommSend(dev, ":CHAN2:INIT")            ' CH2 New measurement
  Call CommSend(dev, "*TRG")                   ' Generate a trigger  (The CH1 and CH2 outputs change
                                               ' simultaneously at this point.)
  Call CommSend(dev, ":CHAN1:FETC?")           ' CH1 Read measured result
  result(0, 0) = Val(CommRecvString(dev))      ' CH1 Convert the measured result to values and store in array
  Call CommSend(dev, ":CHAN2:FETC?")           ' CH2 Read measured result
  result(0, 1) = Val(CommRecvString(dev))      ' CH2 Convert the measured result to values and store in array
```

```
  Call CommSend(dev, ":CHAN1:SOUR:LEV 0.2V")     ' CH1 Source level 0.2   (The actual output has not changed.
                                                  ' Will change on a subsequent trigger.)
   Call CommSend(dev, ":CHAN2:SOUR:LEV -5mA")    ' CH2 Source level-5 mA   (The actual output has not changed.
                                                  ' Will change on a subsequent trigger.)
   Call CommSend(dev,":CHAN1:INIT")              ' CH1 New measurement
   Call CommSend(dev, ":CHAN2:INIT")             ' CH2 New measurement
   Call CommSend(dev, "*TRG")                    ' Generate a trigger  (The CH1 and CH2 outputs change
                                                  ' simultaneously at this point.)
   Call CommSend(dev, ":CHAN1:FETC?")            ' CH1 Read measured result
   result(1, 0) = Val(CommRecvString(dev))       ' CH1 Convert the measured result to values and store in array
   Call CommSend(dev, ":CHAN2:FETC?")            ' CH2 Read measured result
   result(1, 1) = Val(CommRecvString(dev))       ' CH2 Convert the measured result to values and store in array

   Call CommSend(dev, ":CHAN1:SOUR:LEV 0.5V")    ' CH1 Source level 0.5 V  (The actual output has not changed.
                                                  ' Will change on a subsequent trigger.)
   Call CommSend(dev, ":CHAN2:SOUR:LEV -10mA")   ' CH2 Source level-10 mA  (The actual output has not changed.
                                                  ' Will change on a subsequent trigger.)
   Call CommSend(dev, ":CHAN1:INIT")             ' CH1 New measurement
   Call CommSend(dev, ":CHAN2:INIT")             ' CH2 New measurement
   Call CommSend(dev, "*TRG")                    ' Generate a trigger  (The CH1 and CH2 outputs change
                                                  ' simultaneously at this point.)
   Call CommSend(dev, ":CHAN1:FETC?")            ' CH1 Read measured result
   result(2, 0) = Val(CommRecvString(dev))       ' CH1 Convert the measured result to values and store in array
   Call CommSend(dev, ":CHAN2:FETC?")            ' CH2 Read measured result
   result(2, 1) = Val(CommRecvString(dev))       ' CH2 Convert the measured result to values and store in array
   Call CommSend(dev, ":CHAN1:SOUR:LEV 1.0V")    ' CH1 Source level 1.0 V  (The actual output has not changed.
                                                  ' Will change on a subsequent trigger.)
   Call CommSend(dev, ":CHAN2:SOUR:LEV -20mA")   ' CH2 Source level-20 mA  (The actual output has not changed.
                                                  ' Will change on a subsequent trigger.)
   Call CommSend(dev, ":CHAN1:INIT")             ' CH1 New measurement
   Call CommSend(dev, ":CHAN2:INIT")             ' CH2 New measurement
   Call CommSend(dev, "*TRG")                    ' Generate a trigger  (The CH1 and CH2 outputs change
                                                  ' simultaneously at this point.)
   Call CommSend(dev, ":CHAN1:FETC?")            ' CH1 Read measured result
   result(3, 0) = Val(CommRecvString(dev))       ' CH1 Convert the measured result to values and store in array
   Call CommSend(dev, ":CHAN2:FETC?")            ' CH2 Read measured result
   result(3, 1) = Val(CommRecvString(dev))       ' CH2 Convert the measured result to values and store in array

   Call CommSend(dev, ":OUTP OFF")

   Call CommClose(dev)                           ' Close the device

End Function
```

17.1 Troubleshooting

- For the appropriate corrective actions when an error code is shown on the display, see section 17.2.
- If servicing is necessary, or if the instrument is not operating correctly after performing the corrective actions described below, contact your nearest YOKOGAWA dealer.

Problem	Probable Cause	Corrective Action	Reference Section
The power does not turn ON.	Using a power supply outside the ratings.	Use a correct power supply.	3.3
The GS820 does not power	The setup file is corrupt.	If the GS820 still does not power up correctly up correctly. even after cycling the power, turn ON the power while holding down the ESC key and +/- key. The GS820 powers up by formatting the GS820ROM disk. If the GS820 still does not power up correctly, servicing is required.	
Nothing is displayed.	The display is turned OFF.	If the SHIFT key is blinking, the display is turned OFF. Press any key or turn the rotary knob.	11.4
Keys do not work.	The GS820 is in remote mode.	The GS820 is in remote mode when the remote indicator is illuminated. Press the MISC key to enter the LOCAL mode.	-
	The keys are locked.	If the KEYLOCK indicator is illuminated, the keys are locked. Press the SHIFT+TIME key to clear the key lock.	11.8
	Other causes.	If a certain key does not work, it may be due to a bad connection. Perform a key test of the self test. If there are keys that do not operate, servicing is required.	17.3
The USB storage function does not work.	The GS820ROM disk is corrupt.	If only the GS820RAM disk appears on your PC, the GS820ROM disk may be corrupt. Format the disk.	4.6
	The drive assignment on the PC overlaps with another the drive.	Use a management tool on the PC and change drive letter so that it does not overlap with other drives.	-
	The PC does not support the USB mass storage class.	The USB storage function is valid on Windows Me, 2000, and XP. The USB storage function cannot be used on PCs running other operating systems.	-
The file written from the PC cannot be viewed on the GS820.	The file is written only to the PC cache memory.	Carry out “safely remove USB Mass Storage Device” on the PC to make sure that the cache is written to the storage device.	-
The source level or measured value is strange.	Insufficient warm-up.	Warm up the GS820 for 60 minutes after turning ON the power.	-
	The ambient temperature is fluctuating.	Use the GS820 in a stable environment within the specification range.	-
	The signal contains noise.	Use the GS820 in an environment free of noise. Exercise caution especially when handling minute voltage or current.	3.5
	The GS820 is oscillating.	Check whether the load is within the allowable range. Use twisted-pair wires for wiring.	3.5
	The connection is inappropriate.	In the case of a four-terminal connection, check that the connection is correct. Note that in the case of a two-terminal connection, the GS610 receives effects from the lead wire resistance or contact resistance when the output current is large.	3.5

17.1 Troubleshooting

Problem	Probable Cause	Corrective Action	Reference Section
The output turns OFF and the error message “Hardware input abnormal error” is displayed.	Connected a load outside the specifications.	Connect a load within the specifications.	3.1
“Abnormal Temperature” is displayed.	The exhaust or inlet holes are blocked.	Provide adequate space around the GS820.	3.1, 3.2
“Circuit Protection” is displayed.	Connected a load outside the specifications.	Connect a load within the specifications.	3.1
Unable to save data to the disk.	No free space on the disk.	Delete unneeded files or format the disk.	4.6
Unable to set the GS820 via the communication interface.	Communication settings are not matched.	Match the communication settings with the PC.	Chapters 12 to 15

17.2 Error Code Description and Corrective Actions

The following three types of messages can appear in the center of the display.

- Error messages
  Displayed when an inappropriate operation is carried out.
- Confirmation messages
  Confirmation messages are not entered in the error queue, but displayed in the error log.

Syntax Errors (-100 to -199)

Error No.	Error Message	Corrective Action	Page
–101	Invalid_character	Check whether invalid characters such as $ or & are used in the command header or parameters.	-
–102	Syntax_error	Check that the syntax is correct.	-
–103	Invalid separator	Check the use of the separator (comma).	-
–106	Parameter not allowed	Check the command and the number of parameters.	-
–107	Missing parameter	Check the command and the number of parameters.	-
–112	Program mnemonic too long	Check the command mnemonic.	-
–113	Undefined header	Check the command mnemonic.	-
–121	Invalid character in number	Check that the notation of the numeric parameter is correct (for example, binary notation should not contain characters other than 0 and 1).	16-5
–122	Header suffix out of range	Check whether the numeric suffix of the command header is correct.	-
–123	Exponent too large	Check whether the exponent is within the range of -127 to 127.	-
–124	Too many digits	Check that the number of digits in the value does not exceed 255.	-
–128	Numeric data not allowed	Check the parameter format.	-
–131	Invalid suffix	Check the unit that can be used for the parameter.	-
–138	Suffix not allowed	Check the parameter format.	-
–141	Invalid character data	Check the character data that can be used for the parameter.	-
–148	Character data not allowed	Check the command and parameter format.	-
–150	String data error	Check that the closing quotation mark (” or ’) for a string is available.	-
–151	Invalid string data	Check that the string parameter is in the correct format.	-
–158	String data not allowed	Check the command and parameter format.	-
–161	Invalid block data	Check that the block data is in the correct format.	-
–168	Block data not allowed	Check the command and parameter format.	-
–178	Expression data not allowed	Check the command and parameter format.	-

Execution Errors (-200 to -299)

Error No.	Error Message	Corrective Action	Page
–222	Data out of range	Check the selectable range of the parameter. If the command can use MINimum and MAXimum as its parameter, the range can also be queried.	-
–256	Filename not found	Check that the file exists. You can also use the CATalog? command to query the list of files.	16-16, 16-29, 16-38
–285	Program syntax error	Check that the sweep pattern file is in the correct format.	2-20

Device Errors (-300 to -399)

Error No.	Error Message	Corrective Action	Page
–350	Queue overflow	Read the error using :SYSTem:ERRor? or clear the error queue using *CLS.	16-35, 16-40, 16-49
–361	Parity error	Check that the communication settings on the GS820 and PC match. If the settings are correct, check the cable, and lower the baud rate.	15-5
–362	Framing error	Check that the communication settings on the GS820 and PC match. If the settings are correct, check the cable, and lower the baud rate.	15-5
–363	Input buffer overrun	Set the handshaking to a setting other than OFF. Lower the baud rate.	15-4

Query Errors (-400 to -499)

Error No.	Error Message	Corrective Action	Page
–410	Query INTERRUPTED	Check transmission/reception procedure.	16-3
–420	Query UNTERMINATED	Check transmission/reception procedure.	16-3
–430	Query DEADLOCK	Keep the length of a program message less than or equal to 64 KB.	16-3

Instrument Errors (+100 and higher)

Error No.	Error Message	Corrective Action	Page
+101	Too complex expression	Keep the total number of constants, variables, and operators in a MATH definition less than or equal to 256.	8-8
+102	Math file syntax error	Check that the syntax of the MATH definition file is correct.	8-8
+103	Too large file error	Keep MATH definition files less than 4 KB in size.	8-8
+104	Illegal file error	Download the file for updating the system firmware again.	17-10
+105	No slave SMU found	Check that the connection between the master and slave units is correct.	10-5, 10-7
+200	Sweep stopped because of the setting change	Stop the sweep operation before changing the settings.	-
+202	Interlocking	Release the interlock, and then turn the output ON.	-
+203	Cannot relay on in hardware abnormal	Check whether the temperature inside the case is okay.	-
+204	Hardware input abnormal error	Connect a load within the specifications.	-
+205	Analog busy	Change the settings after the calibration or self-test is completed.	-
+206	Low battery	Request to have the battery replaced, because the time stamp when creating files will not be correct.	17-11
+207	Power line frequency measure failure	Directly set the line frequency.	3-10
+304	Cannot change setting in auto measure function	If you want to change the measurement function, select a measurement mode other than auto function.	7-1

Messages (Not Entered in the Error Queue but Shown in the Error Log)

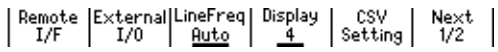
Error Message	Corrective Action	Page
ch1/2 mauto samefunction	Change the measurement range to fixed range, or set the GS820 so that the measurement function and the source function are not the same.	7-2, 7-3
ch1/2 mauto autofunction	Change the measurement range to fixed range or select a measurement mode other than auto function.	7-1, 7-2
ch1/2 illegal math file	Check that the syntax of the MATH definition file is correct.	8-8
ch1/2 no math file	Select a MATH definition file before turning the computation ON.	8-3
ch1/2 illegal compare value	Set the comparison operation settings so that the upper limit is greater than the lower limit.	8-6
ch1/2 limited sweep point 100000	Increase the step value so that the number of points is less than or equal to 100000.	6-1, 6-7
ch1/2 log sweep level 0 cross	Set the start and stop values with values with the same sign.	6-4
ch1/2 log sweep level 0 cross	Set the start value to a value other than 0.	6-4
ch1/2 log sweep stop 0	Set the stop value to a value other than 0.	6-4
ch1/2 abnormal input	Use a load within the specifications.	3-1
ch1/2 calibration data lost	It is possible that the specifications may not be met even when the GS820 is calibrated with the default calibration values. Request to have the GS820 recalibrated.	-

17.3 Self-Test

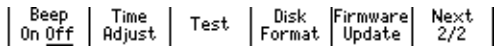
Procedure

Displaying the Self-Test Menu

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **Next 1/2** soft key.



3. Press the **Test** soft key.

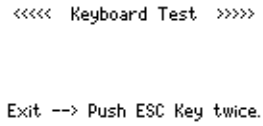
Executing the Display Test

4. Press the **Display Setup** soft key. The entire display illuminates.

5. To end the test, press **ESC**.

Executing the Key Test

4. Press the **Key** soft key.



5. Press each key and check that the name of the respective key is displayed.

6. To end the test, press **ESC** twice.

Executing the Self-Test

4. Press the **Selftest** soft key to start the test.

```
<<<<<  Selftest Result  >>>>>
          ROM ... OK
          RAM ... OK
        Digital ... OK
    CH1 Analog ... OK
    CH2 Analog Checking ....
```

5. When the test is completed, the result is displayed.

```
<<<<<  Selftest Result  >>>>>
          ROM ... OK
          RAM ... OK
        Digital ... OK
    CH1 Analog ... OK
    CH2 Analog ... OK
```

6. To end the test, press **ESC**.

Explanation

Display Test

The display test checks for color dropouts or abnormality on the display. If the display is not correct, contact your nearest YOKOGAWA dealer.

Key Test

Tests whether the front panel keys are operating properly. If the name of the key being pressed is highlighted, the key is operating correctly. If it does not, contact your nearest YOKOGAWA dealer.

Self-Test

Tests whether the internal functions of the GS820 are operating correctly. If an error appears, contact your nearest YOKOGAWA dealer.

<<Corresponding Command Mnemonic>>

`*TST?`

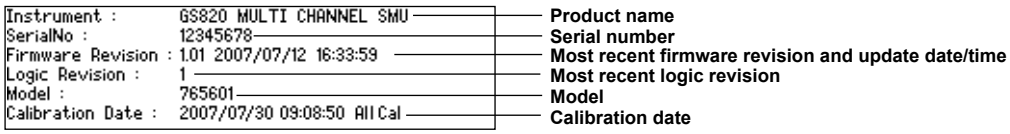
17.4 Viewing the Product Information

Procedure

1. Press **SHIFT+ERROR (INFO)**.

Explanation

The following information is displayed.



<<Corresponding Command Mnemonic>>

`*IDN?`

17.5 Updating the System Firmware

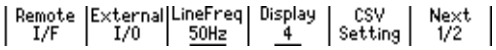
Procedure

Obtaining the Update File

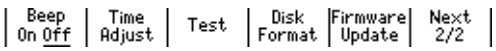
1. Download the most recent system file from YOKOGAWA GS820 Web page (http://www.yokogawa.com/tm/gmi/gs820/tm-gs820_01.htm) to your PC.
2. Connect the PC and the GS820 using a USB cable.
3. Copy the system file to the volatile disk (GS820RAM).

Updating the System Firmware

1. Press **SHIFT+SETUP (MISC)** to display the MISC menu.



2. Press the **Next 1/2** soft key.



3. Press the **FirmwareUpdate** soft key.
   The system file automatically opens and the update operation is carried out.
   An error will occur if there is no system file in the GS820RAM.

4. When the update operation is completed, a message prompting you to power cycle the GS820 appears. If the message is displayed, cycle the GS820 power.

Note

- It takes some time to completely copy the system file to the volatile disk (GS820RAM). Carry out the procedure below to check that the file copy operation is complete before updating the firmware.
  Double-click the Safely Remove Hardware icon in the notification area on the Windows desktop. In the window that opens, click USB Mass Storage Device, and then click Stop. In the Stop a Hardware device dialog box that opens, confirm the information, and click OK.
  If the copy operation has been completed, the "Safe to Remove Hardware" message will appear.
- Do not turn the power OFF after you select FirmwareUpdate until the system is completely written. If you do, the GS820 may malfunction.
- If the system firmware is updated, all of the data files stored on the GS820RAM will be cleared. Be sure to move important data files to a different directory in advance.

Explanation

To update the system firmware, the most recent system file must be stored on the GS820RAM in advance.
You can download the system file from YOKOGAWA website. Check the site at the following URL.
http://www.yokogawa.com/tm/gmi/gs820/tm-gs820_01.htm

17.6 Recommended Replacement Parts and Maintenance

Recommended Replacement Parts

The one-year warranty applies only to the main unit of the instrument (starting from the day of delivery) and does not cover any other items nor expendable items (items which wear out). The replacement period for expendable items varies depending on the conditions of use. Refer to the table below as a general guideline. Contact your nearest YOKOGAWA dealer to have parts replaced.

Parts Name	Recommended Replacement Period
Cooling fan	3 years
Backup battery (lithium battery)	5 years
VFD	3 years

Calibration

We recommend that you calibrate the GS820 once a year to assure its measurement accuracy. Contact your nearest YOKOGAWA dealer to have your GS820 calibrated.

18.1 Source Section

DC Voltage Source

Range	Range Generated	Resolution	Max. Load Current	Accuracy (One Year) ± (% of setting + V)	Temperature Coefficient ± (% of setting + V)/°C
200 mV	±200.000 mV	1 μV	±3.2 A	0.02 + 250 μV	0.003 + 35 μV
2 V	±2.00000 V	10 μV	±3.2 A	0.02 + 400 μV	0.003 + 60 μV
7 V	±7.0000 V	100 μV	±3.2 A	0.02 + 2 mV	0.003 + 300 μV
18 V	±18.0000 V	100 μV	±1.2 A	0.02 + 2 mV	0.003 + 300 μV

Accuracy: One year accuracy for 23 ± 5°C.

Temperature coefficient: Add the temperature coefficient at 5 to 18°C and 28 to 40°C.

Output resistance (for four-wire system remote sensing)

• 200 mV, 2 V range: (Shunt resistance*/40000) Ω or less

• 7 V, 18 V range: (Shunt resistance/5000) Ω or less

* For details on the shunt resistance, see “DC Current Measurement” in section 18.2, “Measurement Section.”

DC Current Source

Range	Range Generated	Resolution	Max. Load Voltage	Accuracy (One Year) ± (% of setting + A)	Temperature Coefficient ± (% of setting + A)/°C
200 nA	±200.000 nA	1 pA	±18 V	0.06 + 3 nA	500 pA
2 μA	±2.00000 μA	10 pA	±18 V	0.04 + 3 nA	500 pA
20 μA	±20.0000 μA	100 pA	±18 V	0.03 + 3 nA	0.0045 + 450 pA
200 μA	±200.000 μA	1 nA	±18 V	0.03 + 30 nA	0.0045 + 4.5 nA
2 mA	±2.00000 mA	10 nA	±18 V	0.03 + 250 nA	0.0045 + 37.5 nA
20 mA	±20.0000 mA	100 nA	±18 V	0.03 + 2.5 μA	0.0045 + 375 nA
200 mA	±200.000 mA	1 μA	±18 V	0.03 + 25 μA	0.0045 + 3.75 μA
1 A	±1.20000 A	10 μA	±18 V	0.05 + 900 μA	0.0075 + 135 μA
3 A	±3.20000 A	10 μA	±7 V	0.05 + 1.5 mA	0.0075 + 225 μA

Accuracy: One year accuracy for 23 ± 5°C.

Temperature coefficient: Add the temperature coefficient at 5 to 18°C and 28 to 40°C.

Output resistance

• 1 A, 3 A range: 10 kΩ or greater

• 20 μA to 200 mA range: (Shunt resistance* × 50000) Ω or greater

• 200 nA, 2 μA range: 10 GΩ or greater

* For details on the shunt resistance, see “DC Current Measurement” in section 18.2, “Measurement Section.”

Current Limiter

| Setting |[1]	Range	Resolution	Minimum Setting[2]
10.000 nA to 200.000 nA	200 nA	1 pA	10 nA
200.001 nA to 2.00000 μA	2 μA	10 pA	10 nA
2.00001 μA to 20.0000 μA	20 μA	100 pA	100 nA
20.0001 μA to 200.000 μA	200 μA	1 nA	1 μA
200.001 μA to 2.00000 mA	2 mA	10 nA	10 μA
2.00001 mA to 20.0000 mA	20 mA	100 nA	100 μA
20.0001 mA to 200.000 mA	200 mA	1 μA	1 mA
200.001 mA to 1.20000 A	1 A	10 μA	10 mA
1.20001 A to 3.20000 A	3 A	10 μA	10 mA

1: Larger of the two values |high limit value| or |low limit value| if tracking is OFF

2: Minimum setting if tracking is OFF.

Voltage Limiter

| Setting |[1]	Range	Resolution	Minimum Setting[2]
1.000 mV to 200.000 mV	200 mV	1 μV	1 mV
200.001 mV to 2.00000 V	2 V	10 μV	1 mV
2.00001 V to 7.0000 V	7 V	100 μV	5 mV
7.0001 V to 18.0000 V	18 V	100 μV	5 mV

1: Larger of the two values |high limit value| or |low limit value| if tracking is OFF

2: Minimum setting if tracking is OFF.

Response Time (Typical)

Voltage Source

200 mV range	250 μs
2 V range	50 μs
7 V, 18 V range	100 μs

Current Source

200 nA range	250 ms
2 μA range	25 ms
20 μA range	2.5 ms
200 μA and 2 mA range	250 μs
20 mA to 3 A range	80 μs

In normal mode.
The time for the output to reach within 0.1% of the final value after the output starts changing.
Pure resistive load. The limiter setting is at the full scale of the range.
Source voltage or current is at the maximum value of the range.
Voltage source at maximum load current. Current source at a load voltage of 2 V.

LC Load

Current Source/Measurement/ Limiter Range	Normal Mode		Stable Mode	
	Maximum C Load	Maximum L Load	Maximum C Load	Maximum L Load
200 nA to 2 mA	0.01 μF	10 μH	100 μF	1 mH
20 mA	0.1 μF	10 μH	100 μF	1 mH
200 mA	1 μF	10 μH	100 μF	1 mH
1 A and 3 A	10 μF	10 μH	100 μF	1 mH

Output Noise (Typical)

20 mVp-p
For DC to 20 MHz, 2-V voltage source range, and 1-A current limiter range

18.2 Measurement Section

DC Voltage Measurement

Range	Range Measured	Resolution	Accuracy ± (% of reading + V)	Temperature Coefficient ± (% of reading + V)/°C
200 mV	±210.000 mV	1 μV	0.015+200 μV(250 μV){300 μV}[500 μV]	0.0025+30 μV(40 μV){45 μV}[60 μV]
2 V	±2.10000 V	10 μV	0.015+200 μV(400 μV){1 mV}[5 mV]	0.0025+30 μV(60 μV){200 μV}[800 μV]
7 V	±7.1000 V	100 μV	0.015+2 mV(4 mV){10 mV}[50 mV]	0.0025+300 μV(600 μV){2 mV}[8 mV]
18 V	±18.0000 V	100 μV	0.015+2 mV(4 mV){10 mV}[50 mV]	0.0025+300 μV(600 μV){2 mV}[8 mV]

Accuracy: One year accuracy for 23 ± 5°C.

Temperature coefficient: Add the temperature coefficient at 5 to 18°C and 28 to 40°C.

Values inside parentheses are for 0.1 PLC ≤ integration time < 1 PLC. Values inside braces are for 0.01 PLC ≤ integration time < 0.1 PLC. Values inside brackets are for 0.001 PLC ≤ integration time < 0.01 PLC.

DC Current Measurement

Range	Range Measured	Resolution	Shunt resistance	Accuracy ± (% of reading + A)	Temperature Coefficient ± (% of reading + A)/°C
200 nA	±210.000 nA	1 pA	1 MΩ	0.05+3 nA(3 nA){3 nA}[4 nA]	500 pA(500 pA){500 pA}[600 pA]
2 μA	±2.10000 μA	10 pA	1 MΩ	0.025+3 nA(3 nA){4 nA}[6 nA]	500 pA(500 pA){500 pA}[600 pA]
20 μA	±21.0000 μA	100 pA	100 kΩ	0.025+4 nA(6 nA){10 nA}[50 nA]	0.004+600 pA(900 pA){1.5 nA}[8 nA]
200 μA	±210.000 μA	1 nA	10 kΩ	0.02+40 nA(60 nA){100 nA}[500 nA]	0.003+6 nA(9 nA){15 nA}[80 nA]
2 mA	±2.10000 mA	10 nA	1 kΩ	0.02+400 nA(600 nA){1 μA}[5 μA]	0.003+60nA(90nA){150nA}[800nA]
20 mA	±21.0000 mA	100nA	100 Ω	0.02+4 μA(6 μA){10 μA}[50 μA]	0.003+600nA(900nA){1.5 μA}[8 μA]
200 mA	±210.000 mA	1 μA	10 Ω	0.02+70 μA(100 μA){150 μA}[500 μA]	0.003+10 μA (15 μA){20 μA}[80 μA]
1 A	±1.30000 A	10 μA	1 Ω	0.03+700 μA(1 mA){ 2 mA}[6 mA]	0.0045+100 μA(150 μA){300 μA}[900 μA]
3 A	±3.20000 A	10 μA	1 Ω	0.05+1 mA(1.5 mA){2 mA}[6 mA]	0.0075+150 μA(200 μA){300 μA}[900 μA]

Accuracy: One year accuracy for 23 ± 5°C.

Temperature coefficient: Add the temperature coefficient at 5 to 18°C and 28 to 40°C.

Values inside parentheses are for 0.1 PLC ≤ integration time < 1 PLC. Values inside braces are for 0.01 PLC ≤ integration time < 0.1 PLC. Values inside brackets are for 0.001 PLC ≤ integration time < 0.01 PLC.

18.3 Function

Source

Source function:	Voltage and current
Source waveform:	DC and pulse
Sweep mode:	Linear, logarithmic, program (up to 100000 steps), and single-step
Trigger source:	External, internal timer1 and 2 (period: 100 μs to 3600 s)
Sweep start source:	External, internal timer1 and 2 (period: 100 μs to 3600 s)
Source delay:	15 μs to 3600 s
Response characteristics:	Normal and stable

Measurement

Measurement function:	Voltage, current, auto, voltmeter mode, ammeter mode, and resistance meter modes
Integration time:	0.001 to 25PLC (Power Line Cycle)
Trigger source:	External, internal timer1 and 2 (period: 100 μs to 3600 s)
Measurement delay:	0 μs to 3600 s
Measurement data storage:	Up to 100000 data points
Average:	Moving average (average count: 2 to 256)
Voltage sense:	Two-wire system and four-wire system

Computation

Equation Computation

Loads the equation definition file created in text format and performs the computation.
Preinstalled built-in equations available.

Operators:	+[addition], -[subtraction], *[multiplication], /[division], ^ [exponentiation], %[remainder], | [logic OR], & [logic AND], ! [NOT], < <= > >= == != [comparison], = [substitution]
Functions:	ABS() [absolute value], SQRT() [square root], LN(), LOG() [logarithm], SIN(), COS(), TAN() [trigonometric functions], ASIN(), ACOS(), ATAN () [inverse trigonometric functions], SINH (), COSH(), TANH () [hyperbolic functions], RAND () [random number generation], EDGE [logic change extraction], TRUNC(), FLOOR() [rounding to an integer], ISINF() [infinity judgment], ISNAN [not-a-number judgment]
Condition statements:	IF, THEN, and ELSE

NULL Computation

Displays the result obtained by subtracting the NULL value from the measured value.
The NULL value can be set to a measured value at a given time or a user-defined value.

Comparison Operation

Determines the magnitude relationship between the displayed value and the reference values (upper and lower) and displays the result.

18.4 External I/O Section (BNC (TRIGGER IN/OUT and START IN/OUT), Digital I/O (EXT I/O), and I/O for Synchronous Operation (SYNC IN/OUT))

BNC I/O

Connector:	BNC connector
I/O level:	TTL
I/O logic format:	Negative logic, falling edge
Minimum pulse width:	10 μs

Digital I/O

Connector:	15 pins (765601 standard model) 50 pins (765602 digital I/O model)
I/O level:	TTL
Minimum pulse width:	10 μs

I/O for Synchronous Operation

Connector:	RJ-11 connector
I/O level:	TTL
Minimum pulse width:	10 μs

18.5 Interface

GP-IB Interface

Electrical and mechanical specifications:	Conforms to IEEE St'd 488-1987
Functional specifications:	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, and C0
Protocol:	Conforms to IEEE St'd 488.2-1992
Address:	0 to 30

RS-232 Interface

Electrical specifications:	Conforms to EIA RS-232
Connection format:	Point-to-point
Transmission mode:	Full duplex
Synchronization mode:	Start-stop synchronization
Baud rate:	9600, 14400, 19200, 38400, 57600, and 115200 bps

USB Interface

Number of ports:	1
Connector type:	Type B connector (receptacle)
Electrical and mechanical specifications:	Conforms to USB Rev. 2.0
Protocol:	Mass storage class, USB-TMC

Ethernet Interface

Number of ports:	1
Connector type:	RJ-45 connector
Electrical and mechanical specifications:	Conforms to IEEE 802.3
Transmission system:	100BASE-TX/10BASE-T
Data rate:	100 Mbps/10 Mbps
Protocol:	VXI-11 server, HTTP server, FTP server, DHCP client, and command socket

18.6 Contents of the Factory Default Setup File (Default.txt)

	Item	CH1	CH2
Source	Mode	DC	DC
	Function	Voltage	Voltage
	Auto range	OFF	OFF
	Voltage range	18 V	18 V
	Voltage level	0 V	0 V
	Voltage pulse base	0 V	0 V
	Current range	200 mA	200 mA
	Current level	0 mA	0 mA
	Current pulse base	0 mA	0 mA
	Pulse width	25 ms	25 ms
	Response mode	Normal	Normal
	Trigger source	Timer1	Timer2
	Source delay	15 μs	15 μs
	Voltage zero impedance	HiZ	HiZ
	Current zero impedance	LoZ	LoZ
Limiter		ON	ON
	Tracking	ON	ON
	High limit value of current	200 mA	200 mA
	Low limit value of current	-200 mA	-200 mA
	High limit value of voltage	18 V	18 V
	Low limit value of voltage	-18 V	-18 V
Sweep	Mode	OFF	OFF
	Voltage start value	100 mV	100 mV
	Voltage stop value	200 mV	200 mV
	Voltage step value	10 mV	10 mV
	Voltage log sweep step count	10	10
	Current start value	100 μA	100 μA
	Current stop value	200 μA	200 μA
	Current step value	10 μA	10 μA
	Current log sweep step count	10	10
	Repeat count	1	1
	Sweep start source	External start	External start
Measurement		ON	ON
	Mode	Fixed function	Fixed function
	Function	Current	Current
	Auto range	OFF	OFF
	Voltage range	18 V	18 V
	Current range	200 mA	200 mA
	Resistance range	200 kΩ	200 kΩ
	Integration time	1 PLC	1 PLC
	Auto zero	ON	ON
	Trigger source	Source change	Source change
	Wiring system	2W	2W
	Measurement delay	0 μs	0 μs
	Averaging	OFF	OFF
	Average count	2	2
NULL computation		OFF	OFF
Equation computation		OFF	OFF
	Param A	0	0
	Param B	0	0
	Param C	0	0

	Item	CH1	CH2
Comparison operation		OFF	OFF
	Upper limit	0	0
	Lower limit	0	0

	Item	Setting
Synchronization	Channel	Asynchronous
	Between units	Master
External I/O	BNC START terminal	IN (input)
	BNC TRIGGER terminal	IN (input)
	Auxiliary trigger output source	Through
Store		OFF
	Store count	100
	Result file generation function	ON
Time	Timer1	50 ms
	Timer2	50 ms

18.7 General Specifications

Safety Standards[1]

Complying Standard

EN61010-1
Measurement category I (250 Vpeak)[2]
Pollution degree 2[3]

Emission[1]

Complying Standards

EN61326-1 Class A
EN55011 Class A, Group 1
EN61000-3-2 Class A
EN61000-3-3
C-Tick EN55011 Class A, Group 1
This is a Class A product.
In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

- **Test Conditions**
  200-mV range infinite sweep source, limit: ±2 mA, load resistance: 30 Ω, local sense (2W)
  With a cable connected to the SENSE terminal and other settings at factory default.

Cable Conditions

- **Output Terminal**
  Use a measurement lead set (758933, red and black 1 pc, length: 1 m) provided to connect to the OUTPUT terminal.
  We recommend that the same cable be used to connect to the SENSE terminal for a four-terminal connection (use a cable of length no longer than 1 m).
- **BNC IN/OUT Terminal**
  Use a BNC cable that is equivalent to the 1.5D-QEW cable or a better cable for the connection.[4]
- **ETHERNET Port**
  Use a category 5 shielded (STP) LAN cable or a better cable for the connection (use a cable of length no longer than 30 m).
- **USB Port**
  Use a Hi-Speed USB 2.0 cable for the connection.[4]
- **GP-IB Connector**
  Use a GP-IB (IEEE488) cable for the connection.
- **I/O Connector**
  Use a shielded cable for the connection.[4]
- **SERIAL (RS-232) Connector (765601 Only)**
  Use a shielded RS-232 cable for the connection.
- **RJ-11 IN/OUT Terminal**
  Use a shielded cable (758960, 1 m in length) for the connection.

Immunity[1]

Complying Standard

EN61326-1 Table2[5]

- **Immunity Influence**
  Within the measured value ± 20% of range
- **Test Conditions**
  200-mV range DC source or infinite sweep source, no limit, load resistance: 30 Ω, local sense (2W)
  With a cable connected to the SENSE terminal and other settings at factory default (the same cable conditions as emission).

1 Applies to products that have a CE Mark on the rear panel. For information on other products, contact your nearest YOKOGAWA dealer.

2 The transient overvoltage of the measurement terminal section on the GS820 is 1500 V. Do not use the GS820 to make measurements for Measurement Categories II, III, and IV.
Measurement Category describes a number which defines transient stresses from the circuit to which they are connected during measurement or test.
It implies the regulation for impulse withstand voltage.
Measurement Category is applied to the measuring circuit.
Measurement category I
Measurement category I is for measurements performed on circuits not directly connected to MAINS.
Examples are measurements on circuits not derived from MAINS, and specially protected (internal) MAINS derived circuits.
Measurement category II
Measurement category II is for measurements performed on circuits directly connected to the low voltage installation.
Examples are measurements on household appliances, portable tools and similar equipment.
Measurement category III
Measurement category III is for measurements performed in the building installation.
Examples are measurements on distribution boards, circuit-breakers, wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and equipment for industrial use and some other equipment, for example, stationary motors with permanent connection to the fixed installation.
Measurement category IV
Measurement category IV is for measurements performed at the source of the low-voltage installation.
Examples are electricity meters and measurements on primary overcurrent protection devices, ripple control units, overhead lines, cable systems, and so on.

3 Pollution Degree applies to the degree of adhesion of a solid, liquid, or gas which deteriorates withstand voltage or surface resistivity. Pollution Degree 2 applies to normal indoor atmospheres (with only non-conductive pollution).

4 Use cables of length 3 m or less.

5 Immunity test requirements for equipment intended for use in industrial locations.

Display

256 × 64 dots fluorescent tube (VFD)

Internal memory:

GS820ROM: 12 MB (non-volatile. Used to save setup files and output pattern files.)
GS820RAM: 16 MB (volatile (cleared when the power is turned OFF). Used to save the measured results.)

Warm-up time

Approx. 60 minutes

Storage Conditions

Temperature –15°C to 60°C
Humidity 20% to 80% RH (no condensation)
Altitude 2000 m or less

Operating Conditions

Temperature 5°C to 40°C
Humidity 20% to 80% RH (no condensation)
Altitude 2000 m or less

Rated supply voltage

100 to 120 VAC/220 to 240 VAC (auto switching)

Permitted supply voltage range

90 to 132 VAC and 198 to 264 VAC

Rated supply frequency

50/60 Hz

Permitted power supply frequency range

48 Hz to 63 Hz

Maximum allowable input voltage

Across SENSE Hi-SENSE Lo and across OUTPUT Hi-OUTPUT Lo	±18 Vpeak
Across SENSE Hi-OUTPUT Lo and across SENSE Hi-OUTPUT Lo	±0.5 Vpeak
Across each terminal of CH1 and each terminal of CH2	±250 Vpk

Maximum Power Consumption

Approx. 250 VA

Maximum Common-Mode Voltage

Across each terminal and case ±250 Vpeak

External Dimensions

Approx. 213(W) x 132(H) x 450 (D) mm excluding projections.

Weight

Approx. 8 kg

Key Lock

Keys can be locked.

Recommended Calibration Period

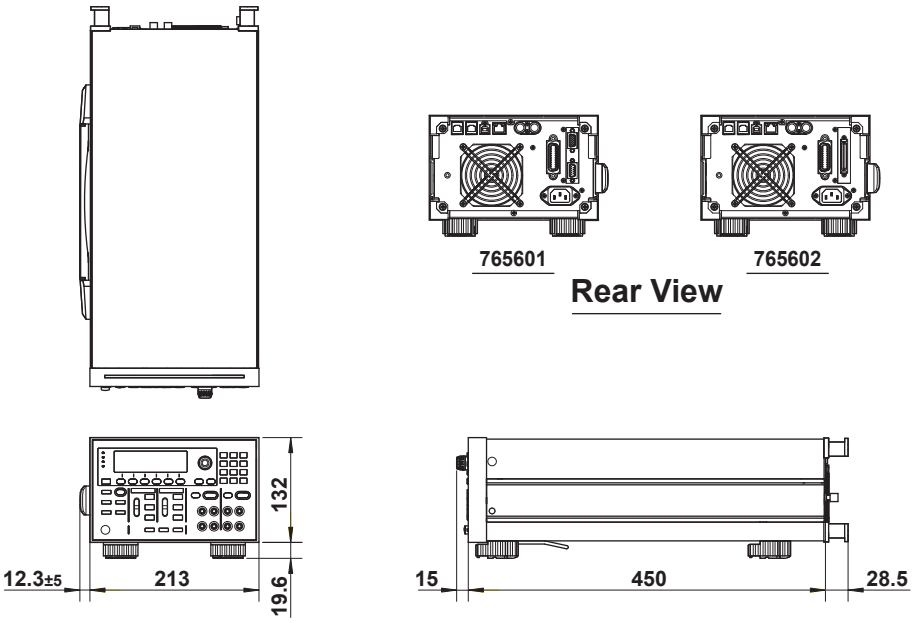
1 year

Standard Accessories

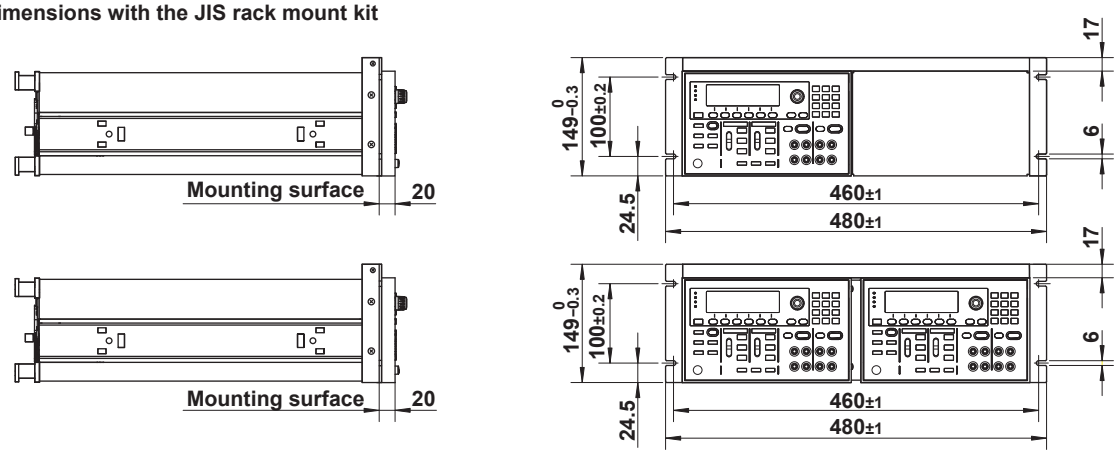
Power cord	1 pc.
Measurement lead	2 sets (1 red and 1 black in each set)
Small alligator clip adapter	2 sets (1 red and 1 black in each set)
Rubber feet	1 sets (2 pcs. in a set)
User’s manual (this manual)	1 pc.
External I/O connector	1 set (a connector and a cover in each set)

18.8 External Dimensions

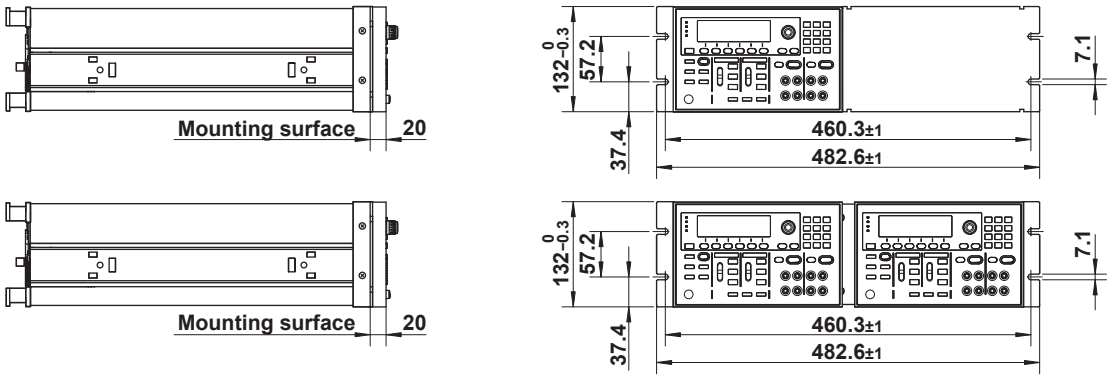
Unit: mm



Dimensions with the JIS rack mount kit



Dimensions with the EIA rack mount kit



Unless otherwise specified, tolerance is ±3% (however, tolerance is ±0.3 mm when below 10 mm).

Index

Symbol

Numbers

A

B

C

D

E

F

G

H

I

K

L

M

N

O

P

R

S

T

U

V

W

Z