Precision Source Measure Unit

GSM-20H10

User Manual

GW INSTEK PART NO. 82SM320H10EB1

ISO-9001 CERTIFIED MANUFACTURER

Copyright Statement

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Table of Contents

SAFETY INSTRUCTIONS

This chapter contains important safety instructions that you must follow during operation and storage. Read the following before any operation to insure your safety and to keep the instrument in the best possible condition.

Safety Notes

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product.

Ensuring that the equipment is operated within its specifications and operating limits, and ensuring that operators are adequately trained. They must be trained in electrical safety procedures and proper use of the instrument， and must be protected from electric shock and contact with hazardous live circuits.

Exercise with extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. A shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground.

The instrument and accessories must be used in accordance with its specifications and operating instrument, or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories as defined in the specifications and operating information (as shown on the instrument or test fixture panels).

When fuses are used in a product, replace with the same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT used as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

Symbols

These symbols may appear in the manual or on the instrument.

⚠ ATTENTION	Ensure conditions or practices suit instrument in case breakdown or operating life reduction of instrument. Always read the associated information very carefully before performing the indicated procedure.
⚠ CAUTION	Ensure conditions or practices suit instrument in case damage to the GSM-20H10 or to other properties. Such damage may invalidate the warranty.

WARING	Ensure conditions or practices suit instrument in case injury or death.
DANGER	If the symbol is marked on the instrument, it means that the instrument can supply or measure a voltage of 1000V or more, including the common influence of normal voltage and common mode voltage. Use standard safety precautions to avoid personal exposure to these voltages.
GROUND	Protective Conductor Terminal, connect it to safety earth ground using the wire recommended in the user documentation if required.
	Indicates the terminal connected to the device shell.
	Do not dispose electronic equipment as unsorted municipal waste. Please use a separate collection facility or contact the supplier from which this instrument was purchased.

Guidelines

General Guideline

⚠ **CAUTION**

- **Do not place any heavy object on the unit.**
- **Avoid severe impact or rough handling that leads to damaging the unit.**
- **Do not discharge static electricity to the unit.**
- **Do not block the cooling fan opening.**
- **Do not disassemble the GSM-20H10 unless you are qualified.**
- **EN 61010-1 specifies the measurement categories and their requirements as follows. The GSM-20H10 operates under category of Not II, III, IV.**
    - Measurement category IV is for measurement performed at the source of low-voltage installation.
    - Measurement category III is for measurement performed in the building installation.
    - Measurement category II is for measurement performed on the circuits directly connected to the low voltage installation.
    - 0 is for measurements performed on circuits not directly connected to Mains.
- **EN 61010-1 specifies pollution degrees and their requirements as follows. Pollution refers to "addition of foreign matter, solid, liquid, or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity".The GSM-20H10 operates under degree 2.**
    - Pollution degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.

- Pollution degree 2: Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

- Pollution degree 3: Conductive pollution occurs, or dry, non-conductive pollution occurs which becomes conductive due to condensation which is expected. In such conditions, equipment is normally protected against exposure to direct sunlight, precipitation, and full wind pressure, but neither temperature nor humidity is controlled.

Power Supply

AC Input voltage range: 100~240VAC(±10%), 50/60Hz

⚠ **WARNING: To avoid electrical shock, connect the protective grounding conductor of the AC power cord to an earth ground.**

Fuse

- **Fuse type: T2.0A/250V**

⚠ **WARNING:**

- **Make sure to use the correct fuse type before starting up.**
- **To prevent fire, replace the fuse only with the specified type and rating.**
- **Disconnect the power cord before replacing the fuse.**
- **Make sure the cause of fuse blowout is fixed before replacing the fuse.**

Cleaning the instrument

⚠ **WARNING:**

- **Disconnect the power cord before cleaning the instrument.**
- **Use a soft cloth dampened in a solution of mild detergent and water. Do not spray any liquid into the instrument. Clean the exterior of the instrument only.**
- **Do not use chemicals containing harsh products such as benzene, toluene, xylene, and acetone.**

Operation Environment

- Location: Indoor, no direct sunlight, dust free, almost non-conductive pollution (Note below)
- Relative Humidity: < 80%
- Altitude: < 2000m
- Temperature: 0°C to 40°C

Storage environment

- Location: Indoor
- Relative Humidity: < 80%
- Temperature: -20°C to 70°C

OVERVIEW

This chapter contains a brief introduction to GSM-20H10, including the main features, as well as an overview of the front and rear panel. Use the Getting Started chapter on page 29 to start up instructions and how to setup the appropriate operation environment.

Main Function

Overview

The GSM combines a precise, low-noise, highly stable DC power supply with a low-noise, high-impedance multimeter. It has 0.012% basic accuracy with $6^{1/2}$ digit resolution. At $4^{1/2}$ digits display resolution (Medium), the GSM delivers 520 readings/second over the IEEE-488 bus. At $3^{1/2}$ digits display resolution (Fast), it can read up to 2000 readings/second into its internal buffer.

Because of its built-in source function, the GSM can be used to generate a set of current voltage (I-V) characteristic curves, which is very useful for semiconductor device and material testing.

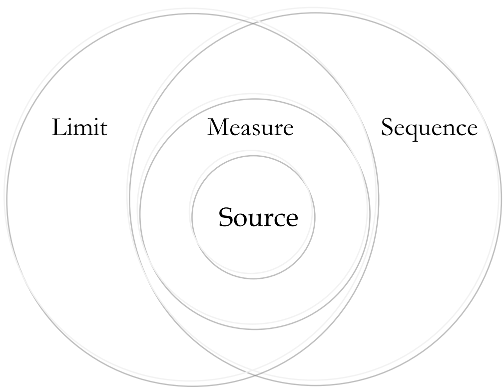
It is equivalent to the combination of voltage source, current source, voltmeter, amperemeter and ohmmeter.

The digital GSM is designed for routine testing and high-speed production testing applications. In the manufacturing of components and modules of communication, semiconductor, computer, automobile and medical industry, GSM is of great practical valuable for their various characteristics analysis and production process testing.It is also usually used in testing and R & D laboratories.

Main Function

Four Quadrant Source Function (V/I)

GSM-20H10, as a conventional power supply, has the function of automatic CC/CV crossover function. You can use the front panel to set as voltage source or current source, and configure parameters such as voltage testing, current testing, display digits, data sampling period, power status, OVP, etc. The voltage and current testing settings and the actual voltage/current testing value are displayed on the LCD. V/I measurement, limit measurement, sequence output and trigger functions are all extended on the basis of source function. The relationship is shown in figure below:



For more source information, see page 46.

Measure Function (V/I/Ω)

GSM-20H10 can also be used as voltmeter/amperemeter and ohmmeter to measure external voltage/current value and resistance. The measurement function can also comply five calculation functions through the built-in mathematical functions: Power, CompOhms, VarAlpha, Vcoeff, DEV. The relevant parameter settings can be set through the front panel keys and displayed on the LCD. See page 80 for details.

* The user can define up to 5 operations through the remote command. For details, see page 201.

Limit Function

There are three types of limits: compliance, coarse limits and fine limits. And summarizes the two operating modes: grading and sorting. For details, see page 100. Covers pass/fail condition for the grading and sorting modes. For details, see page 110.

Sequence Function

There are four basic sweep types: linear Staircase, Logarithmic staircase, Custom and SRC-MEM sweep. For details, see page 123.

TRIG Function

The trigger model consists of two layers (Arm Layer and Trigger Layer) to provide versatility. Programmable counters allow operations to be repeated, and various input and output trigger options are available to provide source-measure synchronization between the GSM and other instruments (via the Trigger Link). For details, see page 139.

Remote Control

To meet the various needs of customers, the GSM-20H10 is designed for USB (TMC), RS-232, GPIB and LAN remote control. For details, see page 170.

External I/O port

The GSM-20H10 has external control signals for customers. Including input trigger signal and output control signal. For details, see Limit function on page 117 and Trigger function on page 146.

Key Features

General

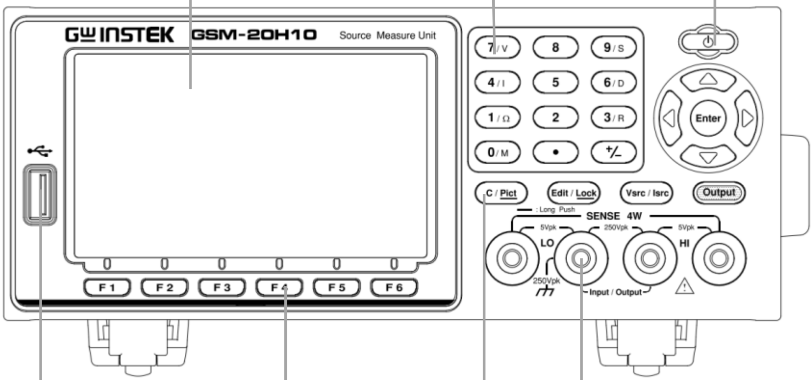
- Low noise, the speed of fan is controlled by thermostatic.
- Compact, meets the 2U height and 1/2Rack width requirement.
- 4.3 inch TFT LCD display.
- Constant voltage and constant current operation (CV/CC).
- Front and Rear output control key (FRONT/REAR).
- Digital voltage and current settings by number pad.
- Alarm buzzer (BEEP).
- Key lock function (LOCK).

Additional

- Source-measure sweep capabilities (Linear and Logarithmic staircase sweeps, source sweep list of up to 2500 points, memory sweep of up to 100 instrument setups).
- 6-wire Ω measurement with programmable I-source or V-source.
- 4-quadrant source and sink operation.
- Up to 11 stages of limit testing with a built-in comparator for pass/fail testing.
- Digital I/O interface for component handler.
- Five built-in math expressions, up to five user-defined math expressions (remote command only).

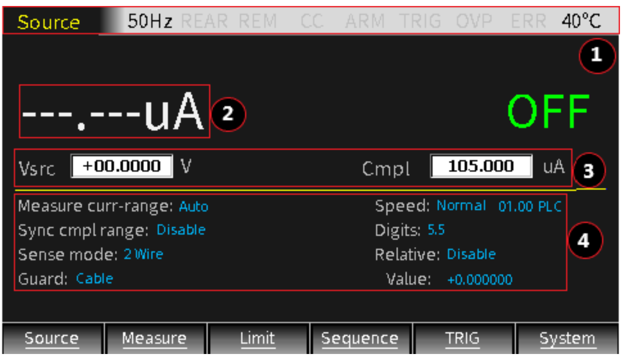
	• Reading and setup storage, up to 2500 readings and six storage area (four user settings, two factory defaults) can be stored and recalled.
Protection	• Overvoltage protection (OVP).
	• Overtemperature protection (OTP).
Interface	• USB remote control.
	• RS-232 remote control.
	• GPIB remote control.
	• LAN remote control.

Front Panel



Display & Parameter

Power on Display (Source)



Description

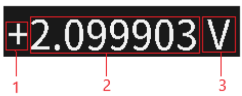
The display is used primarily to program source and compliance values and display the real measured readings, The area is divided as follows.

① Status and Error messages

Status and error messages are displayed momentarily, which are located on the top of the display, indicate various states of operation. The meaning of each status information is described separately in each function introduction chapter. The error message contains a variety of error types, which can be read by instructions under remote control. Typical error messages description and types are listed in page 360.

② Reading Data/Format

The readback value is displayed with a resolution of up to $6^{1/2}$ digits. The number of display digits can be changed by directly setting Digits or modifying the refresh Speed. Take the highest resolution of the readback voltage as an example:



The readback display area is divided into 3 parts: 1: sign, 2: value, 3: units.

- The measurment values of voltage, current and resistance can be positive or negative.
- The digital display has a total of 7 digits at most, and the range is determined by the integer digits combined with the unit.

When measuring V:

- 3 integer digits for 200V or 200mV range
- 2 integer digits for 20V range
- 1 integer digits for 2V range

When measuring I:

- 3 integer digits for 100mA or 100uA range
- 2 integer digits for 10mA or 10uA range
- 1 integer digits for 1A or 1mA or 1uA range

When measuring Ω

- 3 integer digits for 200MΩor 200kΩ or 200Ω range
- 2 integer digits for 20MΩor 20kΩ or 20Ω range
- 1 integer digits for 2MΩor 2kΩ or 2Ω range

The unit of voltage is V or mV; the unit of current is A or mA or uA; the unit of resistance is MΩ or KΩ or Ω; when performing Math, there may not be the above unit.

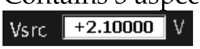
When the output is turned on, the top (main) display area is used for measurement. The read information can be displayed in integer or floating point format using engineering notation or scientific notation. Example of engineering notation: 1.23456μA, example of scientific notation: 1.23456e-6. Using System->Control->Numbers option to select the display format.

③ Edit the source

Under the reading display area, is used for programming source value (Vsrc or Isrc) and compliance (Cmpl) limit. For the settings of OVP, please refer to Source Operation.

Voltage source/Current source setting operation:

Contains 3 aspects, as shown in the figure:



a， Vsrc or Isrc setting, the Vsrc/Isrc key on the operation panel can be selected in turn.

b， To set the Vsrc or Isrc range, using the Edit/Lock key on the operation panel can alternately select the src, Cmpl or parameter area. When the src value area is marked, operate the up and down direction keys and observe the position of decimal point and unit to understand the corresponding range.

c， To set the value of Vsrc or Isrc, when src value area is marked, input the required value from the numeric keyboard according to the high to low digits, or use the left and right arrow keys to select the digit to input the corresponding value.

Compliance instructions and setting operations:

When the source is voltage, GSM can be set to limit the current. Conversely, when the source is current, GSM can be set to limit the voltage. The output will not exceed compliance limits.
--- Current compliance can be set from 1nA to 1.05A
--- Voltage compliance can be set from 200uV to 210V

There are two types of compliance: "real value" and "range".

Depending on which value is lower, the output will be clamped in the compliance setting (Actual compliance) or at the maximum of a fixed measurement range (range compliance). This feature effectively limits the power transmitted to the device. When the GSM is used as a current source, the voltage is clamped at the compliance value; conversely, when the GSM is used as a voltage source, the current is clamped at the compliance value.

CAUTION: If the auto measurement range is selected, range compliance will not occur.

For example, to measure a 20Ω resistor, set Isrc to 105mA, set Cmpl to 21V, set Measure volt-range to 20V, turn on Output, press the 7/V key and the output voltage value is 2.1170V, press the 4/I key and the output current value is 105.005mA. It can be seen that the output voltage value is within the compliance value (Cmpl) and the range (Measure volt-range), and the output current value is source value (Isrc). At this time, the meter is operating in CC (constant current) mode.

Maximum compliance value

The following table summarizes the maximum compliance values of the measuring range:

	Measure range	Max. Cmpl value
Voltage	200mV	±210mV
	2V	±2.1V
	20V	±21V
	200V	±210V
Current	1uA	±1.05uA
	10uA	±10.5uA
	100uA	±105uA
	1mA	±1.05mA
	10mA	±10.5mA
	100mA	±105mA
	1A	±1.05A

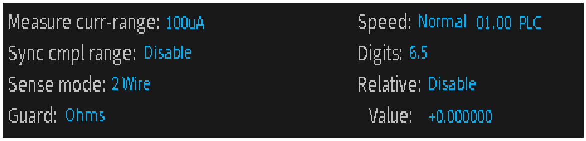
The Cmpl setting of voltage or current contains three aspects, as shown in the figure:

a， The choice of Vcmpl or Icmpl is determined by source. When Vsrc is selected, Icmpl is automatically selected. Similarly, when Isrc is selected, Vcmpl is automatically selected.

b， Vcmpl or Icmpl range setting: The Edit/Lock key on the operation panel can alternately select SRC, Cmpl or parameter area. When the Cmpl value area is marked, operate the up and down direction keys and observe the position and unit of the decimal point to understand the corresponding range.

c， Vcmpl or Icmpl value setting: when the Cmpl value area is marked, input the required value from the numeric keyboard according to the high and low digits, or use the left and right arrow keys to select the digit to input the corresponding value.

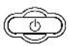
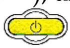
④ Set the parameter
Under the middle horizontal line used for programming related parameters. Take the relevant settings of the voltage source as an example, as shown in the following figure:



⑤ Auxiliary function key
The bottom line is function name of the keys F1 to F6. Under the main interface, F1 is Source function, F2 is Measure function, F3 is Limit function, F4 is Sequence function, F5 is TRIG function, F6 is System function. In other interfaces, the definition of function keys is different.

The underlined key has a secondary function, long press for 2-3 seconds will pop up related settings.

Control Panel

Power standby switch		Long press for at least 2 seconds to turn on or turn off the power supply of the instrument (turn on the AC power switch on the rear panel first, and make the GSM standby light red ), and the light turn to yellow  after turning on the mathine.

Cancel/Hardcopy key		Short press C/Pict key to cancel the chosen setting value. Long press (2 to 3sec) C/Pict key to copy current display interface. The screenshot will be stored to USB flash disk automatically. See page 168 for operation details.
Voltage and Current Setting key		Voltage-source (Vsrc)/ Current-source (Isrc) toggle key. See page 56 for operation details.
Output key		The Output key turns the output on or off. The Output key will light up when the output is on. On: 
Auxiliary function key		Under the LCD is the F1 to F6 function key. In different interfaces, the definition of auxiliary function key is different.
Direction keys and Enter key		The direction keys are used for parameter and menu selection as well for fine adjustment of the current/voltage range settings. The Enter key is used to confirm the selection of any settings or parameters and to exit after a setting is complete.

Edit /Lock key 

The instrument must be in the edit mode to set source and compliance values.The edit mode is selected by short pressing the Edit/Lock key. The editing cursor (marking digit) appears for the source or compliance edit. If a value is not edited within 6 seconds, the edit mode is cancelled.

While in the edit mode, the Edit/Lock key toggles between the source value, compliance value and parameters setting.

Long pressing Edit/Lock key is used to disable all the panel keys except the Output key.

Pressing the Edit/Lock key for at least 2 seconds will turn the panel locked or unlocked.

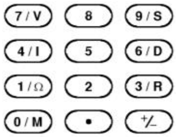
- When the panel lock is activated, or when remote communication is performed, the lock light will be on.

  Locked: 

 ⟹ 

- Long pressing Edit/Lock key can turn the panel unlocked, or use :SYSTem:LOCal Command to take GSM-20H10 out of remote, both of these two ways can slake the Edit/Lock light.

Number pad



a， The number pad is used to enter various parameters values.

b， V/ I/ Ω/M, measurement shortcut keys. These keys can only operate in the case of non digital input .V/ I shortcut keys can operate in Source and Measure function, Ω/M shortcut keys only operate in Measure function.

V: Measure and display the voltage

I: Measure and display the Current

Ω: Measure and display the resistance

M: Measure and display the calculation result

Measurement operation under each function:

Source:	V, I
Measure:	V, I, Ω, M
Limit:	V, I, Ω, M
Sequence:	V, I, Ω, M

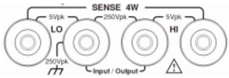
NOTE: When measuring resistance under Sequence, set Ohm source as Manual.

c， S/D/R, parameters setting shortcut keys. These keys can only operate in the case of non digital input.

S: Speed setting

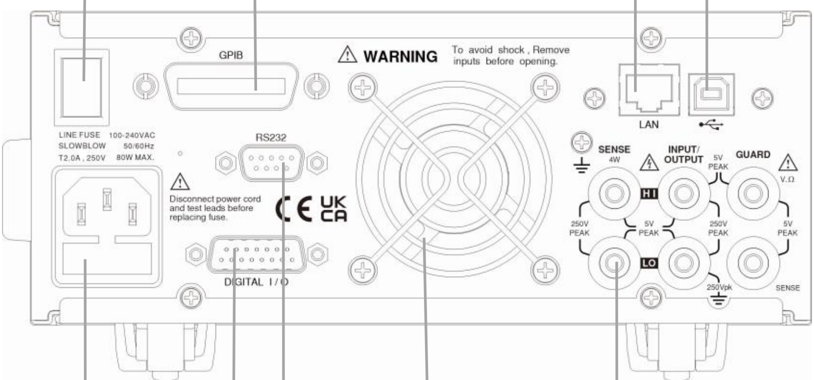
D: Digits setting
R: Relative setting

Terminals

Input/Output Terminals (SOURCE)		The middle two terminals are the Input and Output of the source.
Voltage Feedback Terminals (SENSE)		On both sides are voltage feedback terminals corresponding to positive and negative terminals. These two terminals are used for 4-Wire output or 4-Wire resistance measurement

Rear Panel

AC power switch GPIB port LAN port USB port



AC power socket and fuse

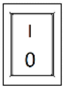
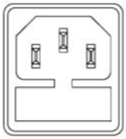
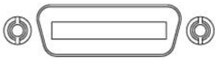
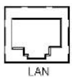
Digital I/O

RS-232 port

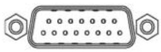
Heat sink fan

Rear panel Inputs/Outputs

Terminals

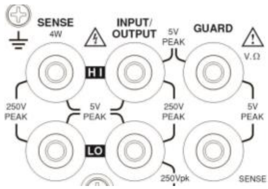
AC power switch		Power on or power off the main circuit, GSM-20H10 is in standby state after pressing I, and the standby light on the front panel is red. I->on, O->off
AC input socket and fuse case		The AC input accepts 100~240VAC(±10%). The frequency is 50Hz/60Hz. Fuse: 2.0A (slow-blow type) Replace the fuse please see page 366 for details.
USB port		USB device port for remote control. See page 170 for details.
GPIB port		GPIB slave port for remote control. Abides to IEEE488.2 (SCPI) protocol. See page 177 for details.
LAN port		LAN port for remote control. See page 180 for LAN setting and operation details.
RS-232 port		RS-232 device port for remote control.See page 173 for details.

Digital I/O port



There are 15 I/O ports: one +5V output ports, one GND port, four digital output lines and four trigger link lines, two input signal lines, three idle lines. See Limit function on page 117 and Trigger function on page 146.

Rear panel inputs/outputs



There are six terminals, including two power Input and Output positive and negative terminals, two voltage feedback positive and negative terminals, one guard terminal and one guard sense terminal. Please refer to the printing of the back panel for the specific order. See page 26 for details.

Heatsink fan

It is used to discharge the heat inside the equipment through air flow. In either case, proper ventilation must be maintained to prevent overheating.

GETTING STARTED

This chapter describes the starting up procedures and the preparation that is necessary before operating the instrument.

Safety Remind

- During the power-up, voltage spikes may appear on the terminals of the GSM-20H10. These voltage spikes could be at hazardous levels (42.4V peak) and could damage sensitive DUTs. Never touch external circuitry or the test leads when powering up the GSM-20H10.

- To prevent electric shock, test connections must be configured such that the user cannot come in contact with conductors or any DUT that is in contact with the conductors. Safe installation requires proper shields, barriers, and grounding to prevent contact with conductors.

- Hazardous voltages may be present on the output and guard terminals. To prevent electrical shock that could cause injury or death. NEVER make or break connections to the GSM-20H10 while GSM-20H10 is on. Power off the equipment from the front panel or disconnect the main power cord from the rear of the GSM before handling cables connected to the outputs. Putting the equipment into standby mode does not guarantee the outputs are not powered if a hardware or software fault occurs.

Prepare & Start Up

Check The AC Voltage

Confirm AC voltage

Before the power is turned on, confirm that the input power supply meets the following conditions:

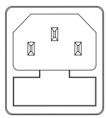
100~240VAC(±10%), 50/60Hz.Check to be sure the operating voltage in your area is compatible. GSM-20H10 can automatically detect and display the power line frequency (if the wrong power line frequency is displayed,you can set it manually).

CAUTION: Operating the instrument on an incorrect line voltage may cause damage, possibly voiding the warranty.

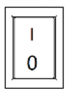
Connect The AC Power Cord

Connect AC power

The fuse is a 2.0A slow-blow fuse. Confirm that the fuse is of the correct type and rating before connecting the power cord.



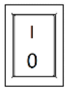
1, Before plugging in the power cord, make sure the rear panel power switch is in the off (O) position.



2, Connect the female end of the supplied power cord to the AC receptacle on the rear panel.

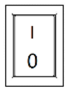
CAUTION: The power cord supplied with GSM-20H10 contains a separate ground for use with grounded outlets. When proper connections are made, instrument chassis is connected to power line ground through the ground wire in the power cord. Failure to use grounding may cause personal injury or death due to electric shock.

Turn The Power On

Turn on the main power switch	Press the power switch on the back panel to turn on the main power. After turning on, GSM-20H10 is in standby mode, and the front panel standby light is red . 
Turn on standby power	Long press the standby power switch for at least 2 seconds, and the standby light turns yellow after turning on .
Power-up sequence	On power-up, the GSM performs self-tests on its EPROM and RAM. If a failure is detected, the instrument momentarily displays an error message, and the ERR annunciator turns on (error messages are listed in page 360).
	If the instrument passes self-tests, the line frequency will be displayed (If the wrong frequency is displayed, it can be set manually as covered below). After the power-up sequence, the instrument goes to its normal display state with the Output off (Output indicator light off). With the output off, the OFF message is displayed, and dashes replace the reading.

Line frequency setting	At the factory, the GSM is configured to sense the power line frequency and display. If the line power source is noisy, the GSM may select the wrong setting on power-up. If this situation occurs, noisy measurement readings will result, and accuracy may be affected. You can manually set the line frequency from the front panel: System-> Control->Line frequence selection, or use :SYST:LFR Command by remote.

Turn The Power Off

Turn off standby power	Long press the standby power switch for at least 2 seconds, and the standby light turns red after turning off the power .
Turn off the main power switch	Press the power switch on the back panel to turn off (O) the main power. 

Terminal Connection

Front/Rear Terminals

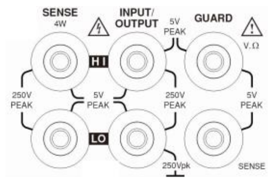
Terminals: The INPUT/OUTPUT (HI and LO) and SENSE (HI and LO) terminals are accessible from both the front and rear panels. The V.Ω GUARD and GUARD SENSE terminals are only accessible from the rear panel.

Front/Rear terminals selection: The front/rear terminal can be selected through the System menu. When the rear terminal is selected, the LCD status bar will display REAR. The front panel is used by default when powered on, there is no display on the status bar.
Manually set from the front panel: System->Control->Rear, or set by the Command: :ROUTe:TERMinals.

NOTE: After change the front and rear terminals, the output will be turned off.

Connect To Load

Description: The maximum allowable voltage differentials between terminals are labeled on the Front/Rear panel, as shown in the figure (rear panel).



WARNING: To prevent electric shock and damages to the GSM-20H10, DO NOT exceed the maximum allowable voltage differentials shown in terminals. The front and rear terminals of the GSM are rated for connection to circuits rated Installation Category 0 only. Do not connect the GSM terminals to CAT II, CAT III, or CAT IV circuits. Connections of the GSM Input/Output terminals to circuits higher

than CAT 0 can cause damage to the equipment or expose the operator to hazardous voltages.

To prevent electric shock and damage to the GSM, external common mode voltage must be limited within 250VDC, 1.05A maximum.

Sense Connect Methods

Description Basic source-measure operations are performed using either 2-wire local sense connections or 4-wire remote sense connections. The factory default sense selection is local.

⚠ **Note: The front panel terminals are isolated from the rear panel terminals. Therefore, if you are using the front panel terminals, ground the front panel LO terminal. If using the rear panel terminals, ground the rear panel LO terminal.**

Connections alone do not determine sense mode. For local sensing, 2-wire sensing must be selected from the Sense mode option from front panel parameter setting area. For remote sensing, 4-wire sensing must be selected. The 2-wire sense mode is the BENCH and GPIB default.

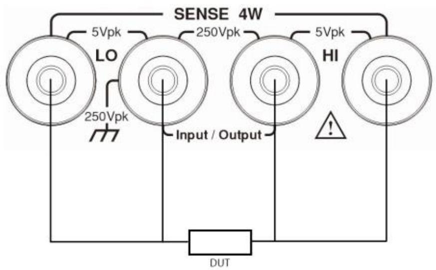
⚠ **WARNING: There is no internal connection between earth ground and INPUT/OUTPUT LO terminal of the GSM.Therefore, hazardous voltages (>30V rms) maybe appear on that LO terminal. Typically, this can occur when the GSM is operating in any mode where the output changes rapidly, such as quick, pulsed waveforms that can be generated using the ZERO, AUTO-OFF output state, or fast pulse sweep operations.**

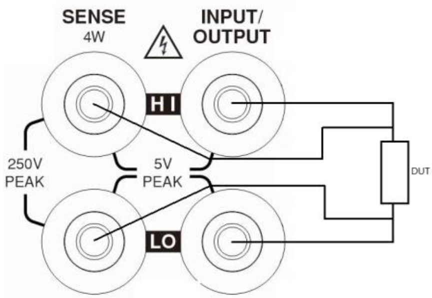
To prevent this from occurring (if your application allows it), connect the INPUT/OUTPUT LO terminal to earth ground. You can connect the LO terminal to the chassis ground screw terminal on the rear panel, or to a known safety earth ground.

4-wire remote sensing

When measuring the voltage, there may be a deviation caused by the line resistance of the leads. Using 4-wire connection can optimize the measurement accuracy and ensure that the programmed voltage is transmitted to the DUT. When measuring the voltage, only the voltage drop on the DUT is measured. The 4-wire connection methods of the front panel power terminals and the rear panel power terminals are shown in the following two figures respectively.Use 4-wire remote sensing for the following source-measure conditions:

- Test circuit impedance <1kΩ.
- Need to obtain the best resistance/voltage measurement accuracy.





NOTE: Specified accuracies for both source and measurement can only be achieved using 4-wire remote sensing.

When the output is turned off in 4-wire sensing mode, for safety reasons, the Sense mode automatically returns to 2-wire. When the output is turned on, the Sense mode automatically restores to 4-wire.

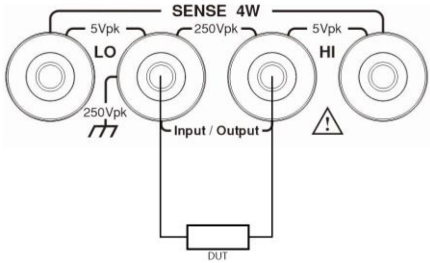
WARNING: When sourcing voltage in remote sense, make sure the sense leads are connected to the DUT. If a sense lead becomes disconnected, 0V will be sensed, and the GSM will increase the output voltage (to possibly hazardous levels) to compensate. For increasin safety, you can limit the voltage output of the GSM (turn on OVP function).

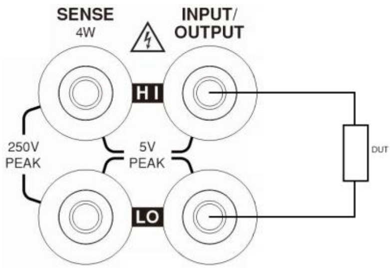
2-wire local sensing

2-wire local sense connections can only be used if the deviation contributed by test lead IR drop is acceptable to the user. When current levels below 100mA, the errors are usually not significant (assuming test lead resistance is not greater than 1Ω). The 2-wire connection methods of the front panel power terminals and the rear panel power terminals are shown in the following two figures respectively.

Since the current in the series circuit is the same at all points in the loop, 4-wire sensing cannot improve the accuracy of I source or current measurement. Therefore, if it is I source measuring current mode, you can use 2-wire sensing. Other conditions that allow the use of 2-wire sensing methods include:

- Test circuit impedance is 1kΩ. Above 1GΩ, Guard option should select Cable.
- Measure V function or measure I function.





Sense And Guard Selections

Sense selection — When using the SENSE HI and LO terminals of the GSM, 4-wire remote sensing must be selected. When not using these terminals, 2-wire local sensing must be selected.

NOTE: When Sense mode or Guard settings are changed, the OUTPUT will turn off.The GSM defaults to the 2-wire mode when the output is off, regardless of the sense setting. When the output is turned on, the present sense setting will be in effect.

Front panel sense selection	On power-up, the instrument is automatically set for 2-wire local sense. Perform the following steps to change the sense selection: 1. Click the Edit/Lock key and the direction keys to make the cursor stop in the Sense mode setting box. 2. Press Enter key, use the direction keys to select 2 Wire or 4 Wire, and press Enter to exit programming.
	⚠ **NOTE: 2 Wire indicates that local sense is selected, and 4 Wire indicates that remote sense is selected.**
Guard selection	Cable guard is used for high-impedance guarding for cables (i.e., coax and triax) and test fixtures. Ohms guard provides a high-current guard output, which allows in-circuit guarded ohms measurements. On power-up, Cable guard is selected.
	⚠ **NOTE: For 6-wire ohms measurements, use the Guard output off mode. See page 155 for details.**
Front panel guard selection	Perform the following steps to change the Guard selection: 1. Click the Edit/Lock key and direction keys to make the cursor stay in the Guard setting box. 2. Press Enter key, use the direction keys to select Ohms or Cable, and press Enter to exit programming.
	⚠ **NOTE: 1, Do not use Ohms guard with coaxial cabling, or oscillations may occur. 2, Ohms guard cannot be selected on the 1A range (source or measure).**

Wires Selections

Recommended Cables	GTL-108A	It can be used on the terminals of source, sense and guard
	GTL-207A	Used to measure external voltage and current

Front and Rear panel wiring: Insert the selected wiring according to the print under the output port

⚠ **NOTE: For safety reasons, the specification of self-distribution wire should be higher than the standard wire.**

Wire type description: Load wires must have enough current capacity to minimize cable loss and load line impedance. Voltage drop across a wire should not excess 0.5V. The following list is the wire current rating at 450A/cm^2.

Wire Size(AWG)	Maximum Current (A)
20	2.3
18	3.7
16	5.9
14	9.4
12	14.9

Power On Settings

Turn on/off standby power	Long press the standby power switch for at least 2 seconds, and the standby light turns yellow . Long press the standby power switch for at least 2 seconds, and the standby light turns red .
Automatic output off	Any of the following actions will cause the output to be automatically off: • Recall the saved setting • toggle Guard mode • toggle Sense mode • switch Front/Rear panel output • switch V-Source or I-Source

BASIC OPERATION

This chapter describes how to set and use various parameters.

Preparation

Operating Environment

Description	The GSM-20H10 use a cooling fan to keep it from overheating, the speed of the fan is controlled by the temperature of the heat sink. When the Output is turned off, the fan will usually run at the low speed. The GSM-20H10 must be operated in an environment where the ambient temperature does not exceed 40°C. If the GSM-20H10 is overheated, the output will be turned off and the cooling fan will run at high speed.

CAUTION: To prevent the effects of overheating, and thus ensure specified performance, Please observe the following precautions:

- **Prevent the sides cooling vents from becoming blocked.**
- **Do not position any devices adjacent to the GSM-20H10 that force heated air into. This additional airflow could compromise**

accuracy performance.

- **When rack mounting the GSM-20H10, make sure there is adequate airflow around the sides to ensure proper cooling.**
- **Rack mounted high power dissipation equipment adjacent to the GSM-20H10 could cause excessive heating to occur. The specified ambient temperatures must be maintained around its surfaces.**
- **A good method to ensure proper cooling in rack situations with convection cooling only is to place the hottest equipment at the top of the rack. Precision equipment, such as the GSM-20H10, should be placed as low as possible in the rack where temperatures are the coolest. Adding a partition below it will help ensure adequate airflow.**

Funtion Overview

Description

From the front panel, the GSM-20H10 can be configured to perform the following operations:

Source Funtion:

- Source voltage — Display current or voltage measurement reading
- Source current — Display voltage or current measurement reading

Measure Funtion:

- Measure resistance — Press 7/V or 4/I hot key to display voltage or current measurement reading of resistor under test.
- Measure only (V or I) — Display voltage or current measurement reading.

Source-Measure limitations

The following table lists the source and measure limits for the voltage and current functions.

Range	Source	Measure
200mV	±210mV	±211mV
2V	±2.1V	±2.11V
20V	±21V	±21.1V
200V	±210V	±211V
1uA	±1.05uA	±1.055uA
10uA	±10.5uA	±10.55uA
100uA	±105uA	±105.5uA
1mA	±1.05mA	±1.055mA
10mA	±10.5mA	±10.55mA
100mA	±105mA	±105.5mA
1A	±1.05A	±1.055A

NOTE: Output transient recovery — The time required for the V-source to recover to its original value (within 0.1% plus load regulation errors) after a step change in load current <250μsec. This does not include the response time of autoranging or the second order effects on loads that are not purely resistive.

Load regulation — The voltage specification for V-source mode load changes is 0.01% +1mV. This means that on the 200mV range, the load current can be changed from zero to full scale with less than 1.02mV of error. Calculation:
error = (0.01% x 0.2V) + 1mV = 1.02mV
Assuming a 0 to 1A change in current, the output impedance equates to 1.02mΩ (1.02mV/1A = 1.02mΩ). This level can only be achieved using 4-wire remote sensing.

Compliance limit

When sourcing voltage, the GSM can be set to limit current. Conversely, when sourcing current, the GSM can be set to limit voltage. The GSM output will not exceed the compliance limit. The following table summarizes the compliance limits based on the range.

Range	Max.Cmpl.value
200mV	±210mV
2V	±2.1V
20V	±21V
200V	±210V
1uA	±1.05uA
10uA	±10.5uA
100uA	±105uA
1mA	±1.05mA
10mA	±10.5mA
100mA	±105mA
1A	±1.05A

Parameter Setting Method

Description: There are roughly the following types of GSM parameters, and the operations are as follows:

Value input:

- Require to select the range, press Enter to make it in the editing state 

(the digital background is black), use the up and down direction keys to select the range first, and then choose the following two methods to input the required value:
  1. Press the numeric key to input the required value, and press the sign key firstly if a negative value is needed, then press Enter to exit editing.
  2. Press the left and right arrow keys, the cursor stops on the digit that needs to be modified, and use the sign key and numerical keys to input the required value; or press the up and down arrow keys to adjust the value to the required number.
- Do not require to select the range, press Enter to make it in the editing state 

(the digital background is

black), then use the above two numerical input methods to operate.

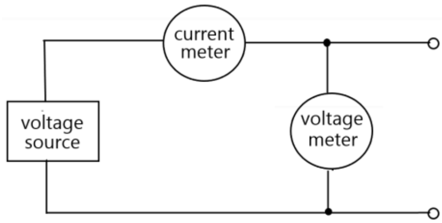
Select input

There are up and down arrows in the edit box, use the up and down arrow keys to select, and use the Enter key to confirm, as shown in the figure:

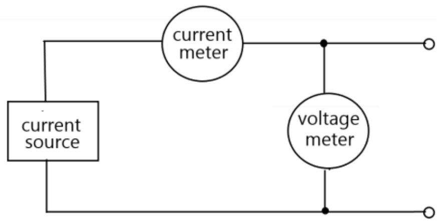
Source Function

Circuit Configuration

The basic source-measurement configuration of GSM-20H10 is shown in the figure. Under the voltage source or current source, you can measure current or voltage.



voltage source

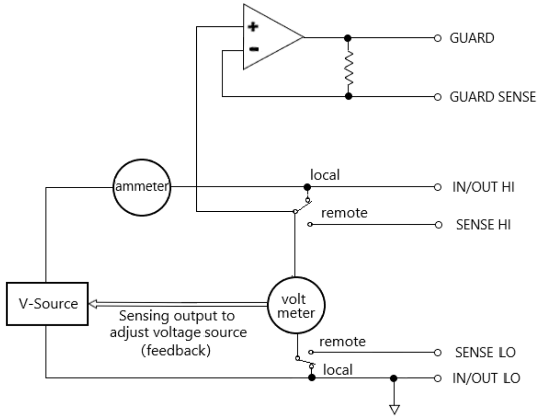


current source

Source V

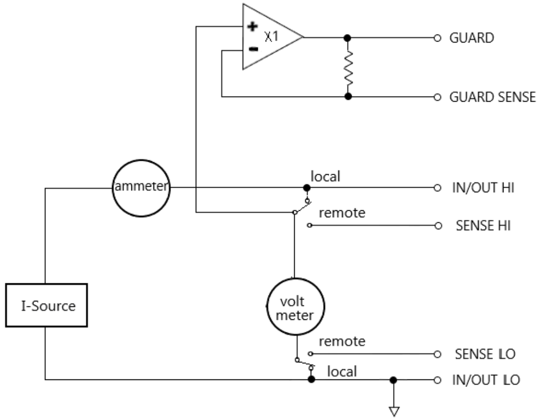
When configured as a V-Source, it operates as a low-impedance voltage source with current limiting capability and can measure current (as an Ammeter) or voltage (as a voltmeter).
The sensing circuit is used to continuously monitor the output voltage and adjust the voltage as needed. The voltmeter senses the voltage on the input/output terminals (2-wire for local sensing) or DUT (using 4-wire remote sensing) and compares it with the programmed voltage level. If the sensing level and the programmed value are not the same, adjust the voltage accordingly. Remote sensing

eliminates the effects of voltage drops in the test leads, ensuring accurate programming voltages on the DUT



Source I

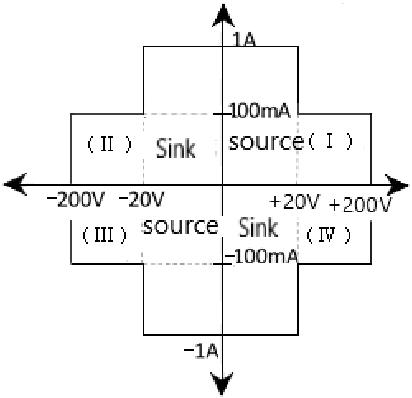
When configured as an I-Source, the GSM operates as a high-impedance current source with voltage limiting capability and can measure current (as an ammeter) or voltage (as a voltmeter).
For voltage measurement, the choice of sensing method (2-wire local or 4-wire remote) determines where to perform the measurement. Under 2-wire local sensing, the voltage is measured at the input/output terminals of the GSM; Under 4-wire remote sensing, the sensing terminal can be used to directly measure the voltage on the DUT. This eliminates any voltage drops that may occur in the test leads or connections between the GSM and the DUT



NOTE: The current source does not require or use Sense leads to improve the accuracy of the current source. When selecting 4-wire sensing, the sensing leads must be connected, otherwise it will cause incorrect results. Please refer to page 34 for the connection method. If there is a possibility that the sensing lead may disconnect, overvoltage protection (OVP) can be used.

V/I Output Range

Source or Sink	According to the settings and connection with the load, the GSM can operate in any one of the four quadrants. The figure below shows the four operating quadrants of the GSM. When operating in the first (I) or third (III) quadrant, the GSM operates as a power source (V and I have the same polarity). As a power source, the GSM provides power to the load. When operating in the second quadrant (II) or the fourth quadrant (IV), the GSM operates as a sink (the polarity of V and I are opposite). As a sink, it is consuming energy, not providing energy.



1A, 20V and 100mA, 200V amplitude is the nominal value. The actual maximum output voltage and output current amplitude are 1.05A, 21V and 105mA, 210V. The limit in the image above is not a range.

Operating limit (source or sink)

I-Source operating boundaries: as shown in Figure 1 below, the boundaries of the four quadrants are similar.

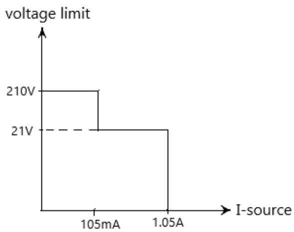


Figure 1

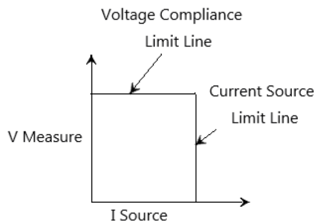
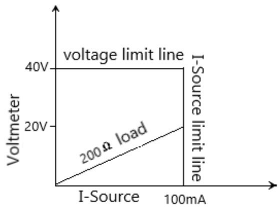
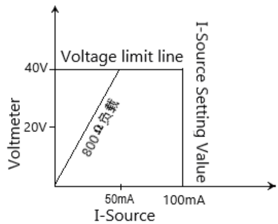


Figure 2

Figure 2 shows the limit line of I-Source, describe the maximum current limit value corresponding to the I_{src} range presently selected. For example, if it is on the 100mA current source range, the current source limit value is 105mA. The voltage compliance limit line represents the actual compliance value. The compliance value can be a real value or a range. These limit values represent the operating limits of the GSM in this quadrant. Restricted to any point in the area or on the restricted line. The limits of the four quadrants are similar.

Voltage compliance boundary of I-Source:
The operating points of the GSM within the boundaries depends on the load. The figures below shows the operating status when 200Ω and 800Ω resistive loads are connected respectively. Isrc is set to 100mA and Cmpl is set to 40V. When a 200Ω load is connected, the GSM provides 100mA current, and the measured voltage on the load is 20V. When the 800Ω load is connected, the output voltage is in compliance, the GSM cannot supply the setting current of 100mA, but can only output 50mA. When the value of the load resistor increases, the slope of the load line also increases. When the value increases to infinity (equivalent to an open circuit), the GSM output current is 0mA and the output voltage is 40V. On the contrary, when the value of the load resistor decreases, the slope of the load line also decreases. When the load resistor is 0 (short circuit), the GSM output current is 100mA, and the output voltage is 0V





V-Source operating boundaries: As shown in Figure 1 below, the boundaries of the four quadrants are similar.

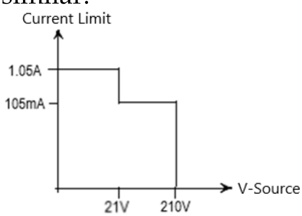


Figure 1

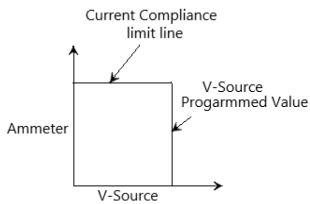
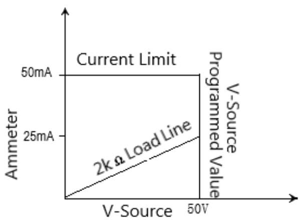


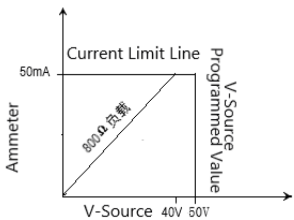
Figure 2

Figure 2 shows the limit boundaries of the V-Source, which characterizes the maximum source value of presently selected voltage source range. For example, for 20V source range, the limit line of the voltage source is 21V. The current compliance limit line represents the actual compliance value. The compliance value can be a real value or a range. These limit lines represent the operating bountaries of GSM in that quadrant. The GSM can operate within the limit lines or any point on the limit lines. The boundaries of the four quadrants are similar.

Current compliance limit of V-Source: The operating point depends on the load. The figures below show the operating mode when the GSM is connected to a 2kΩ and 800Ω resistive load respectively. The GSM is set to source 50V, and the current compliance value is set to 50mA.

When a 2kΩ load is connected, the GSM is sourcing 50V to the load, and the current is 25mA. For 800Ω load which is connected, the current is limited to 50mA by the compliance value, the GSM will not be able to source its programmed voltage. It will only output 40V.





When the load resistor increases, the slope of the load line decreases. When the resistor increases to infinity (open circuit), the actual output voltage of the GSM is 50V and the output current is 0mA. When the load resistance decreases, the slope of the load line increases. When the resistance decreases to 0 (short circuit), the actual output voltage of the GSM is 0V and the output current is 50mA.

When the GSM is set as I-Source, it can measure current at the same time, and when it is set as V-Source, it can measure voltage at the same time. Measurement range is the same as source range.

When in compliance, the measurement reading value is not the programmed source value, but the actual output source value. Press the Edit/Lock key to move the cursor to the parameter setting area, press 0 key to display power value, press 1 key to display resistance value, press 4 key to display current value, and press 7 key to display voltage value.

For example, connect 1kΩ resistor to GSM, as shown in the figure below, GSM is programmed to source 2.1V, the output current should be 2.1mA. Since the current compliance value is set to 105uA, the output current is limited to 105uA. The actual output voltage is 1.04971V.

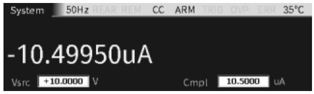
The measurement accuracy of the GSM is higher than the programming accuracy. Therefore, select the same programming and measurement functions and replace the programming accuracy with the measurement accuracy to obtain the best accuracy.

Sink Function

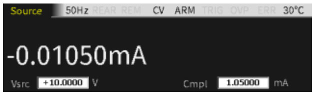
Description	When the GSM is used as a sink (V and I have opposite polarities), it consumes energy. Connecting GSM to an external power source (such

as a battery) or energy storage device (such as a capacitor) can make GSM operating as a sink (quadrant II or IV).

For example, connect the GSM to a 13V battery (Input/Output HI connects to the positive electrode of the battery), set the Vsrc of GSM to 10V, and set the value of Cmpl to make the GSM operate in CC mode. At this time, the GSM operates in quadrant II.

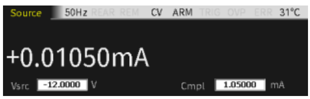


For example, connect the GSM to a 13V battery (Input/Output HI connects to the positive electrode of the battery), set the Vsrc of the GSM to 10V, and set the value of Cmpl to make the GSM operate in CV mode. At this time, the GSM operates in quadrant II.



For example, connect the GSM to a -14V power supply (Input/Output HI is connected to the positive electrode of the battery), set the Vsrc of the GSM to -12V, and set the value of Cmpl to make the GSM operate in CC mode. At this time, the GSM operates at IV Quadrant.

For example, connect the GSM to a -14V power supply (Input/Output HI is connected to the positive electrode of the battery), set the Vsrc of the GSM to -12V, and set the value of Cmpl to make the GSM operate in CV mode. At this time, the GSM operates at IV Quadrant.



⚠ **WARNING: When I-Source is used as a sink, the voltage compliance value Cmpl must be set higher than the external voltage, otherwise the excessive current will damage the GSM (it is necessary to limit the current of the external power supply to meet the maximum value of present range).**

Operation Precautions

Warm up	The GSM must be turned on and warmed up for at least 1 hour to achieve the rated accuracy.
OVP state	Use overvoltage protection to select the maximum voltage that GSM can output. These are absolute values, with a tolerance of 5%. The power-on default selection is "Disable". Even if the voltage protection limit is set to the lowest value, do not touch anything connected to the terminals when the output is turned on. When output is switched on, it is always assumed that there is a dangerous voltage (>30V rms). ⚠ **WARNING: To prevent damage to the DUT (device under test) or external circuits, do not program the voltage source to a level that exceeds the voltage protection limit. Be careful when the GSM floats >30V rms**
Source delay measure ment	The source delay option is used to set the stabilization time of the source. The source delay is the delay phase of the source delay measurement (SDM) cycle, which is conducive to measuring a stable and accurate value. Please refer to the related content of Auto delay on page 73.

Front Panel Programming Interface

Default power on interface

1. Source interface: the parameter setting consists of 3 areas, marked as ①②③ in the picture, press Edit/Lock key to toggle between ①②③.
2. When the cursor is moved to area ① or area ②, use the up and down direction keys to toggle the corresponding range, and enter the required value in the corresponding digit.
3. When the cursor is moved to the area ③, use the arrow keys to move the cursor to the corresponding option, press the Enter key to show up and down arrows (indicating that there are multiple options), select the corresponding option by the up and down keys, and press the Enter key to confirm parameter setting.

For numerical setting items, after selecting and Entering, if the pull-up and drop-down arrows appear, it means that there are multiple range options. Use the up and down keys to select the corresponding range, then enter the required value, and press Enter to confirm to complete the parameter setting. The value settings of other interfaces are similar to this.

NOTE: After moving the cursor to area ③, in the case of non-parameter setting, operating the number "7" and "4" keys can toggle the measurement reading between Voltmeter and Ammeter.

Description Under Source and Measurement mode, the GSM can toggle between V-source and I-source, and can also display the programming source value and measurement reading value. There are two ways of front and rear output (when the identifier REAR in the status bar is displayed, it means the output is from the rear panel, otherwise the output is from the front panel). The front and rear panels cannot output at the same time.

Parameter Description And Operation

V_{src}/I_{src} Set the power supply as V-Source or I-Source. When it is in the editing state (press Edit/Lock key to make the number digits turn into white characters on a black background), the range can be changed by the up and down keys.

NOTE: V_{src} and I_{src} can be toggled by Vsrc / Isrc key. The selected measurement range affects the accuracy of measurement and the maximum signal that can be measured. When the output is off, a dotted line (such as ---. ---- µA) will be displayed to indicate that the measurement is not performed.

Range setting

When in the editing state, operate the up and down direction keys to confirm the required range with the decimal point and unit. Vsrc has 4 ranges, and Isrc has 7 ranges.

200mV range: 200.0000mV

2V range: 2.000000V

20V range: 20.00000V

200V range: 200.0000V

1uA range: 1.000000uA

10uA range: 10.00000uA

100uA range: 100.0000uA

1mA range: 1.000000mA

10mA range: 10.00000mA

100mA range: 100.0000Ma

1A range: 1.000000A

Numerical input

① Number key input: Use the number keys 0~9 to input the required value in digits order, and press Enter key to confirm.

② Digit-by-digit input: After inputting the first digit or sign, it is in the digit editing (single digit background and white character), press the left and right direction keys to select the digit to be fine-tuned, and press the up and down direction keys to increase or decrease the value. After setting, press Enter to confirm.

⚠ **NOTE: The time limit for editing is about 6 seconds. If there is no operation, the system will automatically return to the non-editing state.**

Cmpl Set the compliance value of output voltage or current. When it is in the editing state (press Edit/Lock key to make the number digits turn into white characters on a black background), the range can be changed by the up and down keys.

⚠ **NOTE: When V_{src} is selected, compliance value of current required to be programmed. When I_{src} is selected, compliance value of voltage required to be programmed.**

Range setting

When in the editing state, operate the up and down direction keys to confirm the required range with the decimal point and unit. V-Cmpl has 4 ranges, and I-Cmpl has 7 ranges.

200mV range:	200.0000mV
2V range:	2.000000V
20V range:	20.00000V
200V range:	200.0000V
1uA range:	1.000000uA
10uA range:	10.00000uA
100uA range:	100.0000uA
1mA range:	1.000000mA
10mA range:	10.00000mA
100mA range:	100.0000mA
1A range:	1.000000A

Numerical input

1 Numerical key input: Use the Numerical keys 0~9 to input the required value in digits order,

and press Enter key to confirm.

2 Digit-by-digit input: After inputting the first digit or sign, it is in the digit editing (single digit background and white character), press the left and right direction keys to select the digit to be fine-tuned, and press the up and down direction keys to increase or decrease the value. After setting, press Enter to confirm.

⚠ **NOTE: The time limit for editing is about 6 seconds. If there is no operation, the system will automatically return to the non-editing state.**

Measure -range

This Measure-range refers to the range selection of V, I and Ω measurement reading.

Range limit: When using as V-Source, the voltage measurement range cannot be changed. When using as I-Source, the current measurement range cannot be changed. The measurement range is determined by the selected source range.

Measurement reading range: current has 8 options, Auto and seven ranges 1A, 100mA, 10mA, 1mA, 100uA, 10uA, 1uA; voltage has 5 options, Auto and four ranges 200V, 20V, 20V, 200mV.

Manual range: For Source V/Measure I, Source I/Measure V and Ohms measurement configurations, a fixed range can be selected. Please note that the highest available range depends on the corresponding compliance value.

If inputing power exceeds compliance range(include "real value" and "range"), or if the instrument displays "overflow" information on a specific range, select a higher range until the reading is displayed.

Use the lowest possible range without causing overflow to ensure the best accuracy.

Auto range: For Source V/Measure I, Source I/Measure V and Ohms measurement configurations, set Measure curr-range or Measure volt-range to Auto to enable auto range. After selecting the auto range, the instrument automatically selects the best range for measurement. Please note that the highest available range depends on the corresponding compliance setting.

If Measure curr-range or Measure vol-range option selects Auto, the SDM cycle will repeatedly read the measured value in the new range. Each SDM cycle includes source delay time. For example, if source delay time is programmed to 1s, in the case of needing to change the range, the instrument needs at least 2s to complete a measurement reading.

Auto range algorithm: If a reading reaches 105% of the current range, the instrument will increase 3 ranges, if it cannot increase 3 ranges, it will increase to the highest range. After adjusting the range, take a reading once again to decide whether to continue to increase the range or determine the appropriate range based on the current reading. If the reading is 10% of the current range, the instrument will drop one range; if the reading is 1% of the current range, the instrument will drop two ranges; if the reading is 0.1% of the current range, the instrument will drop three ranges.

Maximum reading: The full-scale input of the voltage, current, and auto ohms measurement range is defined by the selected range. For example, ±2.11V is the full scale reading for the 2V range, ±105.5mA is the full scale reading for the 100mA range, and

±2.11KΩ is the full scale reading for the 2KΩ range. Please refer to page 43.

For manual ohms measurement, the display reading is the result of the V/I calculation. In fact, there are no ohms ranges. Therefore, zero padding is not required for the measurement reading. For example, a resistor measuring 936.236KΩ will be displayed as 936.236KΩ ($5^{1/2}$ digital resolution). When Ohms source selects Manual, use Measure curr-range to select current measurement range or use Measure volt-range to select voltage measurement range.

Input levels exceeding the maximum levels will cause the "overflow" message to be displayed, and 9.91E+37 will return via remote.

NOTE: When V_{src} is selected, the measurement reading range of current can be set, and the measurement reading range of voltage should be set for I_{src}. The measurement reading range is limited by the C_{mpl} range and cannot be higher than the C_{mpl} range.

Range setting: Press the Edit/Lock key to select the Measure volt-range or Measure curr-range option, press the Enter key to make it in the editing state, use the up and down keys to select the required range, press Enter to confirm and exit the editing state.

Sync cmpl range	Setting measurement reading range to synchronize with compliance range, the default setting is Disable when power-on. To enable Sync cmpl range, Auto for Measure volt-range or Measure curr-range should be deselected, that is, turn off the Auto range function. When Sync cmpl range is selected as Enable, the measurement reading range can be automatically synchronized with the Cmpl range.

Sense mode

The basic source-measure operations of GSM performed using 2-wire local sense connections or 4-wire remote sense connections.

2-wire sense connection: Bench and GPIB power on default using 2-wire sense connection. 2-wire sense connection can only be used when the voltage drop generated by the test lead resistance can be accepted. When the loop current is lower than 100mA, the error caused by the test lead resistance can be ignored (assuming that the test lead resistance is less than 1Ω). 2-wire sense connection is used for voltage and current measurement.

4-wire sense connection: reduce the error caused by the test lead resistance, and optimize the output voltage accuracy and measurement accuracy. When used as a V-Source, load the programmed voltage to the load without loss. When used as a voltmeter, the measurement reading is the voltage drop on the load. The following two situations should choose 4-wire sense connection:

a Resistance of DUT is less than 1kΩ.

b The best accuracy of resistance, output voltage or voltage measurement reading is required.

WARNING: When the V-Source is programmed to 4-wire sense mode, you must ensure that Sense HI and Sense LO terminals are connected to both ends of the DUT respectively. If one terminal is not connected, the voltage detected on Sense port is 0V, and the GSM will compensate by increasing the output voltage. It may cause danger to person or cause damage to the DUT, and the OVP function can be set Enable to provide protection.

Guard

There are two protection methods of Ohms and Cable. The default Guard option is Cable Guard.

The purpose of Guard is to eliminate the influence of leakage current and parasitic capacitance that can exist between Input/Output HI and LO. If the Guard terminal is not connected, the leakage current of the external test circuit will affect the measurement accuracy of the GSM. Leakage current may occur through parasitic or non-parasitic leakage paths. For example, the insulating material on a coaxial or triax cable can act as parasitic resistance and become a leakage path. The non-parasitic resistance in parallel with the DUT can be the leakage path.

There are two programmable output impedance levels for the guard output. The high-impedance (~10kΩ) CABLE guard is used to reduce the effects of capacitance and leakage currentpaths in the test circuit. The low-impedance (<1Ω) OHMS guard is used to cancel the effects of parallel resistance when measuring a resistor element of a resistor network.

⚠ **WARNING: GUARD terminal level is the same as Output HI terminal level. If Output HI terminal is high level, GUARD terminal is also high level.**

Cable Guard: Used in the case where the impedance of the circuit under test is greater than 1GΩ, using the high-impedance guard connection. It is usually necessary to use shielded wires and test fixtures to test high-impedance equipment, which can reduce interference and protect the users from being injured by hazardous voltage on the guard shield (or plate). The CABLE guard selection provides a high-impedance (~10kΩ) driven guard to prevent positive feedback, which could cause oscillations when using shielded cables. Cable guard is used to drive the shields of cables and test fixtures. Inside the test fixture, the guard can be connected to a guard plate or shield that surrounds the DUT.

⚠**WARNING: To prevent electric shock injury, a safety shield must be used to prevent physical contact with a guard plate or guard shield that is at a hazardous potential (above 30Vrms or higher than 42.4Vpeak). The guard plate or guard shield must completely be enclosed by the safety shield device which must be connected to the earth ground.**

In the fixed device, a triaxial cable can be used to connect the GSM and the device under test. The wire in the center is connected to the Input/Output HI terminal, the metal plate is connected to the V.Ω GUARD terminal, and the safety shield is connected to the Input/Output LO (connected to the earth ground).

Coaxial cables can be used when the potential of the V.Ω GUARD terminal is not higher than 30Vrms (42.4V peak), the center wire is connected to the InputT/Output HI terminal of the GSM, and the metal plate is connected to the V.Ω GUARD terminal.

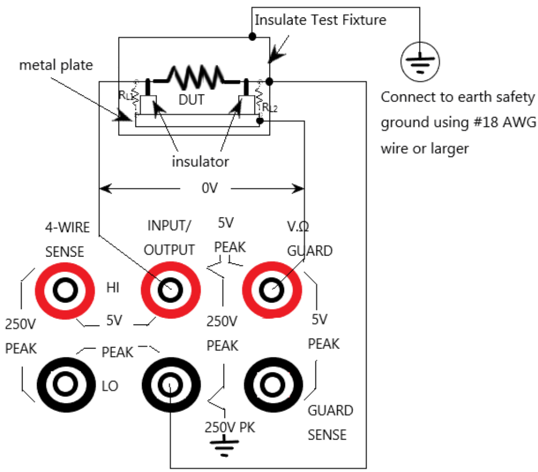
Figure below shows the cable guard connection mode. The V.Ω GUARD is connected to the metal plate equipped with insulated measuring column through test lead. Since the voltage at both ends of the insulation measuring column equal, the voltage drop on its parasitic resistor (RL1 and RL2) is 0, and no leakage current passes. Therefore, the current measured by the GSM is the current flowing through the DUT.

NOTE

a **Cable Guard must choose the connection shown in Figure below.**

b **The insulate test fixture should be connected to the Input/Output LO terminal to reduce noise.**

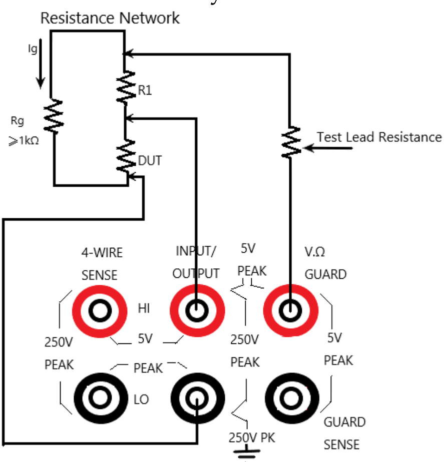
c **Cable Guard should be used when the GSM sourcing or measuring low current (<1uA)**



Ohms Guard: Provide low internal resistance (<1Ω), high output current (up to 50mA) drive protection, allowing resistance measurement in the circuit. When measuring the resistive component in the resistor network, eliminate the influence of the resistor in parallel with it.

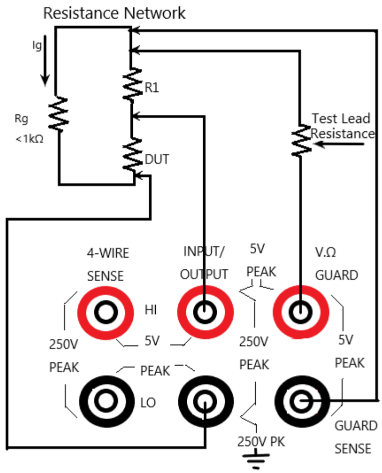
Ohms Guard measurement mode is divided into three connection methods according to the impedance of the DUT:

1. Rg≥1kΩ
   When the impedance Rg from the V.Ω GUARD terminal to the Input/ Output LO terminal is more than 1kΩ, the voltage drop of the lead impedance (about 1Ω) of the V.Ω GUARD terminal is very small relative to Rg, and the voltage drop of R1 is approximately zero, and no leakage current flows through R1. The voltage on the DUT is the Input/Output HI terminal voltage, then the current value flowing through the DUT is measured, and the resistance of the DUT can be calculated by the formula.



2. Rg<1 kΩ

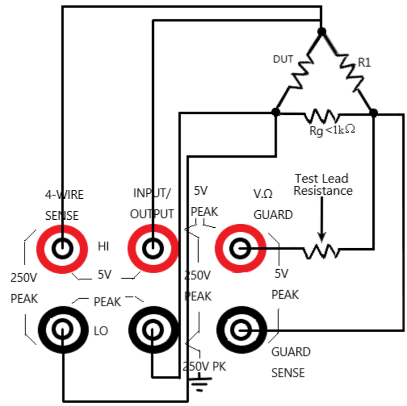
The voltage drop on the test lead (about 1Ω) of the V.Ω GUARD terminal is significant respectively to the voltage drop on the Rg, causing the potential at the connection between R1 and the V.Ω GUARD terminal to be lower than the potential at the connection between R1 and the Input/Output HI terminal. Furthermore, there is leakage current flowing through R1 which will affects the measurement accuracy. In order to eliminate the influence of the voltage drop of the test leads on the V.Ω Guard terminal, use the connection method shown in the figure below to connect the GUARD SENSE port to the resistor network. The GUARD SENSE port senses the terminal voltage of the V.Ω GUARD terminal in the resistor network. When the voltage is lower than the input/output HI terminal voltage, the V.Ω GUARD terminal voltage will increase until the voltage sensed by the GUARD SENSE terminal is equal to the input/output terminal voltage.



3. R_{DUT}<1kΩ

In this situation, 4-Wire sense mode should be used. When Rg<1kΩ, this connection method is 6-

Wire ohms guard measurement. When using this measurement method, select GUARD output-off states for Off state option.



NOTE:

a **Ohms Guard cannot be selected in 1A range (as source or meter). If you have selected Ohms Guard, you cannot select 1A range.**

b **The Guard terminal current cannot exceed 50mA, otherwise the Guard terminal voltage will be less than the Input/Output terminal voltage and affect the measurement data.**

c **Guard sense operation is automatic, and it can be used directly after connecting the test leads without setting.**

Speed Set the data sampling speed, that is, the calculation processing time of A/D conversion, which is determined by the number of power cycles. For example, for 50Hz AC voltage, 1PLC equals to 20ms (1/50). There are five options for data sampling speed: Fast, Medium, Normal, High, and Other. Fast corresponds to the shortest sampling period of 0.01PLC, the accuracy is the lowest, and the display Digits becomes 3.5 bits accordingly. High option corresponds to the longest sampling period of 10PLC, the measurement reading has the highest accuracy, and the display Digits becomes 6.5 bits accordingly. Generally speaking, the fastest sampling speed (Fast: 0.01PLC) will result in an increase in reading noise and a decrease in the number of available digits. The slowest sampling speed (High: 10PLC) provides the best accuracy and noise suppression. The middle settings are compromise between speed and noise. The default power on speed is Normal (1PLC). Other is a custom option.

The method of setting the sampling speed: press the arrow keys to move the cursor to the Speed setting box.

- Fast- Setting the sampling speed to 0.01 PLC, and the Digits option is automatically set to $3^{1/2}$ digits.
- Medium-Setting the measurement speed to 0.10 PLC, and the Digits option is automatically set to $4^{1/2}$ digits.
- Normal-Setting the measurement speed to 1.00 PLC, and the Digits option is automatically set to $5^{1/2}$ digits.
- High-Setting the measurement speed to 10.00PLC, and the Digits option is automatically set to $6^{1/2}$ digits.
- Other-Used to set the measurement speed to any PLC between 0.01 PLC and 10 PLC. When Other is selected, the cursor automatically jumps to the PLC quantity window, press Enter to write the customized value, and then Enter to confirm. When using this option to set the speed, the Digits option will not be changed.

NOTE: After setting the measurement speed, you can use the Digits option to change the number of displayed digits.

*PLC stands for Power Line Cycle.

⚠ **NOTE: Changing the Speed will modify the Digits synchronously, but changing the Digits does not affect the Speed setting.**

Digits

The display digits of the measurement reading. There is four options of 3.5, 4.5, 5.5, and 6.5. This setting is global. After setting the display digits, it is valid for the display reading of all measurement functions (voltage, current, resistance).

There are two ways to set the display resolution:

- Digits-Place the cursor on the required digits option (3.5, 4.5, 5.5 or 6.5) and press ENTER.
- Speed-Place the cursor on the Speed (Fast, Medium, Normal and High) option box, and then press ENTER. Select a different measurement speed, the GSM will automatically change to the corresponding display digits.

⚠ **NOTE: The Digits option is invalid in the remote state, and is irrelevant with accuracy and reading speed. The accuracy and reading speed are only related to the data sampling speed.**

Relative

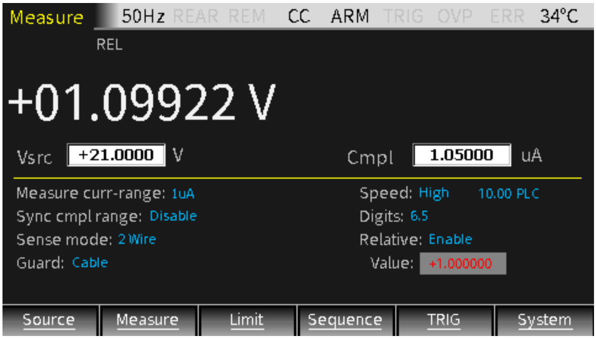
It is used to zero offset or subtract the reference value from the reading (it can be voltage, current or resistance). When Relative is programmed to Enable, the displayed measurement reading is obtained by the following formula:

Displayed Reading=Actual Input-Rel Value

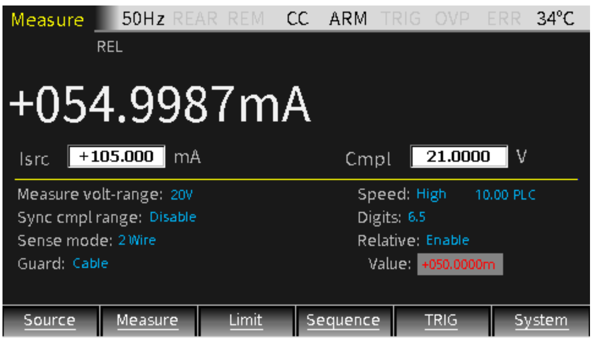
In the above formula, Displayed Reading is the displayed voltage/current value, Actual Input is the actual output voltage/current value of the output terminal, and Rel Value is the programmed baseline value, which is set in the Value option box in the figure below.

For example, if a 2MΩ load is connected, Vsrc is programmed to 21V, and the output current should be

10.5uA. Since Cmpl is set to 1.05uA, the output current is limited to the compliance value. At this time, it is CC mode, Relative option selects Enable, and Value is set to 1V, press the Output key, at this time, the displayed value is the difference between the output voltage value loaded on the load and the Relative Value.



As shown in the figure below, connect a 20Ω resistor. When Isrc is set to 105mA, the output voltage should be 2.1V, Cmpl is set to 21V, and the output voltage is within the compliance value range. At this time, it is in CC mode. Relative option selects Enable, Value is set to 50mA, press the Output key. The displayed value is the difference between the output current value flowing through the load and the Relative Value.



⚠ NOTE:

a Relative Value is valid to all the ranges. For example, if the Relative Value is set to 5V in the 20V range, when the range is changed to 2V or 200V, the Relative Value is still 5V.

b When the programmed Relative Value exceeds the slected range, it will not cause overflow and will not increase the maximum allowable input for the range. On the 20V range, for >21.1V input, the GSM will still overflow.

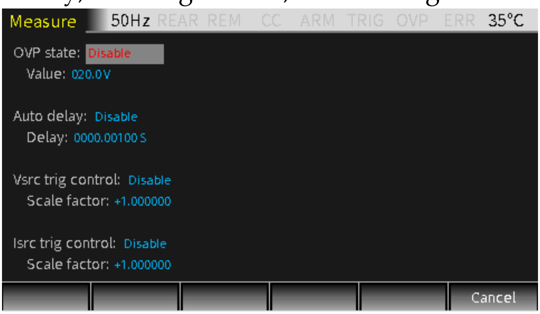
c When Relative is set as Enable, the display area will display REL. If toggling the V/I measurement, Relative option will automatically change to Disable.

Enter a Relative Value manual:

1) Press the arrow keys to move the cursor to the Relative setting box, select Enable, and then press Enter.
2) Press the arrow keys to move the cursor to the Value setting box, set the required value, and then press Enter.

Other Settings

Long press the Source key to open the following interface which are used to set the parameters of OVP, Auto delay, Vsrc trig control, and Isrc trig control.

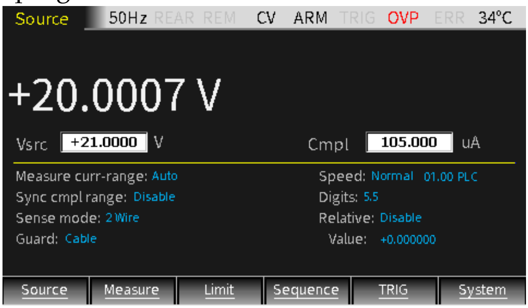


OVP

Press the up and down arrow keys to move the cursor to the OVP state option box and press the Enter key to select Enable or Disable.

When you select Enable, the OVP function is enabled, and the OVP symbol OVP is displayed in the status bar.

When the output exceeds the OVP Value, the OVP status indicator is lit in red OVP, indicating that the OVP status is entered, and the actual output is limited to the programmed OVP Value.

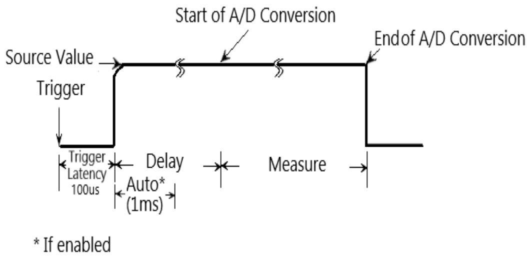


Auto delay

It is used to set the automatic delay time. The delay time refers to the delay phase in the Source-Delay-Measurement (SDM) cycle, which depends on the selected Source range.

In addition to static source and/or measurement operations, GSM operations may include a series of Source-Delay-Measurement (SDM) cycles. During each SDM cycle, the following will happen:

1. Set the source value
2. Wait for the source delay
3. Take measurement reading



The delay of the SDM cycle can make the source stabilize before the measurement. The source delay can be manually set from 0000.00000 seconds to 9999.99900 seconds using Delay setting box; if the Auto delay is Enabled, the delay time depends on the presently selected source range.

The manually set delay (up to 9999.99900 seconds) can be used to compensate for the longer setting time required by the external circuit. The more capacitance at the output, the longer stabilization time the source will require. The actual delay time required can be calculated or determined by trial and error. For purely resistive loads or at higher current, the delay time can be programmed to 0ms.

The measurement time depends on the selected Speed. For example, if the Speed is programmed to 0.01 PLC (power line cycle), the measurement time for 60Hz operation (0.01/60) is 167µs.

The Delay option is used to manually set the delay from 0000.00000 seconds to 9999.99900 seconds. Manually setting the delay time need to program the Auto delay option to Disable. The default Auto delay option is Disable, and the Delay time depends on the selected range.

Move the cursor to the Auto delay option box. When Enable is selected, the delay time is automatically determined by the selected measurement range. When Disable is selected, enter a custom time in the Delay box.

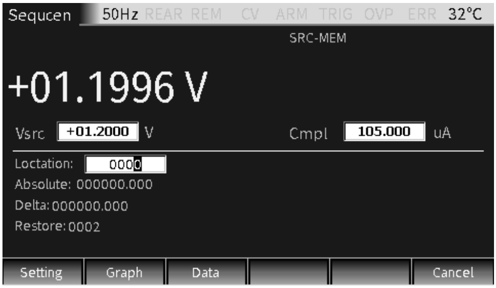
Current Range	1uA	10uA	100uA	1mA	10mA	100mA	1A
Auto dalay (V_{src})	3ms	2ms	1ms	1ms	1ms	1ms	1ms
Auto dalay (I_{src})	3ms	1ms	1ms	1ms	1ms	1ms	2ms

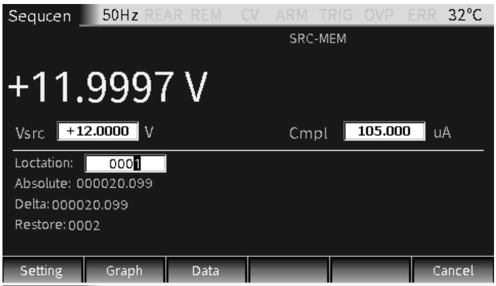
Vsrc trig control

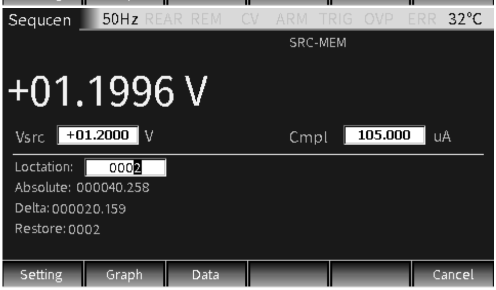
Used to control the V-Source trigger, move the cursor to the V_{src} trig control box, press Enter and the up and down keys to select Enable or Disable, and when Enter is selected, input the value in the Scale factor box.

This function is used for SRC-MEM sequence, for example, set a sequence of 3 measurement points, the V_{src} of first point is set to 12V, and the Scale factor is set to 0.1. After the setting is completed, return to Source interface and long press F6 key (System) to enter System setting interface, then press F2 key (Control) and use derection key to move the cursor to the Memory save box, press Enter key to input 001 in the box, finally press Enter key and there will pop up a inquiry window, press Enter then the settings of the first point saved to the first location of Memory. Set the Scale factor of the second point and the third point to 10 and 0.1 respectively, and save the settings of the two points in the second and third location of Memory correspondingly. Set the Start location of SRC-MEM to 1, and set the number of Sequence points to 3. After the sequence is completed, the data processed by the trigger control is stored in the data buffer area. Turn off the Output key and press F4 (Sequence) upon the main interface to view the information of the 3 points after the trigger control processing.

After sweeping the first sequence point, V_{src} becomes 1.2V by the initially programmed voltage value of 12V multiplying the Scale factor (0.1). After sweeping the second sequence point, Vsrc becomes 12V by the first sweeping point V_{src} value 1.2V multiplying the Scale factor (10). After sweeping the third sequence point, Vsrc becomes 1.2V by the second sweeping point V_{src} value 12Vmultiplying the Scale factor (0.1). The output voltage after trig control are shown in the figures below:



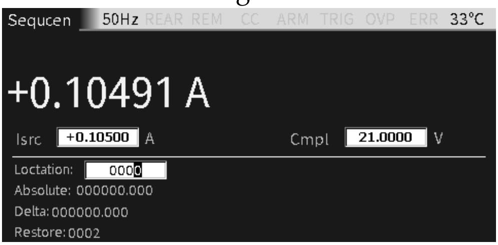




Isrc trig control	Used to control the current source trigger, move the cursor to the Isrc trig control box, press Enter and the Arrow keys to select Enable or Disable, when selecting Enter, input the value in the Scale factor box.

This function is used for SRC-MEM sequence, for example, set a sequence of 3 measurement points, the I_{src} of first point is set to 1.05A, and the Scale factor is set to 0.1. Save the settings of the first point to the first location of Memory. Set the Scale factor of the second point and the third point to 10 and 0.1 respectively, and save the settings of the two points in the second and third location of Memory correspondingly. Set the Start location of SRC-MEM to 1, and set the number of Sequence points to 3. After the sequence is completed, the data processed by the trigger control is stored in the data buffer area. Turn off the Output key and press F4 (Sequence) upon the main interface to view the information of the 3 points after the trigger control processing.

After sweeping the first sequence point, I_{src} becomes 0.105A by the initially programmed current value of 1.05A multiplying the Scale factor (0.1). After sweeping the second sequence point, Isrc becomes 1.05A by the first sweeping point I_{src} value 0.105A multiplying the Scale factor (10). After sweeping the third sequence point, Isrc becomes 0.105A by the second sweeping point I_{src} value 1.05A multiplying the Scale factor (0.1). The output current after trig control are shown in the figures below:



Output Operation

Step	Generally have the following:
	a Connect the external connection (front-panel or rear-panel) according to the requires of the test.
	b For rear-panel output, enter System->Control->Rear in turn.
	c Set Vsrc or Isrc and Cmpl on the front panel.
	d Set other parameters in the parameter area (Measure interface).
	e Select the required measurement reading V/I (corresponding to 7/V, 4/I keys).
	f Press the Output key to start the measurement.

State Description

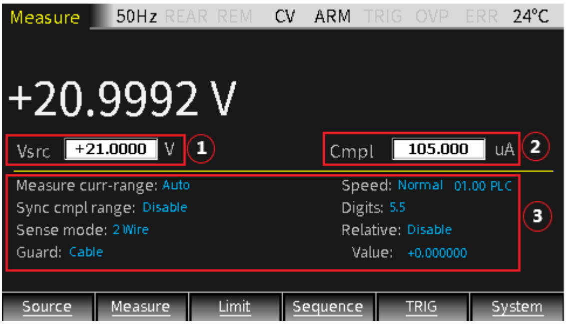
REAR	Display when setting as rear-panel output. Otherwise, it is the front-panel output
REM	Remote control
CV	When the GSM is set as I-Source, in case that the terminal output voltage is restricted by Cmpl or Measure vol-range, the GSM operates in CV (constant voltage) mode When the GSM is set as V-Source, in case that the terminal output current is not restricted by Cmpl or Measure cur-range, the GSM operates in CV (constant voltage) mode
CC	When the GSM is set as V-Source, in case that the terminal output current is restricted by Cmpl or Measure curr-range, the GSM operates in CC (constant current) mode When the GSM is set as I-Source, in case that the terminal output voltage is not restricted by Cmpl or Measure vol-range, the GSM operates in CC (constant current) mode
ARM	Source-measure operation is in progress
TRIG	Select external trigger source (Tlink, Rising Edge, Falling Edge, Edge)
OVP	When the OVP function is enable, the OVP mark is black, and the mark is red when the OVP function is triggered.
ERR	When reading failure or invalid calibration steps occur, ERR mark will display in status bar. For detailed error codes, see page 360.

Measure Function

In addition to being used as a source, the GSM can also be used as meter with the Measurement function, which can directly measure voltage, current, and resistance, and can also do some calculation measurements.

Measurement Interface

Display



1. The Measure interface is basically the same as the Source (only increase setting items for resistance measurement). The parameter setting area is composed of 3 areas shown as①②③ in Figure above. Press the Edit/Lock key to switch between ①②③.
2. For the programming of the three areas, please refer to the Source section, see page 56.

⚠ **NOTE: In the case of non-numerical input, operating the number key "7", "4", "1", and "0" keys can correspondingly switch the measurement reading to V-Meter for voltage measurement, I-Meter for current measurement, and resistance measurement Ω-Meter or calculation function (Power, CompOhms,** Vcoeff, **VarAlpha, DEV).**

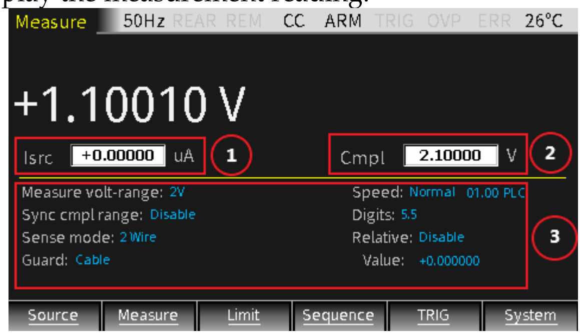
Decription The GSM can also be set to V-source or I-source under

Measure. There are two ways of front and rear output (when REAR displayed in the status bar, it means the output is from the rear panel, otherwise the output is from the front panel). The front and rear panels cannot output at the same time.

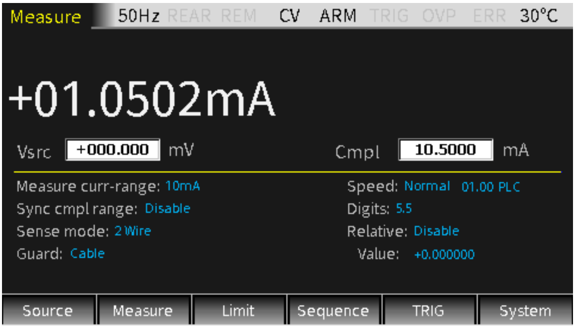
V/I Meter

Set operation	Press the F2 (Measure) key to display the measurement interface. Under non-numerical programming, press the 7/V key to set as the voltmeter (Source must be Isrc), or press the 4/I key to select as the current meter (Source must be Vsrc).
Set source and compliance value	a Set Isrc (Voltmeter) or Vsrc (Current Meter) to the lowest range, and then set the value of Isrc or Vsrc to 0 (0.00000uA or 000.000mV). b Set Cmpl to a level higher than measurement required to test c Press the output key to start the measurement

For example, to measure 1.1V voltage, set the GSM as I-Source, I_{src} set to 0.00000uA, Cmpl set to 2.1V, and set Measure volt-range set to 2V. Press the output key to display the measurement reading.



For example, to measure 1.05mA current, set the power supply as V-Source, set V_{src} to 000.000mV, Cmpl to 10.5mA, and set Measure curr-range to 10mA. Press the output key to display the measurement reading.



WARNING: When the GSM is used as a voltmeter, Cmpl must be set to be higher than the voltage that is to be measured. If this setting is not done, excessive current will flow into the GSM and cause damage.

Set range

When setting Measure volt-range or Measure curr-range, select a range suitable for the voltage or current to be measured. Usually, the lowest possible range should be selected for the best accuracy.
When measuring current, select AUTO range, the GSM will automatically go to the most sensitive range.
When measuring voltage, do not select AUTO range.

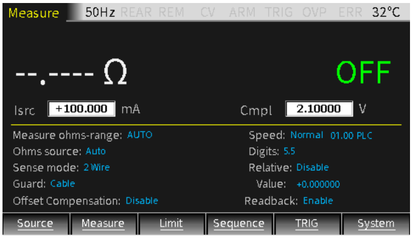
WARNING: When the GSM is only used as a voltmeter, do not select AUTO range for measurement, and also do not select a measurement range lower than the voltage to be measured. Because in these two cases, a high current will flow into the GSM from the external source, which may damage the external source or test circuit.

NOTE: When only measuring voltage or current, connect the DUT and the GSM with 2-wire mode.

Ohms Meter

Measurement interface

Press the F2 (Measure) key, and then press the "1/Ω" key to enter the resistance measurement interface.



Description

Use I_{src}/V_{src} to set the source value when measuring resistance.

When the Ohms source is selected to Auto, the GSM is defaulted as I-Source and operates as a traditional I-Source ohmmeter. When using Auto Ohms source, select a Measure ohms-range or select the AUTO option, and press the Output key to measure the resistance. When Auto Ohms source is selected, the default output current depends on the selected Measure ohms-range.

When the resistance to be measured is less than or equal to 2Ω or more than 200MΩ, selecting Manual as the Ohms source. The corresponding uncertainty of Ohms measurement refer to the following chapter “Ohm accuracy calculation“.

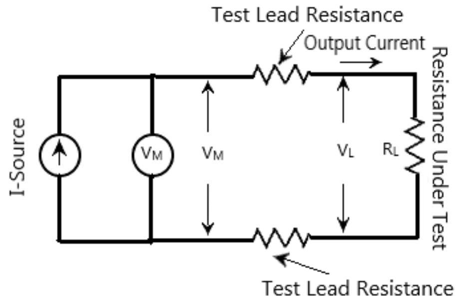
When selecting Ohms source as Manual, you can select GSM as V-Source or I-Source, set the required source value, and select a voltage or current measuring range that is most suitable for the resistance to be measured to obtain the highest measurement accuracy. Generally, the current range corresponding to the resistance range is as follows:

Range(Ω)	2	20	200	2k	20k	200k	2M	20M	200M
Current range	-	100mA	10mA	1mA	100uA	10uA	1uA	1uA	100nA

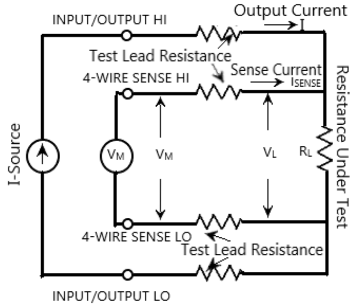
Cmpl is used to set the compliance value, and the lowest allowable compliance value depends on the load and the source value. For example, if sourcing 2V to a 2kΩ resistor, the lowest allowable current compliance is 1mA (2V/2kΩ = 1mA). Setting a Cmpl value lower than 1mA will place the source in compliance.

Using 4-wire sense mode to measure resistance can obtain higher measurement accuracy than 2-wire sense mode.

The figure below shows the 2-wire sense mode. You only need to use two test leads to connect the DUT to the Input/Output HI and LO terminals. The test leads resistance will affect the resistance measurement accuracy, especially low-resistance measurement.



The figure below shows the 4-wire sense mode which add another set of test leads to connect the SENSE HI and LO terminals to the DUT on the basis of the 2-wire connection to minimize the effects of lead. Because of the high input impedance of the V_M (voltmeter), the current of the sense leads connected to both ends of DUT can be ignored, and the voltage measured by the voltmeter is the voltage at both ends of the DUT.



Ohm accuracy calculation:

The following is an example of measuring resistance value of 200mΩ when the current source is set to 10mA to calculate the resistance measurement accuracy when the combination of Readback and OffsetCompensation is selected as the following table:

Normal mode (OffsetCompensation setting Disable)	
Readback setting Disable	Ohms accuracy=Isource accuracy+Vmeas accuracy Isource accuracy=(10mA)(0.045%)+2uA=6.5uA ➔ 6.5uA/10mA=0.065% Vmeas accuracy=(10mA)(200mΩ)(0.012%)+300uV =300.24uV ➔ 300.24uV /2000uV=15.012% Total uncertainty of Ohms measurement: 200mΩ±(0.065%+15.012%)=200mΩ±30.154mΩ
Readback setting Enable	Ohms accuracy=Imeas accuracy+Vmeas accuracy Imeas accuracy=(10mA)(0.035%)+600nA=4.1uA ➔ 4.1uA/10mA=0.041% Vmeas accuracy=(10mA)(200mΩ)(0.012%)+300uV =300.24uV ➔ 300.24uV /2000uV=15.012% Total uncertainty of Ohms measurement: 200mΩ±(0.041%+15.012%)=200mΩ±30.106mΩ

Enhanced mode (OffsetCompensation setting Enable)	
Readback setting Enable	Ohms accuracy=[Imeas % Rdg accuracy+Vmeas % Rdg accuracy]+System noise Imeas accuracy=(10mA)(0.035%)=3.5uA Measured system noise: 00.0000mA 3.5 uA +00.0000mA=3.5uA ➔ 3.5uA/10mA=0.035% Vmeas gain accuracy for (200mΩ)(10mA)=2000uV (2000uV)(0.012%)=240nV Measured system noise: 000.002mV 240nV+2uV=2.24uV ➔ 2.24uV/2000uV=0.112% 0.035%+0.112%=0.147% Total uncertainty of Ohms measurement: 200mΩ±0.147%=200 mΩ±0.294 mΩ System noise includes external connections to the DUT. To determine system noise, voltage and current noise are measured with test leads connected to the DUT. For example, connect the 200mΩ resistor, pressing voltage measurement function, selecting the 200mV range, setting the Relative option to Enable, and record the noise of the system as the noise voltage. In this case, the measured value is 000.002mV. To measure current source noise, pressing current measurement function, selecting the appropriate current range (10mA in this case), setting the Relative option to Enable and record the system noise value. In this example, the system noise current is 00.0000mA.

Calculation

Description

Long press the F2 (Measure) key, enter the interface for calculation operation, including five function menus: Power, CompOhms, Vcoeff, VarAlpha, and DEV.
The Power and DEV functions perform single-point measurements to obtain results.
CompOhms, Vcoeff and VarAlpha functions require two-point measurement which require to set two

source values, and then the corresponding measurement readings are used to perform calculations.

Power:

This calculation function calculates power using the measurement voltage reading V and the measurement current reading I, and the unit of the displayed reading is watts.

Power=V*I

CompOhms:

Ohm compensation function. The existence of thermoelectric potential affects the low-resistance measurement accuracy, CompOhms function can be used to reduce the influence of offset voltage.

Calculated as follows:

CompOhms Ω=(V2-V1)/(I2-I1)

V1 represents the voltage measurement reading measured by the first programmed Source value, V2 represents the voltage measurement reading measured by the second programmed Source value, I1 represents the current measurement reading measured by the first programmed Source value, I2 represents the current measurement reading measured by the second programmed Source value.

NOTE:

1. **The two programmed sources can be set as V-Source or I-Source.**
2. **When pressing the "1" key upon the Measure interface to toggle to the ohms measurement**

interface, the Offset Compensation option can also set the CompOhms function. When Enable is selected, the ohms compensation function is turned on, and the GSM automatically selects 0 as the second source.

Vcoeff:

The high value or megohm-level resistors will occur resistance change as the applied voltage changes. This effect produces a voltage coefficient, which can be expressed by the following formula:
Coefficient%=[△R/(R2*△V)]*100%

in the formula: △R=R2-R1
△V=V2-V1

R1 represents the resistance measured by the first programmed source value, R2 represents the resistance measured by the second programmed source value, V1 represents the voltage measurement reading measured by the first programmed source value, and V2 represents the voltage measurement reading measured by the second programmed source value. When calculating the Vcoeff value, two voltage source values need to be set.

VarAlpha:

The alpha (α) value defines the characteristics of the varistor. The definition of α value is expressed by the following formula:
α=log(I2/I1)/log(V2/V1)
V1 represents the voltage measurement reading measured by the first programmed I-Source value, V2 represents the voltage measurement reading measured by the second programmed I-Source value, (I2/I1) and (V2/V1) take the absolute value for calculation. When performing VarAlpha calculation, two I-Source values need to be set.

Dev:

Provides the percent deviation between the

measurement reading and the reference value set by the user, as expressed by the following formula:
Dev=[(X-Y)/Y]*100%
X represents the displayed measurement reading (voltage, current or resistance), and Y represents the reference value. Y can be manually set by entering a value in the Ref value box. The unit of Y (A, V or Ω) is determined by X.

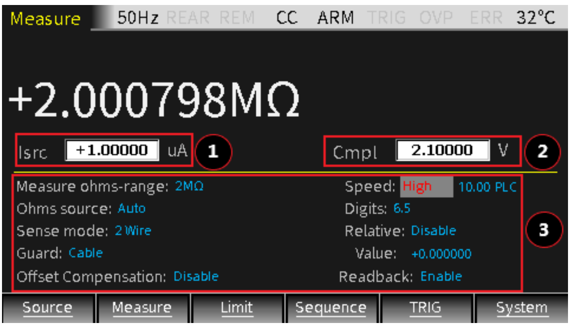
Parameter Description And Operation

Vsrc/Isrc/Cmpl * The detailed setting operations are the same as the Source chapter decription, please refer to page 56.

Measure – range/ Sync cmpl range/ Sense mode *The detailed setting operations are the same as the Source chapter decription, please refer to page 56.

Speed/Digits/ Relative *Press “9/S”, “6/D” and “3/R” to quickly operate to set Speed/ Digits/ Relative option

When it comes to resistance measurement, the following parameters require to be programmed as:



Measure ohms-range It is used to set a sensitive range for the resistance measurement to obtain the best measurement accuracy, or select AUTO that the GSM will automatically go to the most suitable range. There are 9 options for resistance measurement: including 8 ranges 20Ω, 200Ω, 2kΩ, 20kΩ, 200kΩ, 2MΩ, 20MΩ, 200MΩ and Auto.

Setting: Move the cursor to the setting item (it turns into a red letter with a gray background), and press Enter. After the up and down arrow signs appear, operate the up and down direction keys to select the appropriate range, and then press Enter to confirm.

Ohms source This option is used to select manual or auto measurement mode when measuring resistance. When selecting Auto, the GSM operates as a traditional I-Source ohmmeter. When the manual mode is selected, the GSM can be switched to V-Source or I-Source. When switching to V-Source, you need to set the values of Vsrc and Cmpl. Please refer to the following comparison table to set the Cmpl value:

Range(Ω)	2	20	200	2k	20k	200k	2M	20M	200M
Current range	-	100mA	10mA	1mA	100uA	10uA	1uA	1uA	100nA

Setting: Move the cursor to the setting item (it turns into a red letter with a gray background), and press Enter. After the up and down arrow signs appear, operate the up and down direction keys to select the appropriate method (Manual or Auto), and then press Enter to confirm.

NOTE: If slecting Auto, you cannot switch ource between Vsrc and Isrc.

Offset Compensation This measurement method is used to minimize the influence of thermoelectric potential when making low-resistance measurement. The method is to first measure the voltage (V1) and the current (I1) across the resistor using a programed source value(V-Source or I-Source), and then measure the voltage (V2) and the current (I2) when the source is set to zero. When the source is set to zero automatically,

the voltage measured across the resistor is the thermoelectric potential. When Offset Compensation is set to Enable, the resistance can be caculated by the following formula:
R=(V1-V2)/(I1-I2).

⚠ **NOTE: The Offset Compensation option is Disable by default.**

Setting: Move the cursor to the setting item (it turns into a red letter with a gray background), and press Enter. When the up and down arrow signs appear, operate the up and down direction keys to select the required option (Enable or Disable), and then press Enter to confirm.

Readback

When Readback option selects Enable, the measurement reading are the actual output voltage and current which will be used for resistance calculation. When Readback option selects Disable, the GSM uses the programmed value for resistance calculation, which may produce incorrect measurement values. Only when the recommended current test range is selected according to the resistance value to be measured and the reading value is less than the compliance value, selecting Readback option as Disable can make ohms measurements correct.

⚠ **NOTE: The Readback option is Enable by default to achieve optimal accuracy.**

Setting: Move the cursor to the setting item (it turns into a red letter with a gray background), and press Enter. When the up and down arrow signs appear, operate the up and down direction keys to select the required option (Enable or Disable), and then press Enter to confirm.

Parameter Settings of Calculation Function

Power

This calculation function uses the measurement voltage value multiplying the measurement current value to obtain the Power measurement reading, and the unit of the displayed value is watts.

Operation steps:

a Press the F2 (Measure) key to enter the Measure interface, select the required source value(V-Source or I-Source), and then long press the F2 (Measure) key to display the calculation function interface.

b Press the F1 (Power) key to select the Power function (the font turns red).

c Press F6 (Cancel) to return to the Measure interface.

d Press the 0/M key to enter the caculation interface, the POWER symbol appears in the display area, indicating that the POWER caculation is performed.

e Finally, turn on the Output key, and the measurment power reading will be displayed.

⚠ **NOTE: If it is already in the calculation Measure interface before setting calculation parameters, press the F6 (Cancel) key to return to the calculation Measure interface and do not need to press the 0/M key.**

For example, when the GSM is connected to a 2MΩ resistor, Isrc is set to 1uA, and Cmpl is set to 2.1V, the Power measurement reading is shown in the following figure:

CompOhms

Compensation function for resistance measurement.

Operation steps:

a Press the F2 (CompOhms) key, select CompOhms (the font turns red), and the cursor will automatically jump to the CompOhms (Vs/Is) item.

b Operate the Enter key, the arrow keys and the number keys to set the values of I1 and I2 in sequence.

c Press F6 (Cancel) to return to the Measure interface

d Press the 0/M key to switch to the calculation Measure interface. The CompOhms symbol appears in the display area, indicating that the CompOhms calculation to be performed.

e Finally, turn on the Output key, and the measurment rasistance will be displayed.

NOTE: When programming the value of V1 and V2 (or I1 and I2), the up and down direction keys can switch the range of voltage or current. The value should be set in the most suitable range according to the range of the resistance to be measured. Using voltage V1 and V2 or current I1 and I2 depends on the source of the Measure interface.

For example, when the GSM is connected to a 2MΩ resistor, I1 is set to 0.1uA, and I2 is set to 1uA, then the parameter settings and measurement reading are shown in the following figure:

Vcoeff

Used to measure the voltage coefficient of high value or megohm resistance.

Operation steps:

a Press the F3 (Vcoeff) key, select Vcoeff (the font turns red), and the cursor will automatically jump to the Vcoeff item.

b Operate the Enter key, the arrow keys and the number keys to set the values of V1 and V2 in sequence.

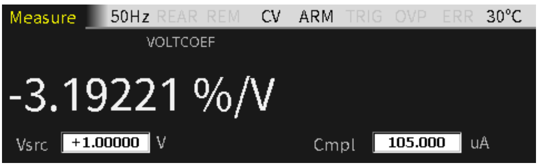
c Press F5 (Cancel) to return to the Measure interface.

d Press the 0/M key to switch to the calculation Measure interface. The Vcoeff symbol appears in the display area, indicating that the Vcoeff to be calculated.

e Finally, turn on the Output key, and the measurment reading of Vcoeff will be displayed.

NOTE: When programming the value of V1 and V2, the up and down direction keys can switch the voltage range, and the value should be set in the most suitable range according to the range of the resistance to be measured.

For example, when the GSM is connected to a 2MΩ resistor, V1 is set to 100mV, and V2 is set to 1V, the parameter settings and measurement reading are shown in the following figure:



VarAlpha

Used to measure the varistor α value.

Operation steps:

a Press the F4 (VarAlpha) key, select VarAlpha (the font turns red), and the cursor will automatically jump to the VarAlpha item.

b Operate the Enter key, the arrow keys and the number keys to set the values of I1 and I2 in sequence.

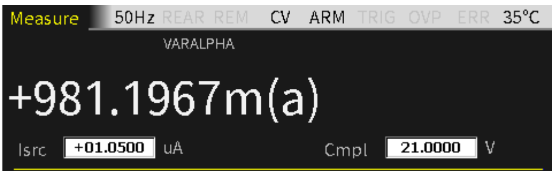
c Press F5 (Cancel) to return to the Measure interface.

d Press the 0/M key to switch to the calculation Measure interface. The VarAlpha symbol appears in the display area, indicating that the VarAlpha to be calculated.

e Finally, turn on the Output key, and the measurment reading of VarAlpha will be displayed.

NOTE: When programming the value of I1 and I2, the up and down direction keys can switch the current range, and the value should be set in the most suitable range according to the range of the resistor to be measured.

For example, when the GSM is connected to a 1MΩ resistor, I1 is set to 0.01uA, and I2 is set to 1.05uA, then the parameter settings and measurement reading are shown in the following figure:



DEV Used to measure the percentage deviation between the measurement reading and the reference value set by the user.

Operation steps:

a Press the F5 (DEV) key, select DEV (the font turns red), and the cursor will automatically jump to the DEV item.

b Operate the Enter key, the arrow keys and the number keys to set the Ref value and also HI tol value and LO tol value in sequence.

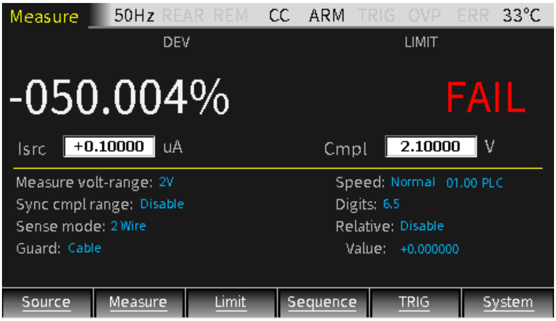
c Press F5 (Cancel) to return to the Measure interface.

d Press the 0/M key to switch to the calculation Measure interface. The DEV symbol appears in the display area, indicating that the DEV to be calculated.

e Finally, turn on the Output key, and the measurment reading of DEV will be displayed.

NOTE: Ref value has no unit. The type of measurement reading(V, I, Ω) set in the Measure interface determines the type of Ref value. When programming the Ref value, the up and down direction keys can switch the magnitude of the value.

For example, when the GSM is connected to a 1MΩ resistor and the Ref value is set to 0.2uA, the parameter settings and measurement reading are shown in the following figure:



Measurement Operations

Steps	Generally there are the following steps:

a Connect the external test leads (front-panel or rear-panel) according to the requires of the test

b For rear-panel output, set it according to System->Control->Rear.

c Set Vsrc or Isrc and Cmpl on the front panel

d Set other parameters in the parameter area (Measure interface)

e Select the required measurement reading V/I/Ω/M (corresponding to the keys 7/V, 4/I, 1/Ω, 0/M)

f Press the Output key to start the measurement.

NOTE: After starting the measurement, the measurement function V/I/Ω/M can also be toggled.

State Description

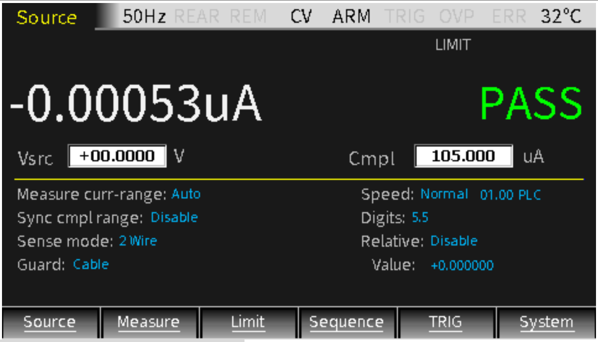
REAR	Display when setting as rear-panel output. Otherwise, it is the front-panel output
REM	Remote control

CV	When the GSM is set as I-Source, in case that the terminal output voltage is restricted by Cmpl or Measure vol-range, the GSM operates in CV (constant voltage) mode When the GSM is set as V-Source, in case that the terminal output current is not restricted by Cmpl or Measure cur-range, the GSM operates in CV (constant voltage) mode
CC	When the GSM is set as V-Source, in case that the terminal output current is restricted by Cmpl or Measure curr-range, the GSM operates in CC (constant current) mode When the GSM is set as I-Source, in case that the terminal output voltage is not restricted by Cmpl or Measure vol-range, the GSM operates in CC (constant current) mode
ARM	Source-measure operation is in progress
TRIG	Select external trigger source (Tlink, Rising Edge, Falling Edge, Edge)
OVP	When the OVP function is enable, the OVP mark is black, and the mark is red when the OVP function is triggered.
ERR	When reading failure or invalid calibration steps occur, ERR mark will display in status bar. For detailed error codes, see page 360.

Limit Function

Display Interface

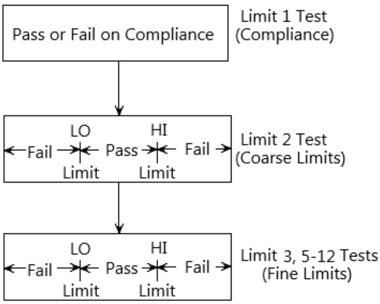
Description



Limit test classification:

There are three types of limits: compliance value (Cmpl), coarse limit (Limit 2), fine limit (limit 3, 5-12). When Output is ON, pressing the F3 (Limit) key will trigger the operation of the limit function as long as a Limit option is set to Enable, and the LIMIT mark will also appear on the display area.

The test procedure is as follows:



Limit type:

There are a total of 11 limit tests that can be applied for the DUT. Either limit test can be performed only when it is Enabled. 11 types of limit tests can be performed simultaneously.

Limit 1 test (compliance): It is a hardware test, which checks the compliance status of the GSM, and uses the programmed compliance value as the test limit.If the measurement reading is the programmed compliance value, indecating that the GSM is in compliance. If the measurement reading is below the programmed compliance value, indecating that the GSM is not in compliance.

Limit 2, limit 3 and limit 5-12 test: are software tests, used to determine whether the DUT is within the specified high and low limits.
Limit 2: Used to test coarse tolerance limts.
Limit 3 and Limit 5-12 : are used to test fine tolerance limits.

Limit mode:
The composite limit test has two modes:

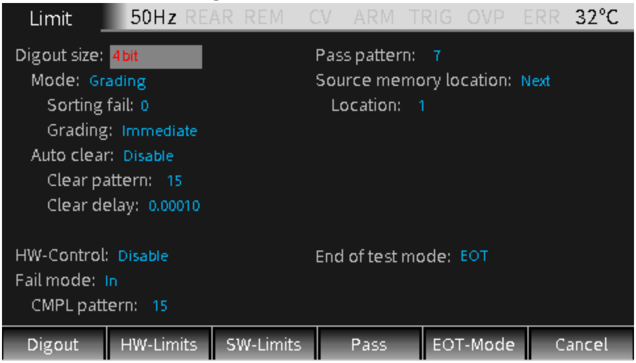
- GRADING
  Maximum 11 limit tests are performed on the measurement reading until FAIL is detected.
- SORTING
  Maximum 11 limit tests are performed on the measurement reading until PASS is detected.

  For Limit 1 test (compliance), the two modes are the same. If Limit 1 does not meet the compliance value limit, FAIL will be displayed in the display area and the test will be terminated. In the case of PASS, it will continue the next Enabled limit tests.

Parameter Description And Operation

Setting interface

Long press F3(Limit) key to enter the setting interface as shown in the figure below:



There are 5 sub-menus to be programmed respectively:

F1（Digout）
F2（HW-Limits）
F3（SW-Limits）
F4（Pass）
F5（EOT-Mode）

Digout

Size

Used to control the bits number of digital I/O. Choose 3 or 4 or 16 digits. In the 3-bit mode, the fourth line of the digital I/O is selected as the EOT, /EOT, Busy or /Busy signal by the End of test mode. In 4-bit mode, when the End of test mode is set to EOT mode, the forth line of digital I/O is manually controlled.
When the Size is 3-bit, the range of the pattern value is 0-7.

When the Size is 4-bit, the range of the pattern value is 0-15.
When the Size is 16-bit, the range of the pattern value is 0-65535.
Setting: Move the cursor to the item to be programmed (it turns into a red letter on a gray background), and press Enter. After the up and down arrow signs appear, operate the up and down direction keys to select the required option (3bit, 4bit or 16bit), and then press Enter to confirm.

Mode

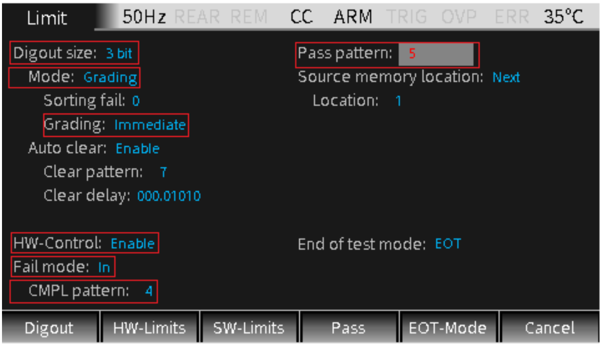
Choose Grading or Sorting mode

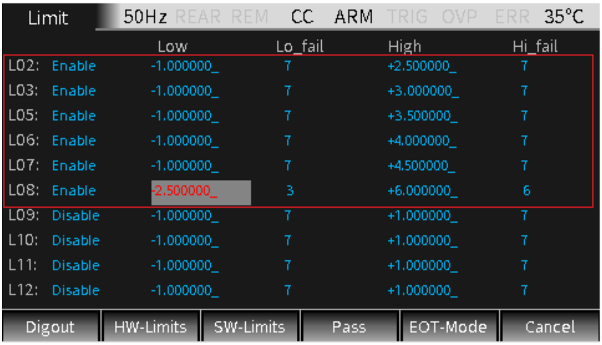
Grading mode: if a measurement reading has passed the compliance test and is within all HI/LO tolerance limits, PASS will be displayed.

Sorting fail option cannot be set in Grading mode.

When Grading is set to Immediate, the measurement process will terminate at the first fail situation. If the measurement reading is less than the Low limit of any of Limit 2, 3, 5-12, the I/O port will output the corresponding Lo_fail value. If the measurement reading is higher than the High limit of any of Limit 2, 3, 5-12, the I/O port outputs the corresponding Hi_fail value. If HW_Limits and SW_Limits are all PASS, the value of Pass pattren will be outputed, and the measurement process will be terminated.

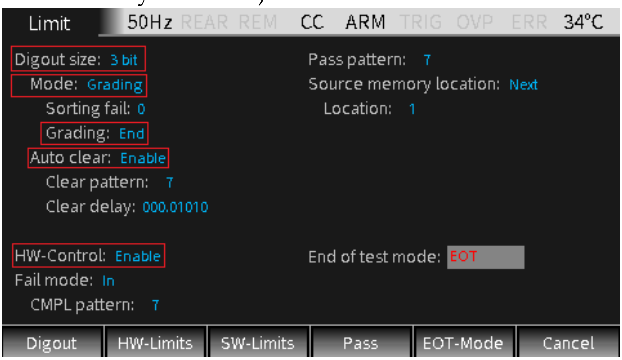
For example, when the GSM is connected to a 20Ω resistor for Limit test, set the GSM as I-Source, programming Isrc to 105mA, Cmpl to 21V, and Measure volt-range to 20V. On the main interface, long pressing F3 key to enter the Limit setting interface, and setting the options in Digout, HW-Limits, SW-Limits and Pass pattern menus. After the setting is completed, press F6 (Cancel) key to return to the Limit test interface, press the Output key, and then press the F3 (Limit) key. Because the measurement reading conforms to HW-Limits and SW-Limits , the interface displays the limit test result PASS, and the I/O port outputs a Pass pattern value of 5 (Line3-Line1 of the Digital lines corresponds to the binary data 101).

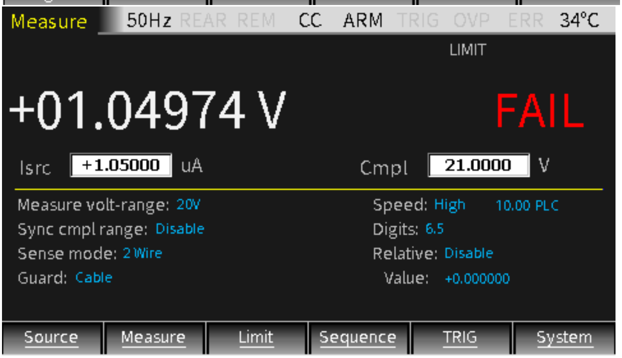




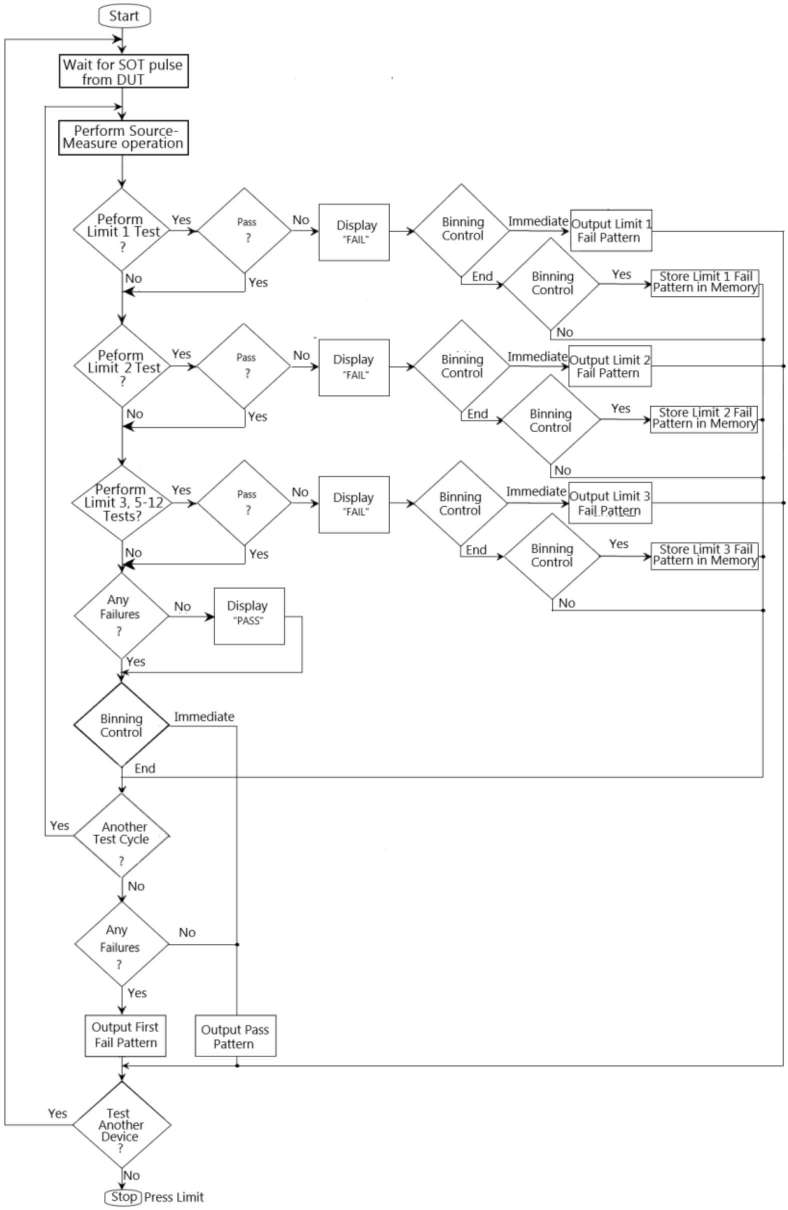
When Grading is set to End, regardless of whether a failure occurs, the test process will proceed to the completion of all the Enabled limit tests. After the measurement is completed, the bit pattern value after the first failure is output. If all Enabled limit tests pass, the value of Pass pattern will be outputed.

For example, when the GSM is connected to a 20Ω resistor for Limit test, set the GSM to I-Source, programming Isrc to 105mA, Cmpl to 21V, and Measure volt-range to 20V. On the main interface, long pressing F3 (Limit) key to enter the Limit setting interface, and setting the options in Digout, HW-Limits, SW-Limits and Pass pattern menus. After the setting is completed, press F6 (Cancel) key to return to the Limit test interface, press the Output key, and then press the F3 (Limit) key. Because the Grading mode is selected as End and the measurement reading is higher than the High value of Limit 7 in SW-Limits. The interface shows that the Limit test result FAIL, and the I/O port outputs Limit 7 Hi_fail value 6 (Line3-Line1 of the Digital lines corresponds to the binary data 110).





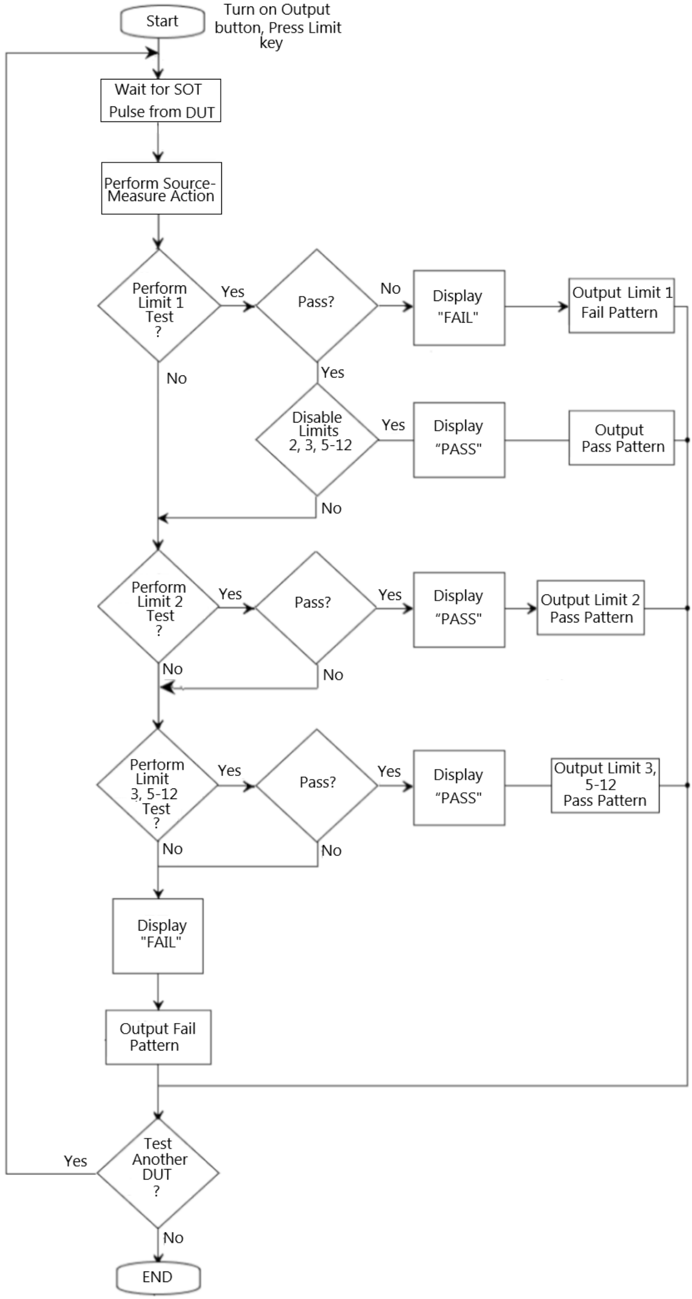
The operating flow of Grading mode is shown in the figure below:



Start
Wait for SOT pulse from DUT
Perform Source-Measure operation
Peform Limit 1 Test ?
Yes
Pass ?
No
Display "FAIL"
Binning Control
Immediate
Output Limit 1 Fail Pattern
End
Binning Control
Yes
Store Limit 1 Fail Pattern in Memory
No
Yes
No
Peform Limit 2 Test ?
Yes
Pass ?
No
Display "FAIL"
Binning Control
Immediate
Output Limit 2 Fail Pattern
End
Binning Control
Yes
Store Limit 2 Fail Pattern in Memory
No
Yes
No
Perform Limit 3, 5-12 Tests?
Yes
Pass ?
No
Display "FAIL"
Binning Control
Immediate
Output Limit 3 Fail Pattern
End
Binning Control
Yes
Store Limit 3 Fail Pattern in Memory
No
Yes
No
Any Failures ?
No
Display "PASS"
Yes
Binning Control
Immediate
End
Yes
Another Test Cycle ?
No
Any Failures ?
No
Yes
Output First Fail Pattern
Output Pass Pattern
Yes
Test Another Device ?
No
Stop
Press Limit

SORTING mode: If a measurement reading fails the Compliance Test, or is not within any SW-Limits range, the Limit test will display FAIL. If the measurement reading passes the Compliance Test and only Limit 1 is enabled, the corresponding PASS pattern value will be output. If in addition to Limit 1, SW-Limits also has an item that is Enabled, in the case of Limit test PASS, the I/O port outputs the corresponding Pass value of the first SW_Limits test band that passes.
If Limit 1 fail, the value of CMPL pattern is output. If all limit test bands in SW-Limits fail, the value of Sorting fail pattern is output. When the SORTING mode is selected, the Sorting fail value can be set.

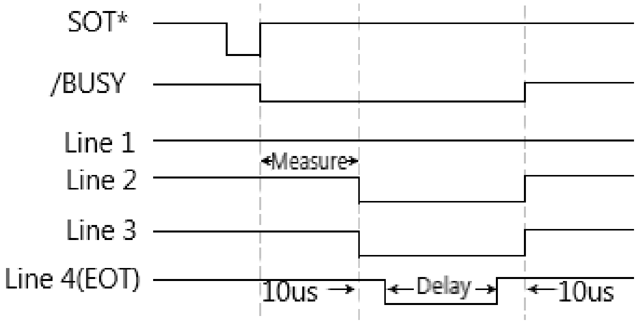
The operating flow of Sorting mode is shown in the figure below:


Start
Turn on Output button, Press Limit key
Wait for SOT Pulse from DUT
Perform Source-Measure Action
Perform Limit 1 Test ?
Yes
Pass?
No
Display "FAIL"
Output Limit 1 Fail Pattern
Yes
No
Disable Limits 2, 3, 5-12
Yes
Display "PASS"
Output Pass Pattern
No
Perform Limit 2 Test ?
Yes
Pass?
Yes
Display "PASS"
Output Limit 2 Pass Pattern
No
No
Perform Limit 3, 5-12 Test ?
Yes
Pass?
Yes
Display "PASS"
Output Limit 3, 5-12 Pass Pattern
No
No
Display "FAIL"
Output Fail Pattern
Test Another DUT ?
Yes
No
END

Setting: Move the cursor to the item to be changed (it becomes a red letter on a gray background), press Enter, and when the up and down arrow signs appear, operate the up and down direction keys to select the appropriate method (Immediate or End), and then press Enter to confirm.

Auto clear

Used to select the automatic clear function of the digital output (Enable or Disable). If Enable, you can set the pulse width of the pass/fail pattern (delay 0 to 60s) and the Clear pattern of the digital output (0-7 for 3 digits, 0-15 for 4 digits). After the GSM is powered on, Auto clear is Enabled by default. The sequence of Auto clear is shown in the figure below:



NOTE: When the arm source in the arm layer selects ↓STEST, event detection occurs when the SOT line is pulsed low. When the arm source in the arm layer selects ↑STEST, event detection occurs when the SOT line is pulsed high. When the arm source in the arm layer selects ↑↓STEST, event detection occurs when the SOT line is pulsed high or low.

HW-Limits

Press F2 (HW-Limits) key to set the fail mode of Limit 1 test.

H/W-Control

Used to turn on or turn off the Limit 1 test (Compliance Test).

Setting: Move the cursor to the item to be changed (it turns into a red letter on a gray background), press Enter, and when the up and down arrow signs appear, operate the up and down direction keys to select the required option (Enable or Disable), and then press Enter to confirm.

Fail mode

Used to select the fail mode of Limit 1 test.

When selecting In, if the measurement reading is within the compliance limit range, HW-Limits test pass; if the measurement reading is restricted by the compliance value, HW-Limits test fail;

When selecting Out, if the measurement reading is within the compliance limit range, HW-Limits test fail; if measurement reading is restricted by the compliance value, HW-Limits test pass;

Setting: Move the cursor to the setting item (it turns into a red letter on a gray background), and press Enter. After the up and down arrow signs appear, operate the up and down direction keys to select the required option (In or Out), and then press Enter to confirm.

CMPL pattern

Used to set the Fail pattern of Limit 1 test:

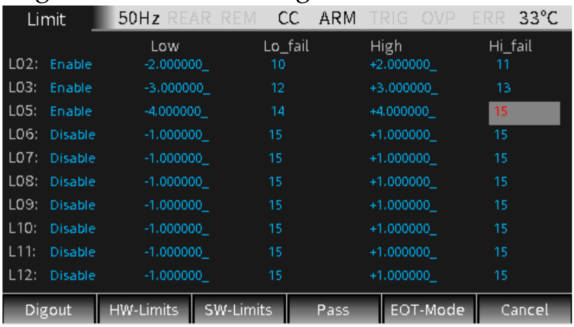
When the Digout size is 3 bits, the value is 0-7; when the Digout size is 4 bits, the value is 0-15.

Setting: Move the cursor to the item to be changed (it becomes a red letter on a gray background), press Enter, and it is in the programming state. Operate the direction keys or numeric keys to input the desired value.

SW-Limits

Press the F3 (SW-Limits) key to control the enabling of LIM2, LIM3, LIM5-LIM12, High/Low limit range and fail pattern value.

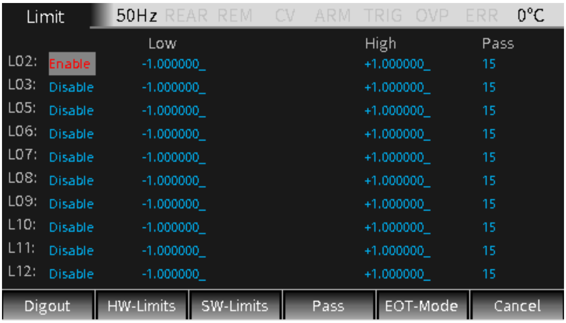
When operating in Grading mode, the SW-Limits setting interface is as the figure below:



Disable/ Enable	Set the function of LIM2, LIM3, LIM5-LIM12 to Enable. Setting: Move the cursor to the corresponding Disable or Enable item (turned into red on a gray background), press Enter, and when the up and down arrow signs appear, operating the direction keys to select the required option (Disable or Enable), and then press Enter to confirm.
Low	Set the low value of the limit range of LIM2, LIM3, LIM5 -LIM12. Setting: Move the cursor to the value of the corresponding item (it becomes a red letter on a gray background), press Enter, and it is in the programming state. Operating the up and down direction keys to select the required magnification, using the left and right direction keys and the numeric keys to input the required value.

Lo_fail	Setting the low fail pattern value of LIM2, LIM3, LIM5 -LIM12. When Digout size is 3 bits, the value is 0 to 7, and when Digout size is 4 bits, the value is 0 to 15. Setting: Move the cursor to the value of the corresponding item (it becomes a red letter on a gray background), press Enter, and it is in the programming state. Operating the direction keys or numeric keys to input the desired value.
High	Set the high value of the limit range of LIM2, LIM3, LIM5 -LIM12. Setting: Move the cursor to the value of the corresponding item (it becomes a red letter on a gray background), press Enter, and it is in the programming state. Operating the up and down direction keys to select the required magnification, using the left and right direction keys and the number keys to input the required value.
Hi_fail	Setting the high fail pattern value of LIM2, LIM3, LIM5 -LIM12. When the Digout size is 3 digits, the value is 0 to 7, and when the Digout size is 4 digits, the value is 0 to 15. Setting: Move the cursor to the value of the corresponding item (it becomes a red letter on a gray background), press Enter, and it is in the programming state. Operating the up, down, left, and right direction keys or numeric keys to input the desired value. When operating in Sorting mode, the SW-Limits setting interface is as the figure below, the meaning

of the parameters except Pass are the same as Grading mode:



Pass Setting the corresponding Pass pattern value of LIM2, LIM3, LIM5 -LIM12.

Setting: Move the cursor to the value of the corresponding item (it becomes a red letter on a gray background), press Enter, and it is in the programming state. Operating the direction keys or numeric keys to input the desired value.

PASS

Press the F4 (Pass) key for the related actions under PASS. Related instructions can refer to page 126.

Pass pattern Used to define the digital output bit value. When the Digout size is 3 digits, the value digits are 0-7, and when the Digout size is 4 digits, the value digits are 0-15. When Mode is set as Grading, output the Pass pattern value in case that all limit tests pass. When Mode is set to Sorting, it is the pass pattern value of Limit 1 (Compliance Test) when SW-Limits are Disable.

Setting: Move the cursor to the value of the corresponding item (it becomes a red letter on a gray background), press Enter, and it is in the programming state. Operate the direction keys and numeric keys to input the desired value.

Source memory location

It is used in SRC-MEM sequence to select the next memory location point in the sequence list when the limit tests of the present point is PASS. If selecting Next, the next location of the present location in the sequence list is selected. If selecting Location, you can jump to any location from the present location in the sequence list (LOCATION 1 to LOCATION 100) by setting the location number.

Setting: Move the cursor to the corresponding item (it turns into red on the gray background), press Enter, when the up and down arrow signs appear, operating the up and down direction keys to select the required option (Next or Location), and then press Enter to confirm.

Location

Specify the branching Location in the sequence list, the range is 1-100. Only need to be set when Source memory location is selected as Location.

Setting: Move the cursor to the value of the corresponding item (it becomes a red letter on a gray background), press Enter, and it is in the programming state. Operating the direction keys or numeric keys to input the desired value.

EOT-Mode

End of test mode

Control the 4th line of the Digital I/O port using as EOT signal or Busy signal. When used as EOT signal, it is used to notify external handler to read the pattern value of the Digital I/O port. Sending a pulse about 10us after the pattern value is output from the I/O port, and the pulse ends 10us before the pattern value is cleared. When used as Busy signal, it indicates the time taken by GSM from receiving the SOT signal to the completion of all measurements, limit tests, and I/O port outputting pattern values. Please refer to page 110.

When EOT is selected, in the case of 3bit Digout size, the 4th line of the Digital I/O lines automatically outputs a HI pulse at the end of test. When the Digout size is 4bit, the End of test signal is not automatically controlled. Need to set Auto clear to Enable.

When /EOT is selected, in the case of 3bit Digout size, the 4th line of the Digital I/O lines automatically outputs a LO pulse at the end of test.

NOTE: When EOT or /EOT is selected for End of test mode, the Auto clear option must be Enabled.

When Busy is selected, the operation mode of the GSM is similar to 3bit Digout size mode. Setting the 4th line HI during the Limit test, need to set Arm in Source as Rising edge/Falling edge/Edge. Please refer to page 110.

When /Busy is selected, the operation mode of the GSM is similar to 3bit Digout size mode. Setting the 4th line LO during the Limit test, need to set Arm in Source as Rising edge/Falling edge/Edge. Please refer to page 110.

NOTE: If Busy or /Busy is selected, the Arm source needs to be set to SOT (falling edge, Rising edge, Edge).

Setting: Move the cursor to the corresponding item (it turns into a red letter on a gray background), and press Enter. After the up and down arrow signs appear, operate the up and down direction keys to select the required option (EOT, Busy or /Busy), and then press Enter to confirm.

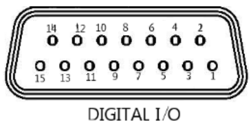
External I/O

Description

The GSM can be connected to an external device through the external Digital I/O port. The Digital I/O port includes 4 output lines. The output level of the Digital I/O port can be controlled by System->Control->Digout. For example, if you set Digout to 15, all 4 I/O ports will be set high.

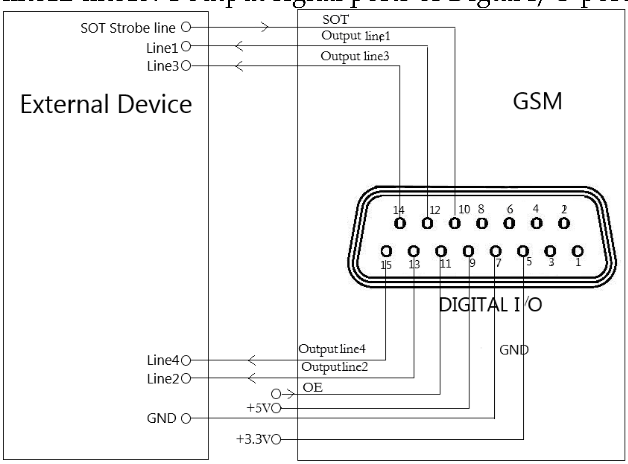
Pin Definition

line5：+3.3V
line7：GND
line6,8：IDLE



line9: +5V output, used to drive external logic circuits. The maximum output current of this port is 300mA.
line10: Start-of-test line, SOT is the input signal.
line11: Output enable, OE is the input signal. It is used with an output enable circuit on a device or test fixture.
line12-line15: 4 output signal ports of Digtal I/O ports

Connection Diagram

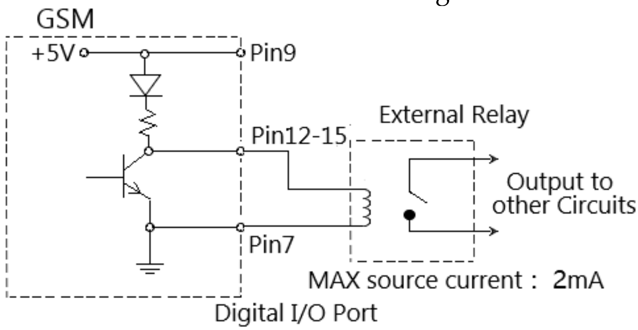


The measurement method shown in the figure above is used to send the pattern values of the limit test.

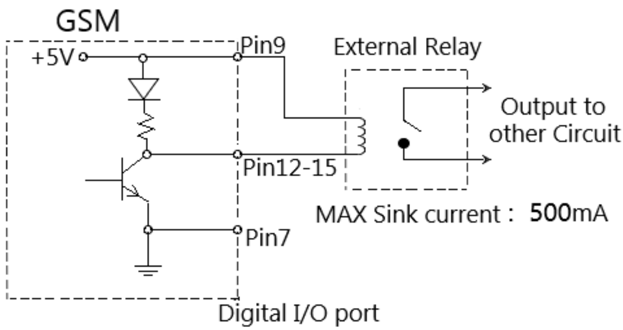
Load connection

Each open-collector output can be set to high level (+5V) or low level (0V), and can source 2mA current or sink 500mA current.

Source operation: Connect an external relay between one of digital output lines and the GND wire. The digital output line must be set to high level to drive the relay. The maximum source current is 2mA. The connection method is shown in the figure below:



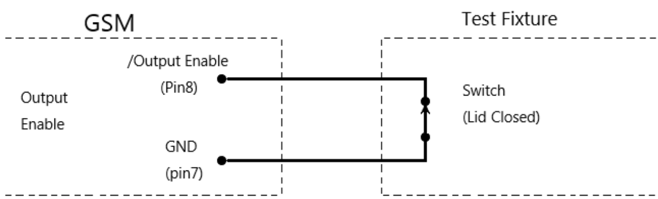
Sink current operation: connect an external relay between one of digital output lines and the +5V power supply. The digital output line must be set to low level to drive the relay. The maximum sink current is 500mA. The connection method is shown in the figure below:

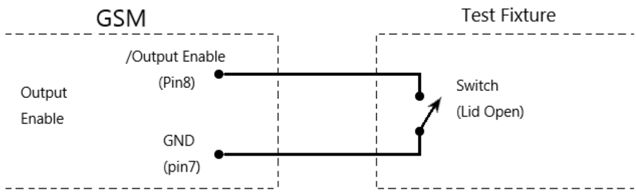


Output Enable control line

The digital I/O port provides an output enable control line to be used together with the output enable switch of a test fixture. When used correctly, the Output of the GSM will turn off if the lid of the test fixture is opened.

As shown in the figure below, when the output enable function is enabled , the output enable line is pulled down if the switch to ground is closed, then the Output of the GSM is turned on. If the lid of the test fixture opens, the switch to ground is opened as well, and the output enable line goes high turning the Output of the GSM off(high-impedance state). Only when the test fixture lid is closed and then press Output key, the output of GSM can be turned on again.





NOTE: The Output enable line can be driven by Digital I/O. Allow 100us settling and response time. The digital I/O lines are edge-sensitive, open-collector, and signals must be debounced to avoid unstable operation.

Limit Operation

Operation

Generally there are the following steps:

a Set up the measurement system. Such as connecting a DUT to the GSM, and can also connecting components to external I/O port according to test requirements.

b Set source-measure related parameters.

c Select and set the relevant parameters of Limit test.

d Select the required measurement reading type V/I/Ω/M (corresponding to the keys 7/V, 3/I, 1/Ω, 0/M).

e Press the Output key to turn on the output, and the GSM will output the programmed voltage.

f Press F3 (Limit) key to run limit test. If the /SOT line of the digital I/O port is connected to a component, limit test needs to wait for the component to send a pulse to the /SOT line. If the /SOT line is not connected, the limit test will start immediately after pressing the F3 (Limit) key.

NOTE: After starting the test, the measurement

function V/I/Ω/M can also be toggled.

⚠**NOTE: PASS and FAIL indicate the result of each limit test. There are two exceptions:**

- **When Off state is set to Normal, High impedance, or Guard and limit measurement is turned on, set Auto off to Enable, and POFF or FOFF will be displayed. When Off state is set to Zero and limit measurement is turned on, whether Auto off is set to Enable or Disable that PZER or FZER will be displayed when Output is turned off.**

- **If the programmed V_{src} exceeds OVP, “OVP” is displayed in red on the status bar. At this time, when the Limit function is running, P OVP or F OVP will be displayed accordingly.**

State Description

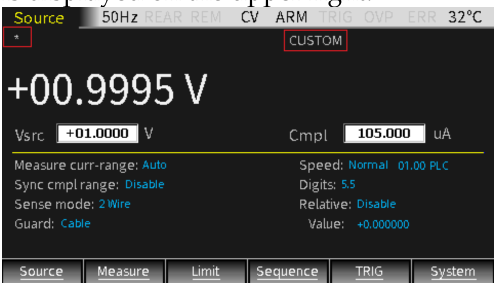
REAR	Display when setting as rear-panel output. Otherwise, it is the front-panel output
REM	Remote control
CV	When the GSM is set as I-Source, in case that the terminal output voltage is restricted by Cmpl or Measure vol-range, the GSM operates in CV (constant voltage) mode When the GSM is set as V-Source, in case that the terminal output current is not restricted by Cmpl or Measure cur-range, the GSM operates in CV (constant voltage) mode
CC	When the GSM is set as V-Source, in case that the terminal output current is restricted by Cmpl or Measure curr-range, the GSM operates in CC (constant current) mode When the GSM is set as I-Source, in case that the terminal output voltage is not restricted by Cmpl or Measure vol-range, the GSM operates in CC (constant current) mode
ARM	Source-measure operation is in progress
TRIG	Select external trigger source (Tlink, Rising Edge, Falling Edge, Edge)
OVP	When the OVP function is enable, the OVP mark is black, and the mark is red when the OVP function is triggered.
ERR	When reading failure or invalid calibration steps occur, ERR mark will display in status bar. For detailed error codes, see page 360.
PASS	Limit test PASS
FAIL	Limit test FAIL

Sequence Function

Display Interface

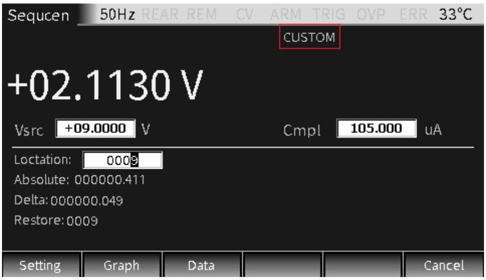
Description This function can be used when different voltage and current waveforms need to be output in practical applications. Users can program the output waveform according to needs. The amplitude range of the output waveform is the range of output voltage or current of the GSM.

When Output is turned on, press the F4 (Sequence) key to enter the running interface. When running a sequence, the * symbol will appear on the upper left of the interface, and the presently running sequence type is displayed on the upper right:



NOTE: When Counts option is set to Infinite, that is, when the times of sequence is infinite, the * symbol will not appear on the upper left of the interface.

When Output is turned off, press the F4 (Sequence) key to enter the sequence points browsing interface after running. The measurement reading of any point in the Sequence will display by changing the number of Location. When Counts option is set to Infinite, the source-measurement readings can not be review in this interface.

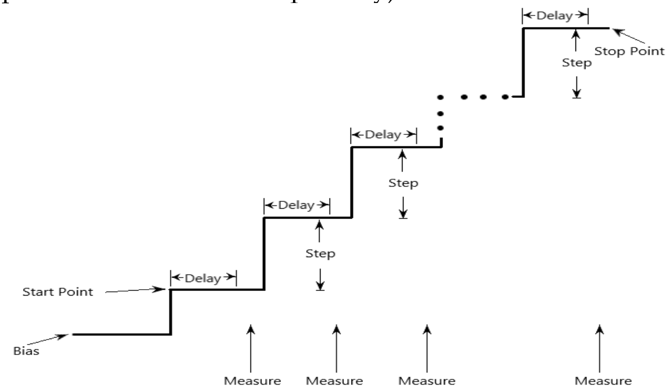


Features

There are four types of Sequence: Stair, Log, Custom, and SRC-MEM.

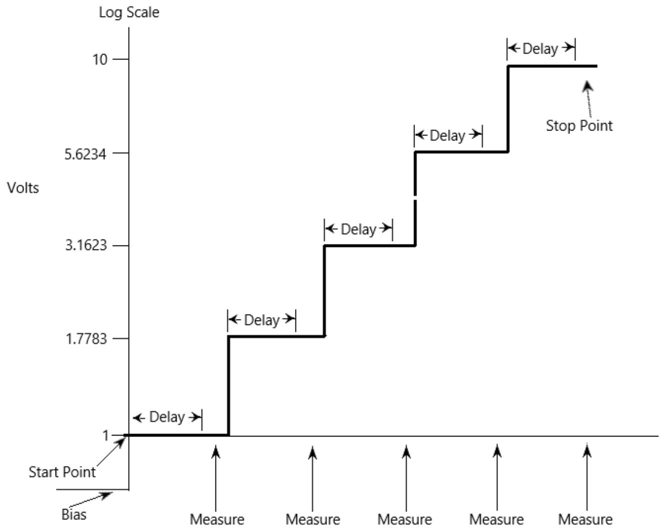
Stair

The output of the waveform depends on the following parameters: Start value, Stop value, Step (Stair) value, Delay time (Determined by Source delay, trigger delay and Speed which can be set separately). Shown as below:



When starting sequence, the output will go from the bias level to the Start point, and run to the Stop point in equal steps. When the trigger delay time is set to 0, the time of each step is determined by the source delay time and the time it takes to perform measurement (NPLC setting).

Log The output of the waveform depends on the following parameters: Start value, Stop value, Points (log) number, Delay time (Determined by Source delay, trigger delay and Speed which can be set separately). As shown below:



When starting sequence, the output will go from the bias level to the Start piont, and run to the Stop point in equal logarithmic steps. When the trigger delay time is set to 0, the time of each step is determined by the source delay time and the time it takes to perform measurement (NPLC setting).

NOTE: The value of logarithmic sequence mode cannot be set as 0.

Custom Custom sequence type. It is necessary to set the number of points and the source value of each sequence point.

When starting sequence, the output will go from the bias level to the Start piont, and run to the Stop point in turn. When the trigger delay time is set to 0, the time of each step is determined by the source delay time and the time it takes to perform measurement (NPLC setting). The delay is the same for all the sequence points.

SRC-MEM	Source memory sequence type. For this sequence type, setup configurations of 100 points can be stored in the memory.

When starting sequence, the setup at each memory point can be recalled, allowing multiple functions and math expressions to be used in a sequence. For example, the first point in the source memory sequence is a voltage source to measure current, the next point may be a current source to measure voltage, the third point may be a voltage source to measure voltage, and the last point may operate math expression.

This sequence type provides a way to customize specific setup of each sequence point.

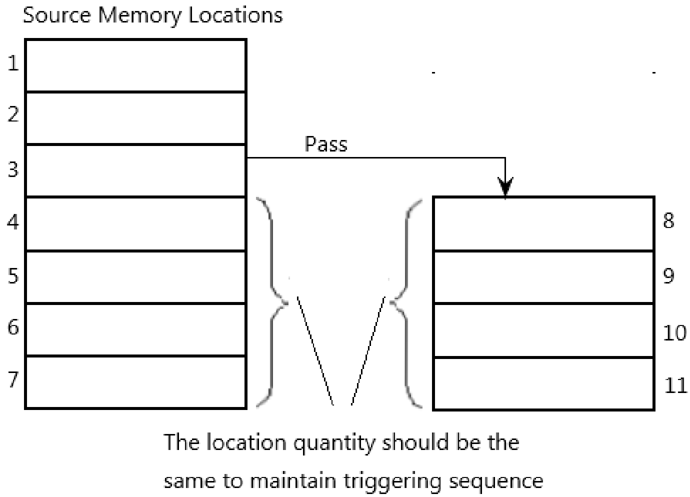
When the parameters of sequence point in the memory are programmed and stored, these settings will be recalled very quickly once the sequence is executed.

Sequence branching

When the the SRC-MEM sequence is performed with limit tests measure the sequence result, the order of the sequence points can be changed. Used to build a different set of tests on the basis of an initial test.

The SRC-MEM sequence can branch to a specified memory location or proceed to the next memory location in the sequence list. When a location is specified, under the PASS condition of limit tests, the sequence will jump to that specified position, and under the FAIL condition of limit tests, the sequence will jump to the next position in the list. When NEXT is selected in Source memory location, regardless of the limit test PASS or FAIL, the sequence will proceed to the next position in the list.

The figure below shows a seven-point sequence branching. Indicating how the unit is programmed to branch to location 8 when a PASS condition occurs at location 3.



Be careful when branching, because you may unintentionally create an infinite memory loop. No matter how many branchs are performed, the point number of the SRC-MEM sequence is the setting value of TRIG count.

The SRC-MEM sequence branching can be set in the Source memory location and Location options in the PASS section of the Limit chapter.

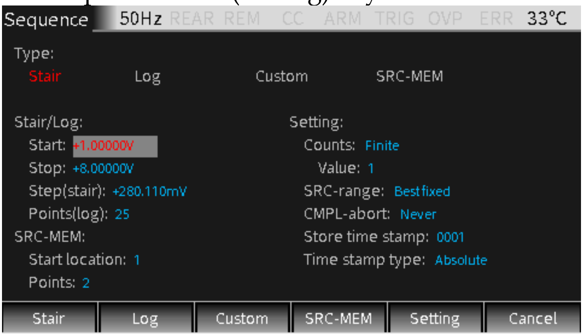
NOTE: When the limit tests is FAIL, only the instruction: CALCulate2:CLIMits:FAIL:SMLocation <NRf> | NEXT can be used to set the branch location.

Parameter Description And Operation

Description There are 2 ways to enter the parameter setting interface of Sequence:

a Long press the F4 (Sequence) key.

b When Output is turned off, press the F4 key to enter the Sequence data browsing interface, and then press the F1 (Setting) key to enter.



Waveform selection Click the F1-F4 keys to select the desired waveform (the corresponding Type name changes from white to red).

Stair/Log waveform parameters

Start Set the start point of the Stair/Log output waveform, Vsrc or Isrc depends on the source type of main interface.

Operation: Use the derection keys to place the cursor on the Start option (the numbers in the edit box turn into red on the gray background), press Enter key to enter the editing state, select the range with the up and down arrow keys, input the required value according to the position with the numeric keys, and then Enter to confirm.

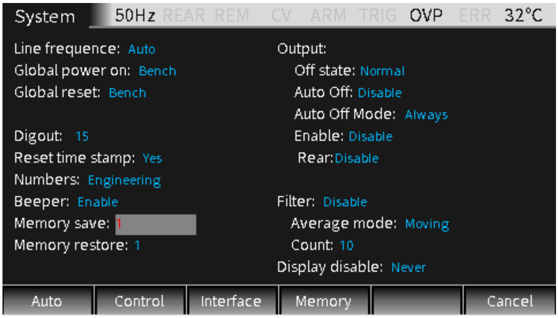
Stop	Set the stop point of the Stair/Log output waveform, Vsrc or Isrc depends on the source type of main interface. Operation: Use the derection keys to place the cursor on the Stop option (the numbers in the edit box turn into red on the gray background), press Enter key to enter the editing state, select the range with the up and down arrow keys, input the required value according to the position with the numeric keys, and then Enter to confirm.
Step (Stair)	Set the step value of the Stair output waveform, Vsrc or Isrc depends on the source type of main interface. Operation: Use the derection keys to place the cursor on the Step option (the numbers in the edit box turn into red on the gray background), press Enter key to enter the editing state, select the range with the up and down arrow keys, input the required value according to the position with the numeric keys, and then Enter to confirm.
Point (Log)	Set the point number of the Log output waveform. Operation: Use the direction keys to place the cursor on the Points option (the number on the option box turns into red on the gray background), press Enter key to enter the editing state, input the required number according to the position with the numeric keys, and then Enter to confirm.

SRC-MEM waveform parameters

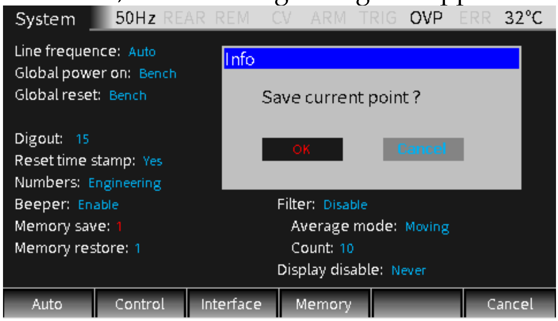
Start location The range of Start location is 1 to 100.

Memory save operation:

a Press the F6 (System) key on the main interface, and then press the F2 (Control) key to enter the following interface:

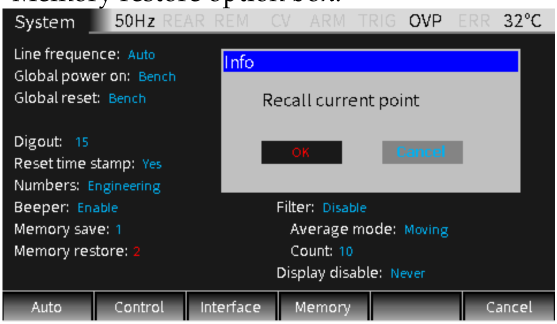


b Move the cursor to the Memory save option box, press Enter, enter a number between 1-100, and press Enter, the following dialog box appears:



c Move the cursor to OK key and press Enter to store the settings of the present Source interface in the memory location indicated by the number in the Memory save box.

d If you need to view the parameter settings of the point in a sequence which stored in the specified location of the memory, move the cursor to the Memory restore option box:



e Press Enter, enter a number between 1-100, press Enter, the following dialog box appears, move the cursor to OK key and press Enter, which means to recall the settings in the corresponding memory location indicated by the number in the Memory restore box to present Source interface.

Points — SRC-MEM memory sequence points, value: 100-Start location.
Operation: Use the arrow keys to place the cursor on Points (the numbers on the edit box turn into red letters on a gray background), enter the editing state after Enter, enter the required value according to the position with the number keys, and then Enter to confirm.

Custom waveform

Custom sequence type. Used to set the number of measurement points in the sequence and the source level of each point.

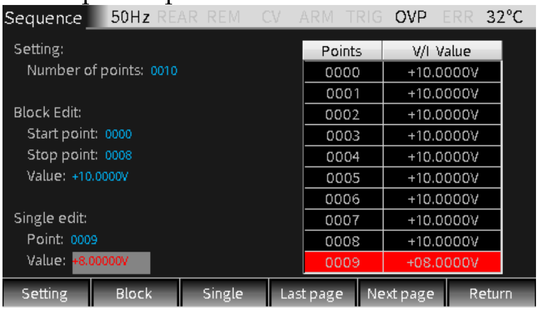
Number of points — Used to set the number of measurement points in the sequence.
Setting: Press the F3 (Custom) key, the cursor jumps to the Number of points option box, press Enter key enter the editing state, input the required number (0 to 2499) and press Enter to confirm.

V/I Edit — There are two ways: Block Edit (setting the points in the block to the same source level) and Single Edit.

Press the F2 (Block) key, the cursor jumps to the Start point to set the start position, set the end position in the Stop point option and set the source level in the Value box, and the source level of the points set in the Block are the same.

Press the F3 (Single) key to set the parameters of a single point.

The time parameters are determined by Source delay, trigger delay and Speed which can be set separately. As shown in the figure below, set the Number of points to 10. Press the F2 (Block) key to set the Start point to 0 and set the Stop point to 8, the Value is set to 10V. The source level of points from 0 to 8 in the right digram is 10V; press the F3 (Single) key to set the 10th sequence point to 8V.



Other Parameters

Counts

Set the sequence times, you can choose Finite or Infinite.

Finite: Indicates that the number of sequence times is limited. When slecting this option, a value can be set in Value box. The maximum number of Finite sequence times can be performed is determined as follows. Sequence results are stored in the data buffer.

maximum Finite sequence times = 2500/Points in sequence

Infinite: Indicates that the number of sequence times is unlimited, and the sequence results are not stored in buffer. The value in Value box has no effect.

Setting: Press F5 (Setting) key, cursor jumps to Counts box, press Enter key and derection keys to select Finite or Infinite and confirm; if it is Finite, move the cursor to Value box, press Enter to input the desired value and confirm.

SRC-range

Used to control the range of the source, you can choose Bestfixed, Fixed or Auto-range, the meaning of each option is as follows:

Bestfixed: Means that a source range suitable for all points in the sequence is automatically selected.
Fixed: Means to keep the source range remain on the range when the sequence is started. When the sweep points exceed the source range, the maximum level of the source range will be output.
Auto-range: Means that the most suitable source range is automatically selected for each point in the sequence.

Setting: Press F5 (Setting) key, move the cursor to SRC-range, press the Enter key and the derection keys to select the required option and confirm.

NOTE: Frequent range changes of Auto-range may cause transients. If these transients are not allowed, selecting Bestfixed option.

CMPL-abort

Set the interrupt mode when the measurement reading is in compliance (limited by Cmpl value) during the sequence process. There are three types:
Never: Interrupt is prohibited.
Early: Indicates that when the measurement reading is in compliance, an interruption occurs at the beginning of the SDM cycle.
Late: Indicates that when the measurement reading is in compliance, an interruption occurs at the end of the SDM cycle.

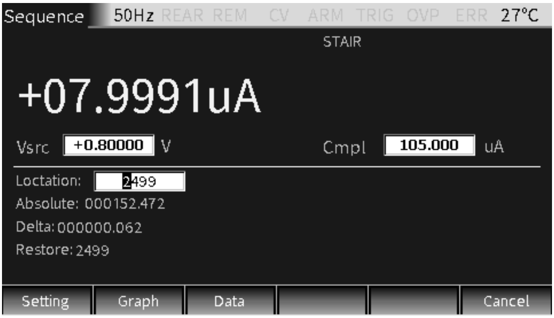
Setting: Press F5 (Setting) key, move the cursor to CMPL-abort option, press the Enter key and derection keys to select the required option and confirm.

Store time stamp	The time stamp for storing the first measurement reading in the buffer (#0000) is marked as 0000000.000s. The buffer of GSM can store 2500 source-measure readings. Each source-measure reading is assigned a storage address and a time stamp. The value of Store time stamp has two meanings: 1. When running the four sequence types of Stair, Log, Custom, and SRC-MEM, the Store time stamp is the actual number of sequence points. 2. If you need to run the sequence with the current source value, when the Output is turned on, long press the F4 (Sequence) key to enter the sequence Setting interface, set the required value in the Store time stamp option box, and press the Enter key to confirm, it will immediately run the sequence, the number of sequence points is the setting value of the Store time stamp.
Time stamp type	Set the timing mode. There are two timing modes: Absolute and Delta. **Absolute**: Represents the cumulative sequence time of all points reference to 0s. **Delta**: Indicates the sequence time of single point. Setting: Press the F5 (Setting) key, move the cursor to the Time stamp type box, press the Enter key to confirm and enter the editing state, and select the required mode with the up and down arrow keys and confirm.

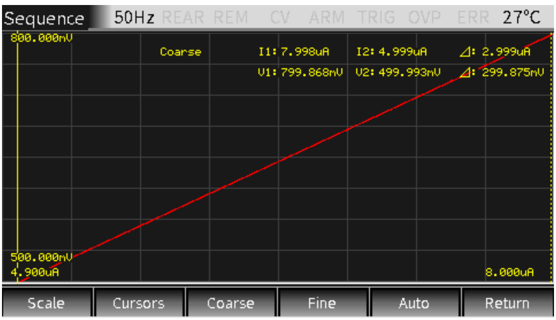
Generating Waveform And Exporting File

Description After a Sequence is completed running, turning Output off, click the F4 (Sequence) key to enter the review interface, and you can look back the running result in time. There are 3 ways:

1. By changing the size of Location, you can review the measurement information of each source point one by one: V/I measurement reading, Absolute and Delta interval time, and the address stored in buffer, etc.

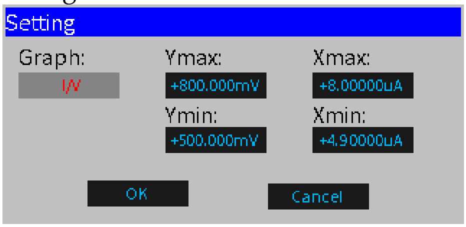


2. Click the F2 (Graph) key in the figure above to look back graphically。



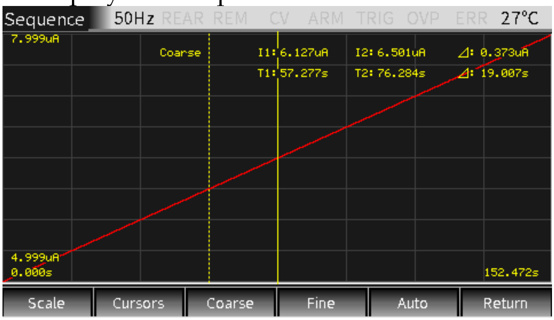
Parameter description:

a **Scale**: Set the type of horizontal and vertical coordinates and the scale, as shown in the dialog window:



There are 4 choices of Graph: I/V, V/I, V/t, I/t; Xmax, Xmin, Ymax, Ymin are the maximum or minimum coordinates value of the X and Y axes. (NOTE: It is better to set the coordinates of data graphics with the full screen display)

b **Cursors**: Click to select cursors 1 and 2 as well as display related parameters.

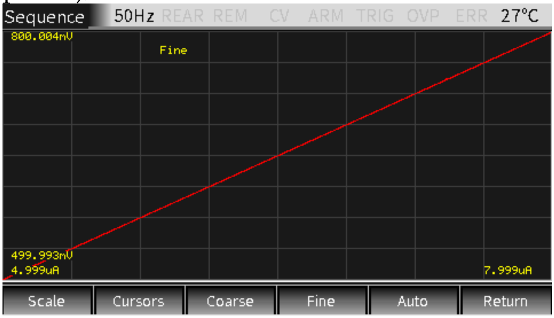


Cursors key has loop function, followed by "cursor and parameters display, cursor 1" → "cursor 2" → "cursors and parameters disappear"... (NOTE: the dotted line cursor is in the selected state)

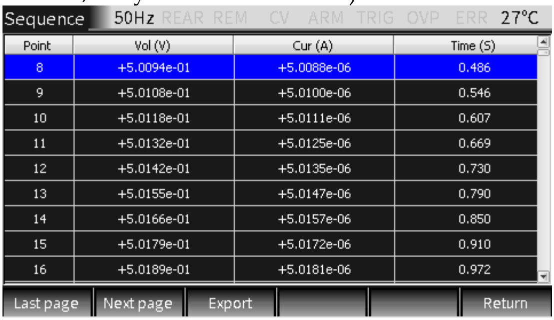
c **Coarse**: Roughly adjust the position of the selected cursor. After selection, it will be displayed in the parameter area. At this time, the bounce speed of the tick mark (operaing the left and right derection keys) is 5 times that of Fine mode.

d **Fine**: Fine-tune the position of selected cursor, and it will be displayed in the parameter area after selection.

e **Auto**: Automatically generate curve for source-measurement readings (sequence points), I-V is the default curve.



3. If you click the F3 (Data) key in the sequence output review interface, you can view the specific output value and export the waveform file (.CSV format, easy to browse on PC).



Point	Vol (V)	Cur (A)	Time (S)
8	+5.0094e-01	+5.0088e-06	0.486
9	+5.0108e-01	+5.0100e-06	0.546
10	+5.0118e-01	+5.0111e-06	0.607
11	+5.0132e-01	+5.0125e-06	0.669
12	+5.0142e-01	+5.0135e-06	0.730
13	+5.0155e-01	+5.0147e-06	0.790
14	+5.0166e-01	+5.0157e-06	0.850
15	+5.0179e-01	+5.0172e-06	0.910
16	+5.0189e-01	+5.0181e-06	0.972

Parameter description:

Last page, Next page: you can turn the page to view; **Export**: you can export the output data to a .CSV file to a mobile disk.

Sequence Output

Operation Generally there are the following steps:

a Connect the external connection (front panel or rear panel) according to the requirement of the test.

b For rear panel output, set it by System->Control->Rear.

c Set Vsrc or Isrc and Cmpl on the front panel.

d Set other parameters in the parameter area (Sequence interface).

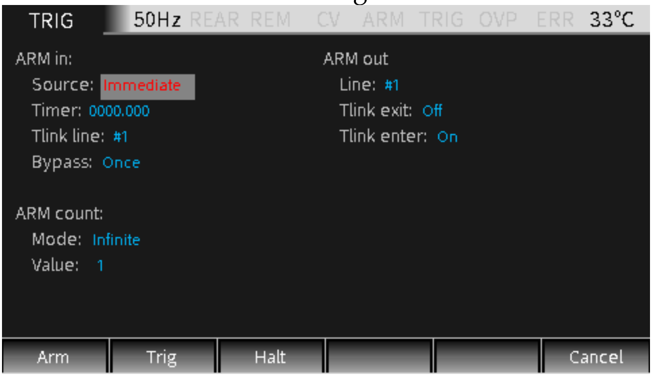
e Select the desired waveform.

f Press the Output key and the F4 (Sequence) key to start outputting the waveform until the last point, and then press the Output key to turn off the output.

TRIG Fuction

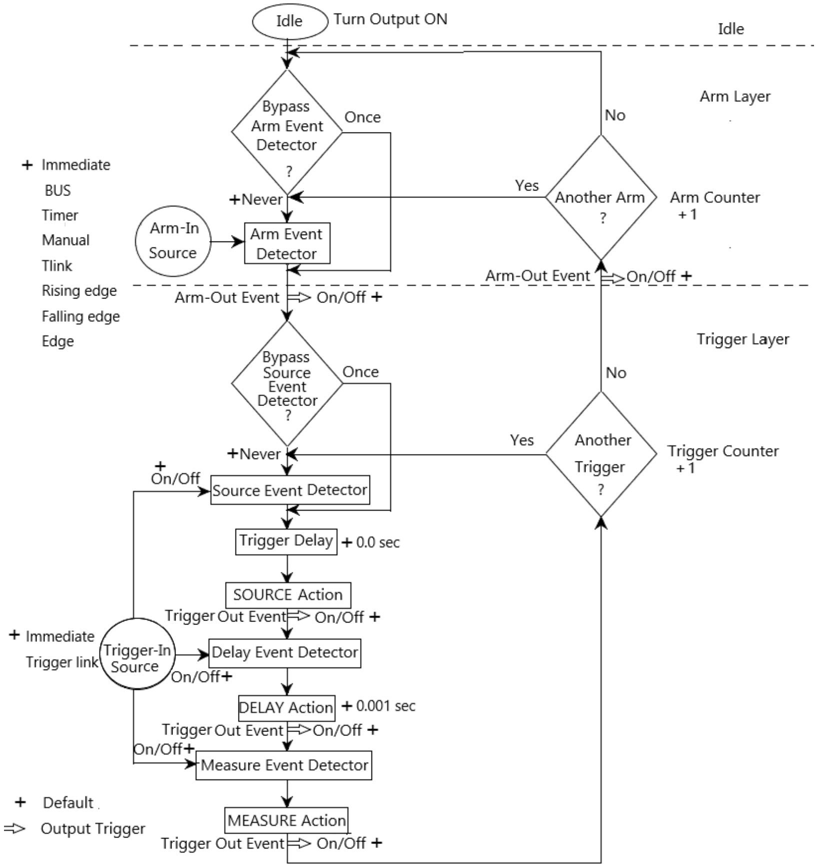
Programming Interface

Description Long press the F5 (TRIG) key on the main interface to enter the TRIG function setting interface:



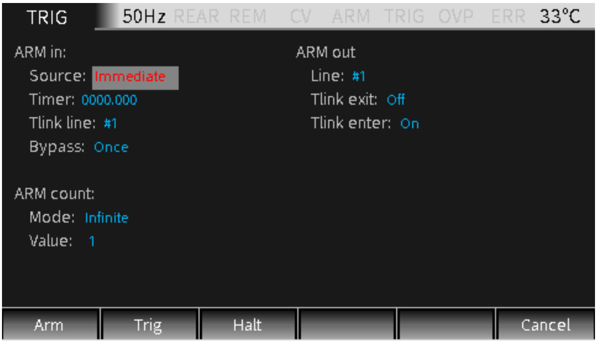
Trigger Process

The trigger mode is composed of the ARM layer and TRIG layer. The process is shown in the figure below:



Parameter Description And Operation

ARM Layer Press the F1(Arm) key, setting the Arm layer of the TRIG mode, and set the options in the ARM in, ARM count and ARM out.



ARM in

Source

Used to select the trigger source of the Arm layer. It can be set as Immidiate, GPIB, Timer, Manual, Tlink, Rising edge, Falling edge, Edge, the specific description is as follows:

Immidiate: Event detection occurs immediately allowing operation to continue.

BUS: Event detection occurs when a bus trigger (GET or *TRG) Command is received.

Timer: Select Timer mode, when Output is turned ON, event detection occurs immediately.When it passes “Another Arm? Yes”, event detection occurs when the programmed timer interval is full. If it passes” Another Arm? No”, the Timer resets allowing event detection to again occur immediately.

Manual: Used for manual TRIG. After selecting this option, TRIG M will be displayed on the measurement interface, and when

Output is turned ON, manually press the F5 (TRIG) key once, the event detection will be triggered to run once.

Tlink: When an input trigger is received through the Trigger Link input line, event detection occurs.When selecting Tlink, you can bypass the Arm Event Detector by selecting the Bypass option to ONCE.

Rising edge: Event detection occurs when the SOT line of the Digital I/O port is pulsed high. This pulse comes from an external component and is used to start limit test.

Falling edge: Event detection occurs when the SOT line of the Digital I/O port is pulsed low. This pulse comes from an external component and is used to start limit test.

Edge: Event detection occurs when the SOT line of the Digital I/O port is pulsed low or high. This pulse comes from an external component and is used to start limit test.

Timer — Used to set the Timer interval when the Source option is set to Timer mode, the timing unit is second.

Tlink line — This option needs to be set only when the Source option is selected as Tlink, which is used to set the required line (#1, #2, #3, or #4) of input trigger signal. Line 2 is the output line by default, and line 1 is the input line by default.

Bypass — Event detector bypass is valid when the Source option is set to Tlink, Rising edge, Falling edge and Edge. There are two options:

Never: Indicates to wait for an input trigger before performing the operation.

Once: Indicates that the operation bypasses the Arm event detector and directly enters the trigger layer.

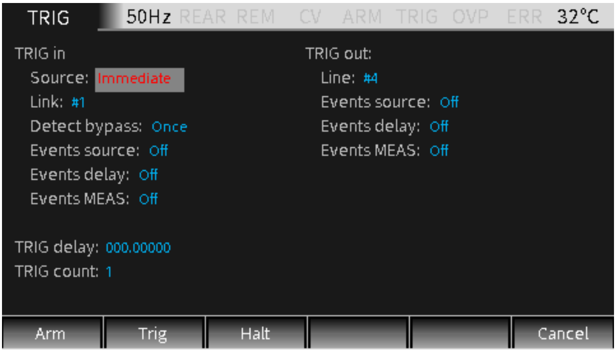
NOTE: The F5 (TRIG) key in the main interface has the highest priority. An event will be triggered as long as you press this key.

ARM count

Mode	Two options of Finite and Infinite are available. **Finite:** Indicates that the number of the ARM count is a certain value. **Infinite:** Indicates that the number of the ARM count is unlimited.
Value	When Finite is selected, set the sepecified number.

ARM out

Line	To select the Tlink line (#1, #2, #3, or #4) to output the trigger signal.
Tlink exit	Can be set to On or Off. **On:** Indicates that an output trigger signal is allowed when exitting the Trigger layer to the Arm layer. **Off:** Indicates that an output trigger signal is prohibited when exitting the Trigger layer to the Armlayer.
Tlink enter	Can be set to On or Off. **On:** Indicates that an output trigger signal is allowed when entering the Trigger layer. **Off:** Indicates that an output trigger signal is prohibited when entering the Trigger layer.
Trigger Layer	Press the F2 (Trig) key to select the Trigger layer of the trigger mode, and set the options in TRIG in, TRIG delay and TRIG out. As shown below:



TRIG in

Source

Select the trigger source of the Trigger layer, which can be set as Immediate or Trigger link.

Immediate: Indicates that the event is triggered immediately. When this option is selected, source event detector, delay event detector and measure event detector will run immediately. The Trigger layer executes the source, delay, and measurement actions in sequence.

Trigger link: If you select this option, you need to set these 5 items of Link/Detect bypass/ Events source /Events delay/ Events MEAS.

Link

To select the input line of the trigger signal, one of the 4 lines (#1, #2, #3, #4) can be selected.

Detect bypass

Used to set whether to bypass the source event detector, you can choose Once or Never.

Once: Indicates that the operation will bypass the event detector.

Never: Indicates that the event detector needs to wait for an input trigger signal before performing subsequent operations.

Events source

Enable (On) or disable (Off) trigger-in source.

On: Indicate that operation will wait at that event for

	an input source trigger. **Off:** Indicate that operation will not wait and it will continue to perform the subsequent operations.
Events delay	Enable (On) or disable (Off) trigger-in delay. **On:** Indicate that operation will wait at that event for an input delay trigger. **Off:** Indicate that operation will not wait and it will continue to perform the subsequent operations.
Events MEAS	Enable (On) or disable (Off) trigger-in MEAS. **On:** Indicate that operation will wait at that event for an input MEAS trigger. **Off:** Indicate that operation will not wait and it will continue to perform the subsequent operations.
TRIG out	
Line	To select the Tlink line (#1, #2, #3 or #4) that outputs the trigger signal.
Events source	It is used to enable (On) or disable (Off) the output triggers after the source operations.
Events delay	It is used to enable (On) or disable (Off) the output triggers after the delay operations.
Events MEAS	It is used to enable (On) or disable (Off) the output triggers after the measure operations.
TRIG delay	Set the delay time for the trigger delay, the default unit is seconds.
TRIG count	Set the number of trigger times.

NOTE: TRIG count and the number of sequence points should be the same, or TRIG count should be multiples of the number of sequence points. For example, when sequence points is set to 5, and the TRIG count is set to 10, the sequence will run twice.

HALT

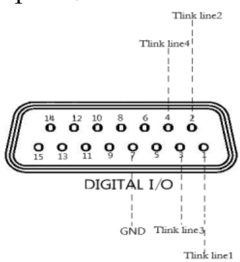
Description Press F3 (HALT) key to return the GSM to idle state, it does not turn off Output, and the programmed source will still be output. The following three operations can make the GSM out of the idle state.

- Turn off Output first, then turn on Output.
- Reselect the Arm in event or Trigger in event.
- Return from the TRIG setting menu, and then long press the F5 (TRIG) key to enter the TRIG setting menu.

Interface Requirements

Pin definition When the TRIG function is enabled, it is associated with the corresponding I/O ports, described as below.

line1 - line4: As the input trigger signal and output trigger signal line of the Arm layer and the Trigger layer.
line5: +3.3V
line6: Idle line
line7: GND



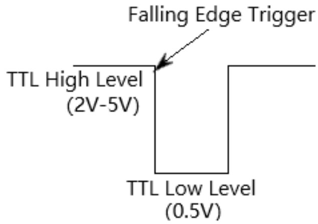
NOTE: The factory default line1 is the input trigger signal line, and line2 is the output trigger signal line. These input and output lines can be

changed in the Arm and Trig setting interface.

Instructions

- line1-line4 input trigger requirements

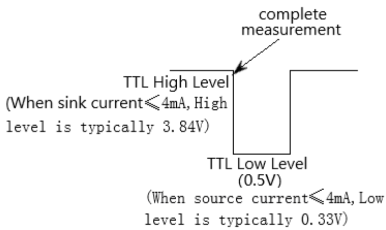
The input trigger is used to trigger the event detector of the Arm layer or the Trigger layer of the trigger model.



Input trigger is falling edge trigger, TTL compatible pulse level.

- line1-line4 output trigger specifications

The GSM can be set to output trigger signals after multiple trigger actions.



Output trigger provides a TTL compatible pulse level that can be used to trigger other peripherals.

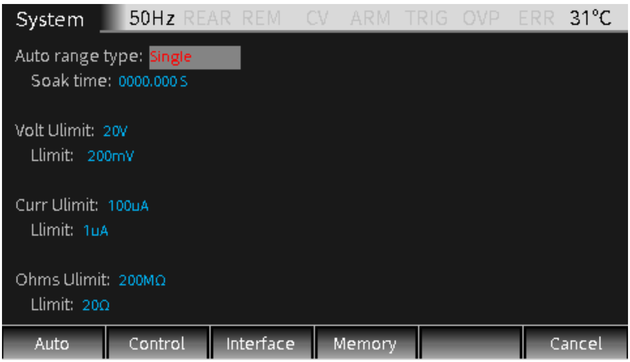
SYSTEM SETTINGS

This chapter mainly includes system parameter settings and software upgrading, such as power-on status/IO port/output status/remote interface/system time and other settings.

Range Limitation

Click F6 (System) key on the main interface to enter the System setting interface. It has four submenus: Auto, Control, Interface, and Memory.

Auto



Auto range type

There are two options, Single and Multiple, which determine the way the GSM automatically obtains the range.

Single: Indicates that the GSM will auto acquire the range only after reading a value for the first time.

Multiple: Indicates that the GSM will auto range up on the Cmpl value during the Delay phase of the SDM cycle to minimize the possibility that the GSM will be in compliance.As long as the GSM taking a measurement reading, it can perform a downrange action.

Soak time: Soak time needs to be set only when Auto range type is set as Multiple. It is used to set the total time after the first point of a sequence that the GSM will sit in a loop actively auto up and down the range during the first SDM cycle after the initial sequence trigger. This is useful for situations with long DUT settling time(such as measuring low current) that requires several downrange cycles from higher ranges.

Setting range: 0 seconds to 9999.999 seconds.

Volt limit	**Ulimit:** voltage upper limit is determined by the compliance value set on the present Source interface. **Llimit:** The lower limit of voltage is set to a voltage value that is not greater than the upper limit of voltage.
Curr limit	**Ulimit:** The upper limit is determined by the compliance value set on the present Source interface. **Llimit:** The lower limit of current is set to a current value that is not greater than the upper limit of current.
Ohms Ulimit	**Ulimit: The upper limit of the Ohms can be set manually.** **Llimit: The lower limit value of the Ohms is set to a value not greater than the upper limit**

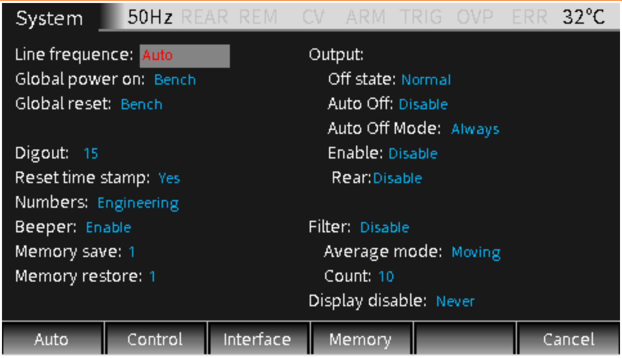
value.

NOTE:

1. **For the three measurement functions of V, I and Ohms, if the programmed Llimit and Ulimit are equal, the Auto range function will be disabled accordingly and you can manually change to a range lower than Llimit(V, I or Ohms) or a range higher than Ulimit (Ohms only).**
2. **Only in Auto range mode, Ulimit and Llimit will be evaluated. If the GSM is already on a range higher than the Ulimit or lower than the Llimit, the range will no change. The Ulimit will be evaluated only when the GSM has to uprange. If it has already on a range higher than the present Ulimit, it will auto downrange and can still take a measurement reading on a range higher than the Ulimit. If it has already on a range lower than the present Llimit, it will auto uprange and can take a measurement reading on a range lower than the Ulimit. The Ulimit and Llimit are effect only when Autoranging is turned on, but the limit will not be evaluated unless the GSM has to take Autorange actions.**

System Parameters

Control



Line frequence Set the power line frequency according to the frequence of the power supply. It can be set as Auto, 50Hz or 60Hz. When setting to Auto, the GSM will detect the power line frequency and set it automatically when power on. When there is a lot of interference on the power line, you can manually set the frequence to avoid the wrong frequence of automatic detection that will affect the measurement result.

Global power on It is used to define whether the power-on setup is to use factory settings (users cannot modify) or custom settings.

The factory settings is Bench and GPIB.

Custom settings include five memory configuration methods of Save0, Save1, Save2, Save3, Save4.

Global reset Used to select Bench or GPIB to return factory settings.

Digout It is used to set the high or low level of the four digital I/O lines. The corresponding decimal values are as follows, for details on setting the Digout bit, see page 117.

Digout bit	3	decimal range	0-7
Digout bit	4	decimal range	0-15

Digout bit	16	decimal range	0-65535

Reset time stamp	Used to reset the time stamp when exiting the idle state. There are two options, Yes or No. **Yes:** In the trigger mode, when exiting the idle mode, the time stamp is allowed to be reset automatically. **No:** In the trigger mode, when exiting the idle mode, the time stamp is not allowed to be reset automatically.
Numbers	Used to select Engineering units or scientific notation to display the measurement reading. The measurement reading can be fixed or floating-point format.
Beeper	Used to select Enable or Disable touch-tone, the factory default is Enable. For Beeper application, please refer to the instructions on page 322.
Memory save	Used for source memory sequence setup configurations. Up to 100 setups can be stored. Enter the number (1-100) in the option box and press Enter to save the present setup in the corresponding location in the memory. The stored setups can be recalled directly (operate by Memory restore) or recall multiple setups continuously (see the SRC-MEM chapter on page 126 for details)
Memory restore	It is used to recall the setups in the memory. Up to 100 setups can be recalled. Enter the number (1-100) in the option box and press Enter to recall the setup information stored in the corresponding location in the memory to the Source interface.
Output	There are several parameters related with Output required to be set here: Off state, Auto off, Enable, Front/Rear Output. **Off state**: Used to select the off state of the Output terminal. There are four options: High impedance, Normal, Zero and Guard.

High impedance: In this Output-off state, when the Output is turned off, the output relay will open, disconnecting the Input/Output terminal from the external circuit. In order to prevent excessive loss of output relay, this output-ff state is not used for tests that require output off and on frequently.

NOTE: The High impedance Output-off function can only be executed when the Auto-off function is enabled.

Normal: When in the relatively high impedance Output-off state, the V-Source is selected and set to 0V, and the current compliance value is set to 0.5% full scale of the present measure curr-range. Theoretically, when the V-Source is set to 0V, the GSM does not output voltage. In fact, the voltage value is not an accurate zero value. Therefore, the GSM can still output a tiny voltage. In most cases, the voltage is very small.

Zero: When in this Output-off state, ZER will be displayed (instead of OFF), and the GSM will be set according to the following steps.

When selected as V-Source:

- The programmed V-Source value remains displayed.
- Internally, the V-Source is set to 0V.
- The current compliance value setting remains the same as the output-on value, and the Real and range compliance detection functions remain valid.
- Measurements are still performed and displayed.

When selected as I-Source:

- The programmed I-Source value remains displayed.
- Internally, select as V-Source and set the voltage to 0V.
- The current compliance is set to the larger value between the programmed I-Source value and 0.5% full scale of the present measure curr-range.
- Measurements are still performed and displayed.

When the GSM is in the Zero Output-off state, it can be used as an amperemeter.

The Zero Output-off state can also be used to make the V-Source and the Output Auto-off function together generating quick pulsed voltage waveforms. For example, when the Output Auto off option is enabled, pulses from 0 to +5V can be generated. When in the relatively low-impedance output-off state, the GSM can quickly sink current generated by high input capacitance (such as cable capacitance) or an external source. This results in fast settling time. If instead using Normal Output-off state in this situation, GSM will sink current very slowly (slow settling time) which results in distorted pulses.

WARNING: When selecting Zero and Auto off option to generate quick pulsed waveforms, dangerous voltage (>30V rms) can appear on the Input/Output LO terminal. To eliminate the risk of electric shock, connect the LO terminal to the earth ground. When using the front panel, connect the LO terminal of the front panel to the ground.

When using the rear panel, connect the LO of the rear panel to the ground. The ground can be selected from the ground screw on the rear panel or other safety ground.

Guard: In the Guard Output-off state, I-Source is selected and set the output current to 0A. The voltage compliance value is set to 0.5% full scale of the present measure volt-range. When making 6-wire guard ohms measurement or for other loads that use power, you should select the GUARD Output-off state.

⚠ **NOTE:**

1. **When using Off state option to change the output-off state, it will immediately change to the selected state.**
2. **When power on, the GSM will instantly enter the HIGH IMPEDANCE output-off state, and then enter the default Normal Off state.**
3. **If an overheating condition or interference on the OE line occurs, the GSM will enter the HIGH IMPEDANCE output-off state.**

Output off state and inductive load: The type of output-off state selected when the inductive load is loaded depends on the power of the inductive load itself. NORMAL output-off state reduces the compliance value setting and is not suitable for inductive loads. ZERO or GUARD is more suitable. The ZERO output-off state does not change the compliance value setting. The GUARD output-off state changes the voltage source to a current source and sets the voltage compliance value at the same time. GUARD output-off state is mainly used for guarded ohms measurement. In order to prevent the GSM from being damaged by the inductive load, this application needs to connect a spark discharge tube between INPUT HI and LO.

Auto off: Used to Enable or Disable "output automatic off" function.

Enable: Output will be turned off after the end of the measurement phase of each SDM cycle. Output will be turned on again at the beginning of the next SDM cycle.

Disable: Output remains on as long as the GSM operates in the trigger mode (the ARM symbol is displayed).

NOTE: In the case of Enable, pressing the Output key will turn off the Auto off function (it becomes the Disable state).

Enable: Enable or Disable the output enable function (/OE line). Enable or Disable Output when the GSM is connected to the DUT or test fixture equipped with a switch controlled by lid. For details, see External I/O port operation on page 117 of the Limit chapter.

Enable: Turn on the output enable function. The output of the GSM is controlled by the input signal of /OE line.

Disable: Turn off the output enable function.

Rear: Used to select the rear-panel output.

Enable: Input/Output is performed from the rear panel.

Disable: Input/Output is performed from the front panel.

Filter

Used to turn on (Enable) or turn off (Disable) the output filter.

Average mode: When Filter is set as Enable, you need to set this option. It is used to select the method how the filter handles the measurement readings with interference. There are two Average methods: Moving and Repeat:

Moving: Use the first-in first-out method. When the stack is full, take the average of the measured value, which is the measurement reading in the display area. For each subsequent measured value put into the stack, taking the new average value as the measurement reading.

Repeat: When this option is selected, you need to wait until the stack is full, then average the measured value in the stack before clear these value, then take the average value after the stack is full next time, and repeat this process.

Count: Used to set the amount of stack value involved in the average calculation, from 1 to 100 data amounts can be set.

NOTE:

1. **The default filter mode is Repeat on power up.**
2. **The filtering method and the amount of stack value will affect the accuracy of the measurement reading. The Moving method is much faster than the Repeat method, because the Moving method does not need to take the measurement reading once to clear the stack and repeat this process. In addition, the readback rate decreases as the amount of stack values increases.**
3. **When the Filter is enabled for the first time, the stack is empty, and the average operation is performed when the stack is full. If the Moving method is selected, when the first measured value is put into the stack, the value will be copied to fill up the stack and then take the**

average value of these values. The average value is actually the first measured value, which may not be the correct measurement reading. Therefore, it is not recommended to choose the Moving method.

4. **The programmed filter method is valid for all measurement functions.**

Display disable	It is used to select the front panel display to be disabled in the following situations. When the front panel display is disabled, the prompt interface as shown in the figure below will appear:

Now: Indicates that the front panel display is disabled immediately.

Never: Indicates that the front panel display is never disabled.

Sequence: Indicates that the front panel display is disabled when sequence is running. When the sequence starts running, the front panel display is immediately disabled and it will be automatically enabled when the sequence completes.

Store: Indicates when the number of storage which is used to store source-measurement readings in the buffer is set (Store time stamp), the front panel display will be disabled immediately. When the buffer is enabled, the front panel display will be disabled and it will be re-enabled after the storage is complete. NOTE that when you select this option, the display will be disabled when sequence is running, the source-measurement readings of the sequence will be automatically stored in the buffer.

Save/Recall

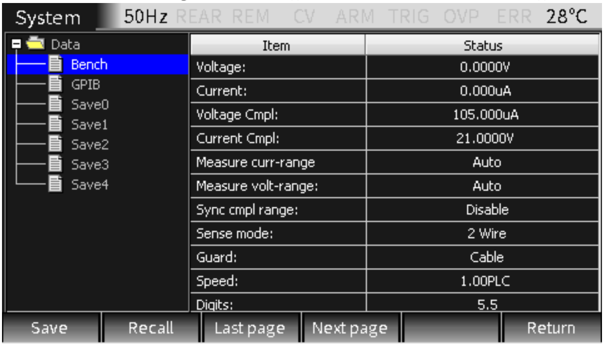
Description

There are 5 sets of system parameters available for users to program, named SAV0, SAV1, SAV2, SAV3, SAV4.

The system has 7 groups of setups that can be recalled which are Bench, GPIB, SAV0, SAV1, SAV2, SAV3, SAV4 reapectively.

Parameter

The setups of each group have the following contents (taking the setups of Bench for example):



Operation

Press F6 (System) -> F4 (Memory) in turn to enter the memory setting interface shown in the figure above.

Save	Use the derection keys to move the cursor to SAV0, SAV1, SAV2, SAV3 or SAV4. Click the Save key and a save prompt box will appear, just select "OK", if you don't want to save, select "Cancel" to exit.
Recall	Use the derection keys to move the cursor to Bench, GPIB, SAV0, SAV1, SAV2, SAV3 or SAV4. Click the Recall key and a reminder box for recall will appear. Just select "OK". If you don't want to recall, select "Cancel" to exit.
Last page	Used to view the settings of the last page, 11 items will jump every time you turn the

		page.
	Next page	Used to view the settings of the next page, 11 items will jump every time you turn the page.
Power on settings	In the System setting interface, there is a Global power on option, which can define the power on settings.	

Factory Settings

Decription	There are two ways to restore the factory default settings: Bench (front panel operation) and GPIB (remote operation).
Operation	On the main interface, click F6 (System), then F2 (Control), operate the derection keys to make the cursor jump to the Global reset option box, select Bench or GPIB, and press Enter after selecting.

Bench factory default settings

OPTIONS	VALUE
Voltage:	0.0000V
Current:	0.000uA
Voltage Cmpl:	105.000uA
Current Cmpl:	21.0000V
Measure cur-range:	Auto
Measure volt-range:	Auto
Sync cmpl range:	Disable
Sense mode:	2 Wire
Guard:	Cable
Speed:	1.00PLC
Digits:	5.5
Relative:	Disable
value:	+0.000000
Line frequency:	No effect
Beeper:	Enable
Digital output:	15
FCTN:	Power
Filter:	Disable
Averaging type:	Repeat

Count:	10
GPIB address:	No effect
Limit tests:	
Digout:	
Size:	4bit
Mode:	Grading
Binning control:	Immediate
Auto clear:	Disable
Delay:	0.00001s
Clear Pattern:	15
H/W Limit:	
Control:	Disable
Fail mode:	In
Cmpl pattern:	15
S/W limits:	
Lim 2:	
Control:	Disable
Low limit:	-1.000000
Low pattern:	15
High Limit:	+1.000000
High pattern:	15
Lim 3:	
Control:	Disable
Low limit:	-1.000000
Low pattern:	15
High limit:	+1.000000
High pettern:	15
Lim 5:	
Control:	Disable
Low limit:	-1.000000
Low pattern:	15
High limit:	+1.000000
High pettern:	15
Lim 6:	
Control:	Disable
Low limit:	-1.000000
Low pattern:	15
High limit:	+1.000000
High pettern:	15
Lim 7:	
Control:	Disable
Low limit:	-1.000000
Low pattern:	15

High limit:	+1.000000
High pettern:	15
Lim 8	
Control:	Disable
Low limit:	-1.000000
Low pattern:	15
High limit:	+1.000000
High pettern:	15
Lim 9	
Control:	Disable
Low limit:	-1.000000
Low pattern:	15
High limit:	+1.000000
High pettern:	15
Lim10:	
Control:	Disable
Low limit:	-1.000000
Low pattern:	15
High limit:	+1.000000
High pettern:	15
Lim 11:	
Control:	Disable
Low limit:	-1.000000
Low pattern:	15
High limit:	+1.000000
High pettern:	15
Lim 12:	
Control:	Disable
Low limit:	-1.000000
Low pattern:	15
High limit:	+1.000000
High pettern:	15
Pass:	
Pass pattern:	15
Source memory:	Next
Location:	
EOT mode:	EOT
Numbers:	No effect
Ohms source mode:	Auto
Offset compemsated ohms:	Disable
Output:	off
Output enable:	Disable
Off state:	Normal

Auto-off:	Disable
Power-on default:	No effect
Measure ohms range:	AUTO
RS-232:	No effect
Source delay:	0.00300s
Auto-delay:	Enable
Sweep:	Stair
Voltage start:	+0.000V
Voltage stop:	+0.000V
Voltage step:	+0.000V
Current start:	+0.00000A
Current stop:	+0.00000A
Current step:	+0.00000A
Sweep count:	1
Sweep Pts:	2500
Source ranging	Best fixed
Abort on compliance:	Never
Voltage protection:	NONE
Triggered voltage:	
Control:	Disable
Scale factor:	+1.0000
Triggered current:	
Control:	Disable
Scale factor:	+1.0000
Triggering:	
Arm layer:	
Event:	Immediate
Count:	1
Output out TL exit:	Off
Output out TL enter:	Off
Trigger layer:	
Event:	Immediate
Count:	1
Output events source:	Off
Output events delay:	Off
Output events MEAS:	Off
Delay:	0.00000s

The GPIB factory default settings include the same content in the table above, as well as the setting information in the table below.

OPTIONS	VALUE
Name0:	POWER

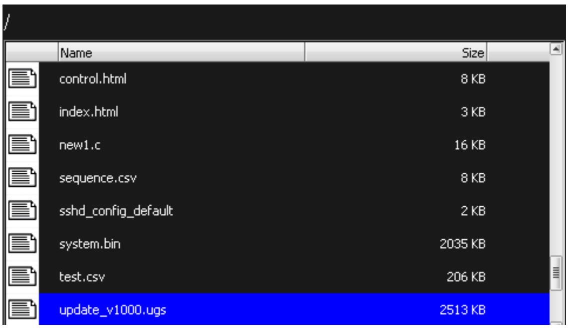
Name1:	OFFCOMPOHM
Name2:	VOLTCOEF
Name3:	VARALPHA
Name4:	
Name5:	
Name6:	
Name7:	
Name8:	
Name9:	
CALCulate2:FEED:	VOLTage
CALCulate3:FORMat:	MEAN
DISPlay subsystem Enable:	ON
Format subsystem:	
Data FORMat	ASCii
SOURce2	ASCii
ELEMents list	VOLT,CURR,RES,TIME,STAT
CALCulate	CALC
BORDer	NORMal
SREGister	ASCii
SENSe1 subsystem:	
CONCurrent	ON
FUNCtion[ON]	CURR
SOURce subsystem:	
SWEep DIRection	UP
SOURce2	
SOURce2 TTL4 MODE	EOTest
SOURce2 TTL4 BSTate	0
System:	
TIME RESet AUTO	OFF
TRACe subsystem:	
FEED	SENSe[1]
FEED CONTrol	NEVer
TSTamp FORMat	ABSolute

Software Upgrade

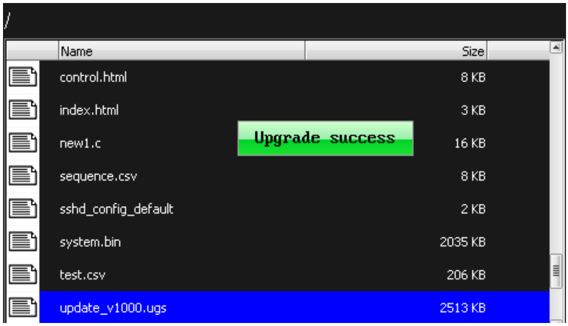
Description	Used to upgrade the system software in order to improve or improve the performance of the machine.	
Conditions	The system is malfunctioning;	
	At the request of the customer or GW INSTEK.	
Required for upgrade	Software file	Provided by GW INSTEK.
	Mobile disk	USB2.0/USB3.0，FAT file system

Operations

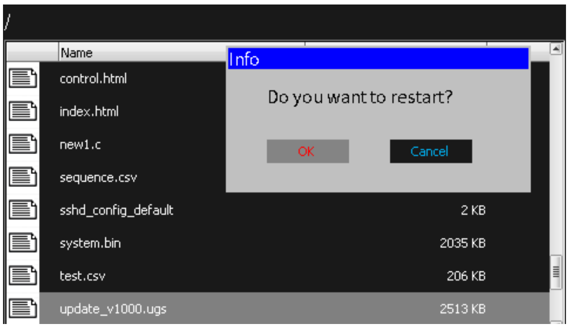
- Plug in the Mobile disk, and a successful connection prompt window will appear.
- Long press F6 (System) on the main interface to enter the Upgrade setting interface, press F3 (Upgrade), the Mobile disk will automatically open.



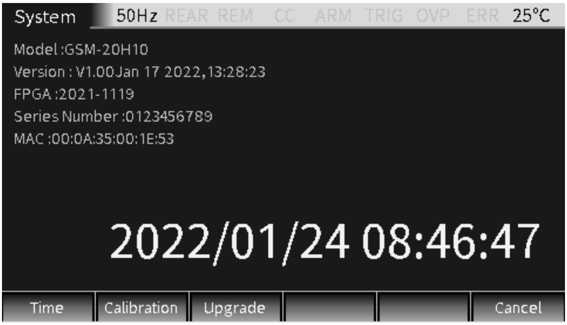
- Press the up and down derection keys to select the upgrade file update_v1000.ugs, press Enter, and the upgrade progress bar appears.



- After the upgrading is complete, the following dialog box will pop up, select whether to restart GSM immediately. If you select OK, you will restart to update the software immediately. If you select Cancel, it means you will not update the software temporarily, and the software will be updated automatically the next time you turn the unit on.

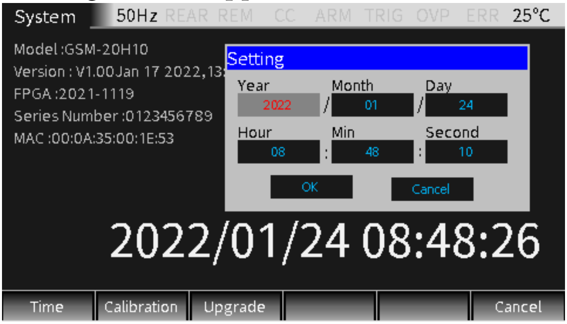


- After power on, press and hold F6 (System) again to view the Version information and confirm whether the upgrading is successful.


System
50Hz REAR REM CC ARM TRIG OVP ERR 25°C
Model :GSM-20H10
Version : V1.00Jan 17 2022,13:28:23
FPGA :2021-1119
Series Number :0123456789
MAC :00:0A:35:00:1E:53
2022/01/24 08:46:47
Time
Calibration
Upgrade
Cancel

System Clock

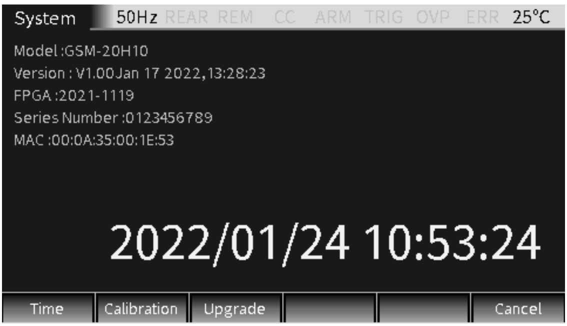
Description	Real-time clock setting for display
Operation	Long press F6 (System) on the main interface to enter the System setting interface, press F1 (Time) and the clock setting window appears.



Settings

Press the derection keys to select the parameters such as year, month, day, hour, minute and second to set;

After setting all the time parameters, move the cursor to the OK box and press Enter to end the setting; at this time, the programmed date and time will be displayed on the LCD.



Press F6 (Cancel) to return to the main interface.

Mobile Disk Usage

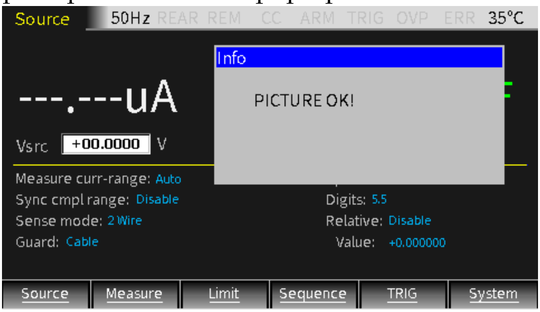
Description Mainly used for software upgrade and file export.

For software upgrade details, see Software Upgrade on page 165;

File export is mainly used for screenshots and copy of .CSV file of the sequence.

Operation Insert the mobile disk into the USB Host interface on the front panel.

Screenshot operation After inserting the mobile disk, operate the interface to which you want to export, long press the C/Pict key. If the mobile disk is recognized, a screenshot success prompt window will pop up:



If the mobile disk is not recognized, a "NO USB Find" prompt window will pop up:

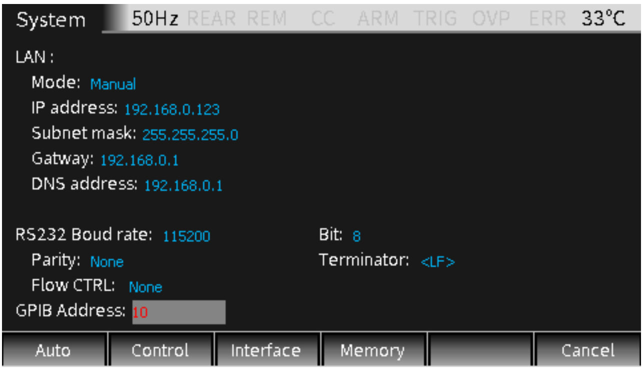
The default location of the screenshot pictures are in the image folder of the mobile disk.

REMOTE CONTROL

Setting Interface

Description GSM has 4 remote communication interfaces which are USB, LAN, RS232 and GPIB. These four communication modes can be used simultaneously.

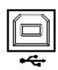
Interface Click F6 (System) to enter the System setting interface, and press F3 (Interface) to set the remote communication mode.



USB

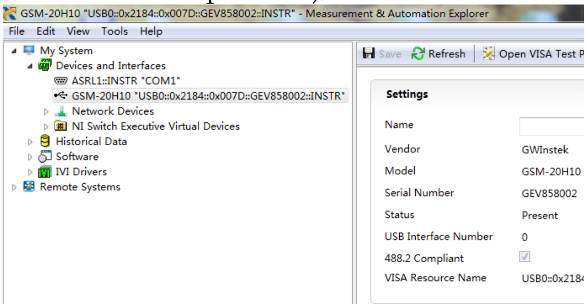
Description Communication via USB interface, using USB Device TMC mode.

Interface USB slave interface on the rear panel

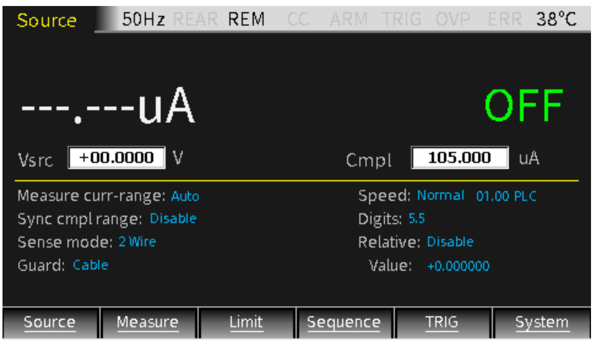


Connection and operation

To use USB communication, you need to use the "NI Visa" software of NI (National Instruments Corporation);

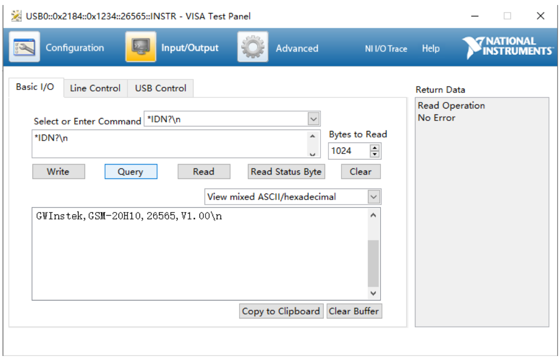


After connecting to the host computer through the USB slave interface on the rear panel, open the "NI Visa" software, as shown in the figure above, select View -> Refresh in the menu bar of Measurement & Automation Explorer, when the connection is successful, click on the drop-down arrow of "Devices and Interfaces" in “My System” menu , the serial number of GSM and the USB Interface number will be displayed on the right side of the page, the status bar will display REM with the front panel operation locked automatically.



Function Measurement

Click the "Open VISA Test Panel" key on the page to pop up the VISA Test Panel, click the Input/Output key in the VISA Test Panel, in the Select or Enter Command box, you can execute all statements including query, setting, measurement, reading and etc. When requiring to query, enter the corresponding query Command and then click the "Query" key to run the Command. Enter the corresponding Command when requiring to operate setting and measurement action and then click the "Write" key. Enter the corresponding Command when requiring to operate reading action and then click the "Read" key. Refer to page 188 for Command List.



Enter the query Command "*IDN?" as shown above, and the instrument identification information such as manufacturer, model, serial number and software version will be returned. The message "Read Operation No Error" is displayed in the Return Data window.

Exit remote control mode

. Send exit Command from PC.

. Long press the Edit/Lock key on the front panel.

NOTE: USB is a hot-swap device, which can be disconnected or connected at any time.

RS-232

Description

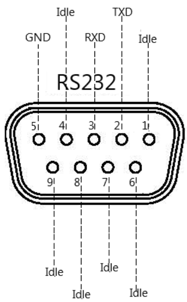
Communication via RS-232 interface

Interface

RS-232 interface on the rear panel

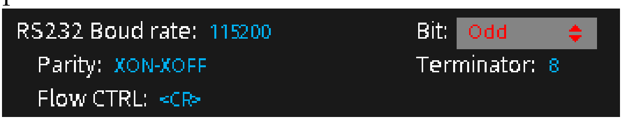
Port definition

1. Idle
2. Transmit data
3. Receive data
4. Idle
5. GND
6. Idle
7. Idle
8. Idle
9. Idle



Parameters setting

The RS-232 interface has 8 data bits, 1 stop bit, and no priority. The following RS232 communication parameters need to be set.

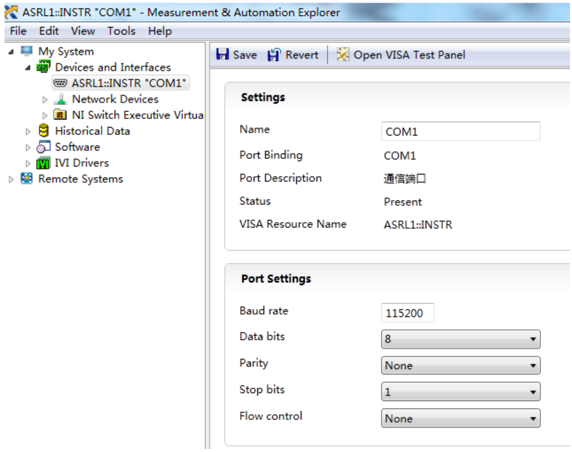


NOTE: The RS-232 interface of the GSM is connected to the serial port of PC using a straight-through RS-232 cable terminated with DB-9 connectors. Do not use a null modem cable.

Baud rate	Refers to the communication rate between the GSM and the PC. You can choose from nine baud rates of 300, 600, 1200, 4800, 9600, 19200, 38400, 57600, and 115200. The default is 115200. The baud rate set on PC should be the same as the baud rate set on the GSM.
Bit	Set the data sent or received as 6bits, 7bits or 8bits.
Parity	Used to select the parity mode as even, odd or None.
Terminator	It is used to select the way to terminate the Command, there are four ways: <CR>, <CR+LF>, <CR>, <LF+CR>.
Flow CTRL	Used to select software flow control mode, there are two modes: XON-XOFF and None. XON-XOFF: Indicates that XON-XOFF flow control mode is enabled, and flow control is performed in the form of XON and XOFF characters. When the amount of data in the input queue of the GSM exceeds the setup high value, an XOFF Command is issued, and the control program responds to the XOFF Command and stops sending data to the GSM. When the amount of data in the input queue of the GSM is less than half, the GSM will issue an XON Command, and the control program restarts sending data. When the GSM is used to send data, it can also identify the XON and XOFF Commands issued from the controller. The input Commands are executed after receiving the Terminator Command sent by the controller.

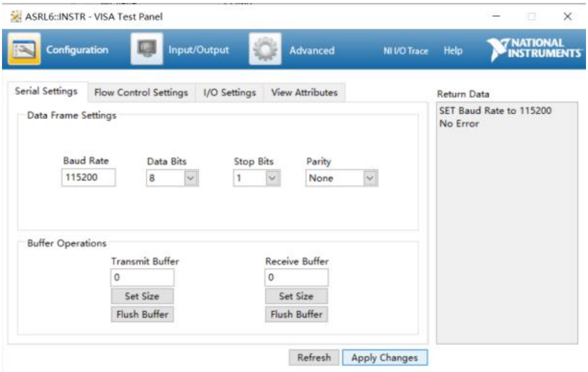
Connection

To use RS-232 communication mode, you need to use the "NI Visa" software of NI (National Instruments Corporation);



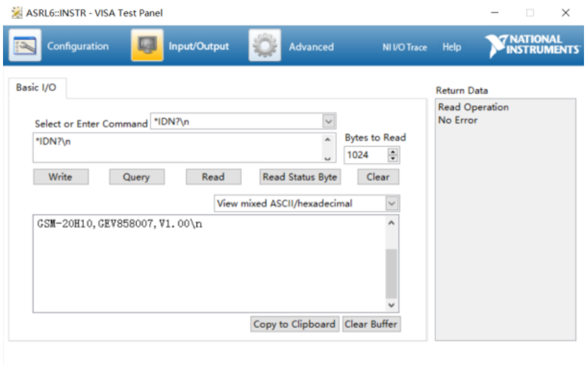
After connecting to the host PC through the RS-232 interface on the rear panel, open the "NI Visa" software, as shown in the figure above, select View -> Refresh in the menu bar of Measurement & Automation Explorer, when the connection is successful, click on the drop-down arrow of "Devices and Interfaces" in “My System” menu will display the connected COM port, The right side of the page is divided into two parts: "Settings" and "Port Settings". The Settings part displays the connected COM port, the Port Settings part displays the RS232 setting information of the GSM. The status bar will display REM with the front panel operation locked automatically.

Click the "Open VISA Test Panel" key to pop up the VISA Test Panel, fill in the baud rate consistent with the Baud Rate of GSM, and finally click Apply Changes, and the Return Data box on the right will display the information that the baud rate setting is sucessful.



Command input

Click the Input/Output key in the VISA Test Panel, in the Select or Enter Command box, you can execute all statements including query, setting, measurement, reading and etc. When requiring to query, enter the corresponding query Command and then click the "Query" key to run the Command. Enter the corresponding Command when requiring to operate setting and measurement action and then click the "Write" key. Enter the corresponding Command when requiring to operate reading action and then click the "Read" key. Refer to page 188 for Command List.



Enter the query Command "*IDN?" as shown above, and the instrument identification information such as manufacturer, model, serial number and software version will be returned. The message "Read Operation No Error" is displayed in the Return Data window.

Exit remote control mode

. Send exit Command from PC

. Long press the Edit/Lock key on the front panel

WARNING: RS-232 is a non Hot Swap device, please disconnect and exit after power off.

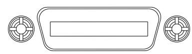
GPIB

Description

When using the GPIB interface, setting the communication address (GPIB Address) on the GSM.

Interface

GPIB slave interface on the rear panel

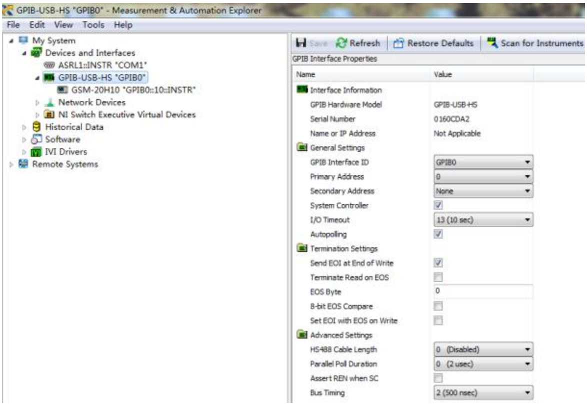


Parameter Settings

The default GPIB Address of the GSM is 10, and the address will be displayed immediately after power on. The address can be changed to a value between 0 and 30, but the same address cannot be assigned to another device or controller on the bus. The address of the controller is usually 0 or 21.

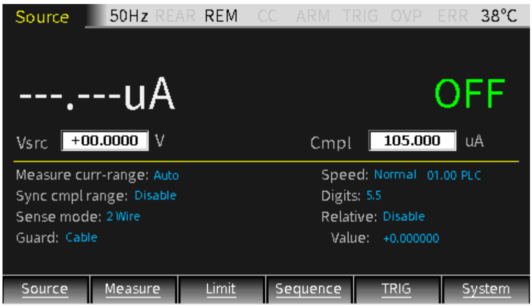
Connection

To use GPIB communication mode, you need to use the "NI Visa" software of NI (National Instruments Corporation); After connecting to the host PC through the GPIB interface on the rear panel, open the "NI Visa" software, as shown in the figure below, select View -> Refresh in the menu bar of Measurement & Automation Explorer, when the connection is successful, click on the drop-down arrow of "Devices and Interfaces" in “My System” menu , the GPIB setup informations will be displayed on the right side of the page.



Click “Scan for Instruments” key to display the connected instrument information.

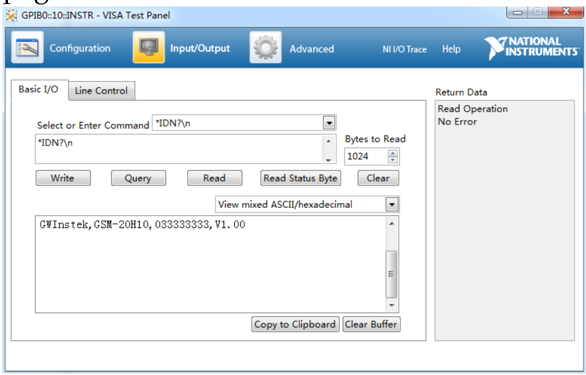
The status bar will display REM with the front panel operation locked automatically.



Click the submenu "Instrument 0" of GPIB0 (GPIB-USB-HS), and then click "Communicate with Instrument", the VISA Test Panel will be shown.

Command input

VISA Test Panel can execute all statements including query, setting, measurement, reading and etc. When requiring to query, enter the corresponding query Command and then click the "Query" key to run the Command. Enter the corresponding Command when requiring to operate setting and measurement action and then click the "Write" key. Enter the corresponding Command when requiring to operate reading action and then click the "Read" key. Refer to page 188 for Command List.



Enter the query Command "*IDN?" as shown above, and the instrument identification information such as manufacturer, model, serial number and software version will be returned.

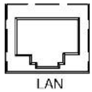
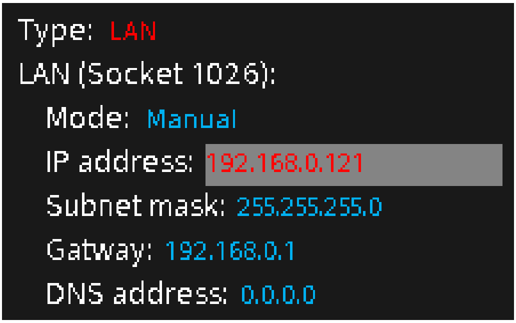
Exit remote control mode

. Send exit Command from PC

. Long press the Edit/Lock key on the front panel

WARNING: GPIB is a hot-swap device, which can be disconnected or connected at any time.

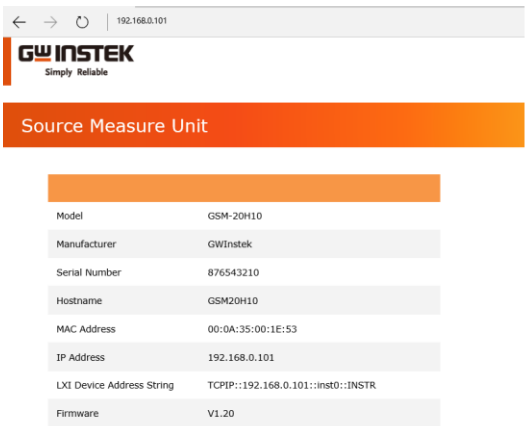
LAN

Description	When using the LAN interface, set the relevant parameters on the front panel.
Interface	LAN interface on the rear panel 
Parameter settings	
Parameter description	Mode： Choose DHCP (obtain IP address automatically) or Manual (set IP address manually); IP Address: ranging from 1.0.0.0 to 223.255.255.255; (excluding 127.nnn.nnn.nnn); Subnet Mask: ranging from 1.0.0.0 to 255.255.255.255; Gateway: ranging from 1.0.0.0 to 223.255.255.255 (excluding 127.nnn.nnn.nnn); DNS Servers: ranging from 1.0.0.0 to 223.255.255.255 (excluding 127.nnn.nnn.nnn).

PC operation

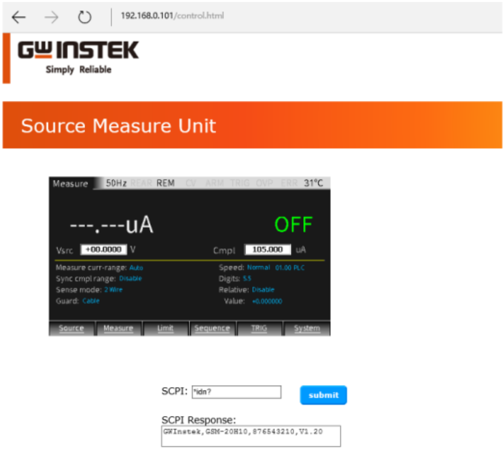
After obtaining the IP address of the GSM, enter the address in the IE browser to enter the gateway interface shown in the figure below, which displays the relevant information and settings of the instrument, including three interfaces of HOME (homepage), WEB CONTROL (network control) and WEB CONFIG (Network settings).

1，Click the "HOME" key to display the instrument Model name, Manufacturer, Serial number, IP address, Software version and other information.

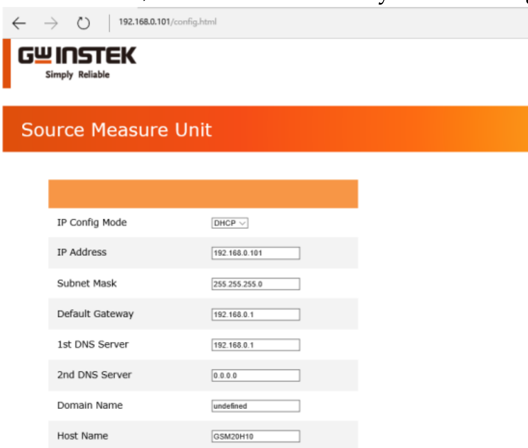


Model	GSM-20H10
Manufacturer	GWInstek
Serial Number	876543210
Hostname	GSM20H10
MAC Address	00:0A:35:00:1E:53
IP Address	192.168.0.101
LXI Device Address String	TCPIP::192.168.0.101::inst0::INSTR
Firmware	V1.20

2、Click the "WEB CONTROL" to enter the network control interface, as shown in the figure below. Through the SCPI Command box, you can execute all Commands such as querying, setting information, measurment, and reading information. For example, input the “*IDN?” query Command in the SCPI Command box, and then click the submit key, the instrument identification information: model, serial number and software version will be returned in the SCPI Response box. At this time, the status bar will display REM with the front panel operation locked automatically.



3、Click the "WEB CONFIG" to enter the web page setting interface, as shown in the figure below. You can set the LAN port configuration information, click the submit key after setting.



Exit remote control mode	. Send exit Command from PC . Long press the Edit/Lock key on the front panel ⚠ **WARNING: LAN is a hot-swap device, which can be disconnected or connected at any time.**

COMMAND SYNTAX

The Commands that are used with the GSM-20H10 meet IEEE488.2 and SCPI standards.

SCPI Commands Overview

Command Format

SCPI is an ASCII based Command language designed for test and measurement instruments. SCPI Commands uses a hierarchical structure (tree system), and is divided into different subsystems. Each subsystem is defined by a different root keyword. Each Command consists of a root keyword and one or more hierarchical key words separated by a colon ":" and followed by a parameter. There is always a space between the keywords and the parameters. Any Commands followed by a question mark (?) are queries.

For Example:
:SYSTem:BEEPer:STATe {0|1|OFF|ON}
:SYSTem:BEEPer:STATe?

SYSTem is the root level keyword and BEEPer and STATe are the secondary and tertiary level keywords. All levels have a ":" separating each keyword. Parameters are enclosed in "{ }".
The Commands SYSTem:BEEPer:STATe has {0|1|OFF|ON } as parameters. The parameters are separated with a space.
SYSTem:BEEPer:STATe? indicates that the Command is a query.
In addition some Commands have multiple parameters that are usually separated by a comma ",".
For example: :STATus:QUEue:ENABle (-110:-222, -220).

Symbol Description

SCPI Commands have the following conventional symbols. These symbols are not Commands but are used to describe the Command parameters.

1. Curly Brackets { }
Curly Bracket enclose Command string parameters, for example: {OFF|ON}

2. Vertical Bars |
Vertical bars are used to separate one or more optional parameters. Only one Command can be selected. With the following two parameters, {ON|OFF} only ON or OFF can be selected.

3. Square Brackets [ ]
The contents inside square brackets represent keywords or parameters that can be omitted. These keywords or parameters will be executed whether or not omitted. For example: For the Commands :OUTPut[:STATe] {ON|OFF}, [STATe] can be omitted.

4. Angle Brackets < >
The parameters in angle brackets must be substituted with a valid parameter. For example: For the Command :DISPlay: CONTrast <brightness>, <brightness> must be use a numerical value instead such as, :DISPlay:CONTrast 1

Parameter Types

The Commands have a number of different parameter categories. How the parameters are set depend on the parameter categories.

1. Boolean
Commands parameter that have to states “OFF” and “ON”, for example, :DISPlay:FOCUs {ON|OFF}. “ON” will turn on the focus display function, while “OFF” will turn it off.

2. Consecutive Integers
   Parameters that use consecutive integers, for example: For the Command :DISPlay:CONTrast <brightness>, <brightness> is an integer value with a range of 1~3.

3. Continuous Real Number
   Parameter that must be a continuous real number can have any value within the effective range and accuracy. For example: The Command CURRent {<current>|MINimum|MAXimum}, is used to set the current value for the current operating channel. <current> can be any value within the setting range of the current channel.

4. Discrete
   For discrete parameters, only those values that are listed can be used. For example: The *RCL {0|1|2|3|4|5} Command can only use 0, 1, 2, 3, 4, 5.

5. ASCII Strings
   ASCII string parameters must use a combination of ASCII characters in a string. For example: For the Command: MODE <name>, <name> must be an ASCII string.

Command Abbreviations

The syntax for SCPI Commands contains a combination of upper and lower case letters. The upper case letters in a Command represent the short form of that Command.
Commands are not case sensitive and can used in both upper and lower case. NOTE, however, to use the short form of the Command, only the capital letter part of the Command can be used (no other abbreviation can be used). For example:

:MEASure:CURRent?
Can be abbreviated to:
:MEAS:CURR?

Command Terminators

When sending a Command to the function generator, the Command must be terminated with a <new line> character. The IEEE-488 EOI can also be used as a <new line> character. A Command can also be terminated using a carriage return + <new line> character. The Command path will always be reset back to the root level after a Command has been terminated.

Return values are terminated with 0x0A.

Command List

Calculate Instructions

Display Commands

Data Format Commands

Output Commands

Source Commands

Measurement Commands

Status Commands

System Commands

Trigger Commands

IEEE488.2 Common Commands

Command Details

Calculate Commands

Command	:CALCulate[1]:MATH[:EXPression]:CATalog?
Function	It is used to list the math expression names. It includes the built-in and user-defined expression names: "POWER" -- Instantaneous power equation. "OFFCOMPOHM" -- Offset compensated ohms equation. "VOLTCOEF" -- Resistor voltage coefficient equation. "VARALPHA" -- Varistor alpha equation. "%DEV" -- Percent deviation equation. "user-name" -- Assigned name for user-defined expression where the user name is made up of ASCII characters (up to 10). The Command will return the above names as well as the names of any user-defined expressions.
Example	:CALCulate:MATH:CATalog?

Command	:CALCulate[1]:MATH[:EXPression]:NAME <name>
Function	It can be used to select a math expression that already exists (built-in or user-defined). Math expression names that already exist can be listed using :CATalog? command. The actual math expression can be read using the :MATH? command. The built-in math expressions (except POWER) require a two-point sweep in order to perform the calculation.

<name>= "POWER"

"OFFCOMPOHM"

"VOLTCOEF"

"VARALPHA"

"user-name"

When you want to create a new user-defined math expression, perform the following steps in order:

1. Assign units to the calculation result, It is stored for the calculation.
2. Assign a name to the expression (using up to 10 ASCII characters) using this command.
3. Define the expression using the :DEFine or EXPRession Command.

Math expression errors:

+801 “Insufficient vector data” — Returned to idle before acquiring enough data to fully populate the vector. A CALC1 result is not built.

+804 “Expression list full” — Attempted to create a new expression name when the list (catalog) is full. The maximum number of user-defined expression names is five.

+805 “Undefined expression exists” — Attempted to create a new expression name while a previous expression name remains undefined. Remember, after creating a name, you have to define the expression.

+806 “Expression not found” — Attempted to delete a named math expression that cannot be found.

+807 “Definition not allowed” — Attempted to define an expression that has not been previously named.

+808 “Expression cannot be deleted” — Attempted to delete one of the built-in math expressions.

+809 “Source memory location revised” — Occurs when a :SOURce:MEMory sweep location references an expression that no longer exists.

+811 “Not an operator or number” — Defined a null math expression by not using a valid operator or number.

+812 “Mismatched parenthesis” — Number of open parentheses must be the same as the number of closed parentheses. For example, CALC1:MATH:EXPR (2*sin(VOLT) generates this error.

+813 “Not a number of data handle” — An invalid floating point number or symbol other than VOLT, CURR, RES, or TIME appears in the math expression.

+814 “Mismatched brackets” — Improper use of brackets for vectored math expression indices. For example, CALC1:MATH:EXPR (VOLT[0*CURR[0]) generates this error.

+815 “Too many parenthesis” — Too many closed parentheses were detected. For example, CALC1:MATH:EXPR (In(VOLT)) generates this error.

+816 “Entire expression not parsed” — Occurs when the input expression does not produce a function for the GSM to calculate.

+817 “Unknown token” — Attempted to define an expression using an invalid function name.

+818 “Error parsing mantissa” — Occurs when a floating point number has an invalid mantissa.

+819 “Error parsing exponent” — Occurs when a floating point number has an invalid exponent.

+820 “Error parsing value” — Occurs when an invalid floating point number is entered.

+821 "Invalid data handle index" — An invalid array index value was assigned to a vectored expression. Array indices start at 0 and can be as high as 2499.

NOTE:

- **Up to five user-defined math expressions can be created.**
- **A selected math expression can only be performed if CALC1 is enabled.**
- **When the math expression is vectored, the math result will not be generated until all source-measure operations for the vector array are performed.**
- **Initializing memory (:SYSTem:MEMory:INITialize) deletes all user-defined math expressions and selects the POWER expression.**

Example	:CALCulate:MATH:NAME "POWER1"

Command	:CALCulate[1]:MATH[:EXPression]:NAME?
Function	Query selected math expression(built in or user defined). "POWER" -- Instantaneous power equation. "OFFCOMPOHM" -- Offset compensated ohms equation. "VOLTCOEF" -- Resistor voltage coefficient equation. "VARALPHA" -- Varistor alpha equation. "%DEV" -- Percent deviation equation. "user-name" -- Assigned name for user-defined expression where the user name is made up of ASCII characters (up to 10).
Example	:CALCulate:MATH:NAME?

Command	:CALCulate[1]:MATH[:EXPRession]:DELete[:SELected] <name>
Function	This Command is used to remove (delete) the specified user-defined math expression from the catalog. Once removed, that math expression can no longer be selected. You can use the :CATalog? command to verify that the math expression is gone. You cannot delete built-in math expressions. This will result in error+808.
Example	:CALCulate:MATH:DELete "user-name"

Command	:CALCulate[1]:MATH[:EXPRession]:DELete:ALL
Function	This will delete all user-defined math expressions from the catalog, Built-in math expressions are not affected.
Example	:CALCulate:MATH:DELete:ALL

Command	:CALCulate[1]:MATH:UNITs <name>
Function	It is used to specify the units suffix name for a userdefined math calculation. Use ASCII characters for the units suffix name. For example, if the units name is "Z", using the following command: :calc:math:unit "Z". The units name can also be enclosed in single quotes, for example :calc:math:unit 'Z'. <name>= ASCII characters enclosed in single or double quotes
Example	:CALCulate:MATH:UNITs "%"

Command	:CALCulate[1]:MATH:UNITs?
Function	Query units for user-defined calculation.
Example	:CALCulate:MATH:UNITs?

Command :CALCulate[1]:MATH[:EXPRession] <form>

:CALCulate[1]:MATH[:EXPRession][:DEFine] <form>

Function Use either of these two Commands to define a math formula using measure and source readings, numeric constants, and standard math operator symbols. After the math expression is defined, it will be assigned to the name that was created using the :NAME Command and will become the selected math expression.

. Valid math operators and their operations are listed as follows:
+ (Add), - (Subtract), * (Multiply), / (Divide), ^(Exponent), log (Logarithmic, base 10), ln (Natural log), sin (Sine), cos (Cosine), tan (Tangent), exp (ex).

. The log and ln operations are performed on the absolute value of the specified number. For example, log (100) = 2 and log (-100) = 2.

. Expressions are evaluated according to the following precedence rules:
1. Enclosed by parentheses
2. Unary operators (+ and -)
3. ^ (exponentiation)
4. * (multiplication) and / (division)
5. + (addition) and - (subtraction)
6. Left to right.

. Measure readings take priority over source readings. Thus, if configured to Source V Measure V, the voltage reading for the calculation will be the voltage measurement (not the programmed V-Source value). Conversely, if configured to Source I Measure I, the current reading for the calculation will be the current measurement.The result of a calculation using a reading that is not sourced or measured will be the invalid NAN (not a number) value of +9.91e37. For example, using a current reading in a calculation for Source V Measure V will cause a NAN result. Example using Source I Measure V configuration: :calc:math (volt * curr) Calculate power using voltage measurement and I-Source value. After a calculation is configured and enabled, the results are displayed when source-measure operations are performed. Use the :data? Command to send the results to the computer.

. Vectored math

By incorporating vectors, you select which readings to use for the math calculation. After all programmed source-measure operations are completed, the math calculation(s) are performed using readings indicated by the specified vectors.Vector numbers are enclosed in brackets ([]), and start at 0. Thus, vector 0 is the first reading in the array, vector 1 is the second reading in the array, and so on. The largest vector number in the expression defines the vector array size.For example, assume the GSM is programmed to perform 10 source-measure operations, and the following vectored math calculation is used:(volt[3] - volt[9]), The above expression defines a vector array that is made up of 10 readings. Since the GSM is programmed to perform 10 source-measure operations, the calculation will yield one result every 10 SDM cycles. The 4th voltage reading (vector 3) and the 10th voltage reading (vector 9) are used for the calculation.

Now assume that the GSM is configured to perform 20 source-measure operations. Since the vector size is still 10, two 10-reading arrays will be created. The calculation will now yield two results, one for each array.

The first result, as before, is based on the fourth and 10th readings of the first array. The second result is based on the 14th and 20th readings. These are the fourth (vector 3) and 10th (vector 9) readings of the second array.

NOTE that you need complete vector arrays to acquire valid calculation results. If, in the preceding example, the GSM is changed to perform 25 source-measure operations, then the third array will be incomplete (first array is 10 readings, second array is 10 readings, third array is only 5 readings). After the GSM goes back into idle, the "Insufficient vector data" error message will be displayed, and the third result will be NAN (+9.91e37).
To avoid incomplete vector arrays, make sure the programmed number of source-measure operations (arm count × trigger count) is a multiple of the vector array size. In the preceding example, vector array size is 10. Thus, in order to avoid "Insufficient vector data" errors, the programmed number of source-measure operations has to be a multiple of 10 (10, 20, 30, 40, and so on).

The following vector math expression to calculate offset compensated ohms demonstrates proper syntax:

:calc:math ((volt[1] - volt[0]) / (curr[1] - curr[0]))

NOTE:

1. **Use nested parentheses to force math operations that are imbedded in the calculation.**
2. **A calculation expression can be up to 256 characters in length, including parentheses and white spaces.**
3. **When using the filter, the measured readings used in the calculation are filtered - NOT the result of the calculation.**
4. **For vector math, it is recommended that only the REPEAT filter be used. For the repeat filter, the calculations use only the filtered readings of the vector points. If you instead use the MOVING filter, each vector point will reflect the filtered average of all the previous readings in the vector array.**

5. **The data format (ASCII or binary) for calculation results is selected using the :FORMat:DATA? Command. The *RST and :SYSTem:PRESet default is ASCII.**
6. **When brackets ([]) are left out of an expression, it is assumed that it is referencing the first vector point in the array (i.e., VOLT is the same as VOLT[0]).**

Example	:CALCulate:MATH (volt * curr)

Command	:CALCulate[1]:MATH?
Function	Query user-defined math expression.
Example	:CALCulate:MATH?

Command	:CALCulate[1]:STATe <b>
Function	This Command is used to enable or disable the CALC1 calculation. When enabled, the selected math expression will be performed when the GSM is triggered to perform the programmed source-measure operations. After the GSM returns to idle, you can read the result of the selected math expression using the :CALC1:DATA? Command. When disabled, the :CALC1:DATA? Command will return the NAN(not a number) value of +9.91e37. <b> = 0 or OFF — Disable CALC1 calculation 1 or ON — Enable CALC1 calculation
Example	:CALCulate:STATe 0

Command	:CALCulate[1]:STATe?
Function	Query state (on or off) of CALC1.

Example	:CALCulate:STATe?

Command	:CALCulate[1]:DATA?
Function	This query Command is used to read the result of the CALC1 calculation. The largest valid calculation result can be ±9.9e37, which (defined by SCPI) is infinity. For scalar math (non-vectored math), this Command is used to return calculation results for all the programmed source-measure points. For example, if 20 source-measure operations were performed, this Command will return 20 calculation results. For vector math, this Command will only return the calculation results for the specified vector points. An invalid NAN (not a number) result of +9.91e37 indicates that one of the following conditions exist: • Error in the expression. • The required measurement function is disabled. • CALC1 is disabled.
Example	:CALCulate:DATA?

Command	:CALCulate[1]:DATA:LATest?
Function	This Command operates exactly like CALC1:DATA? except that it returns only the latest CALC1 result.
Example	:CALCulate:DATA:LATest?

Command	:CALCulate2:FEED <name>
Function	This Command is used to select the input path for the limit tests. With CALCulate[1] selected, the specified limits will be compared to the result of CALC1. With

	VOLTage selected, limits will be compared to the voltage measurement. With CURRent or Resistance selected, limits will be compared with the respective current or resistance measurement. <name> = CALCulate[1] Use result of CALC1 VOLTage Use measured voltage reading CURRent Use measured current reading RESistance Use measured resistance reading
Example	:CALCulate2:FEED VOLTage

Command	:CALCulate2:FEED?
Function	Query input path for limit tests.
Example	:CALCulate2:FEED?

Command	:CALCulate2:NULL:OFFSet <n>
Function	This Command lets you establish a null offset (REL) for the selected feed. When Null Offset is enabled the result is the algebraic difference between the feed reading and the offset value: CALC2 reading = feed reading - null offset. <n> = -9.999999e20 to 9.999999e20 Specify null offset value
Example	:CALCulate2:NULL:OFFSet -9.999999e20

Command	:CALCulate2:NULL:OFFSet?
Function	Query null offset value.

Example :CALCulate2:NULL:OFFSet?

Command :CALCulate2:NULL:ACQuire

Function This Command automatically acquires the null offset value. If no reading is available, then the next available reading will become the null offset value.

Example :CALCulate2:NULL:ACQuire

Command :CALCulate2:NULL:STATe <b>

Function This Command is used to enable or disable null offset. When enabled,the CALC2 reading will include the null offset value. When disabled, CALC2 will not include the null offset.

<b> = 1 or ON	Enable null offset
0 or OFF	Disable null offset

Example :CALCulate2:NULL:STATe 1

Command :CALCulate2:NULL:STATe?

Function Query state of null offset.

Example :CALCulate2:NULL:STATe?

Command :CALCulate2:DATA?

Function This Command is used to acquire all the readings used for the CALC2 limit tests. NOTE that if null offset is enabled, then the CALC2 readings will include the null offset value. At least one of the limit tests have to be enabled to acquire limit test readings.

Example :CALCulate2:DATA?

Command :CALCulate2:DATA:LATest?

Function	This Command operates exactly like CALC2:DATA?, except it returns only the latest null offset or limit result.
Example	:CALCulate2:DATA:LATest?

Command	:CALCulate2:LIMit[1]:COMPliance:FAIL <name>
Function	This Command is used to specify the condition that will cause Limit 1 test to fail. With IN specified, the test will fail when the GSM goes into compliance. With OUT specified, the test will fail when the GSM comes out of compliance. <name> = IN Fail Limit 1 test when unit goes into compliance OUT Fail Limit 1 test when unit comes out of compliance
Example	:CALCulate2:LIMit:COMPliance:FAIL IN

Command	:CALCulate2:LIMit[1]:COMPliance:FAIL?
Function	Query when Limit 1 test failure occurs.
Example	:CALCulate2:LIMit:COMPliance:FAIL?

Command	:CALCulate2:LIMitx:LOWer[:DATA] <n>
Function	This Command is used to set the lower limits for LIMIT 2,LIMIT 3, and LIMIT 5 through LIMIT 12 tests. The actual limit depends on which measurement function is currently selected. For example, a limit value of 1µ is 1µA for the amps function and 1µV for the volts function. A limit value is not range sensitive. A limit of 2 for volts is 2V on all measurement ranges. LIMitx x=2, 3, 5-12 <n> = -9.999999e20 to 9.999999e20 Specify limit value

	DEFault	Set specified lower limit to -1
	MINimum	Set specified limit to -9.999999e20
	MAXimum	Set specified limit to +9.999999e20

Example	:CALCulate2:LIMit2:LOWer DEFault

Command	:CALCulate2:LIMitx:LOWer?	
Function	:LOWer?	Query specified lower limit.
	:LOWer? DEFault	Query *RST default lower limit.
	:LOWer? MINimum	Query lowest allowable lower limit.
	:LOWer? MAXimum	Query largest allowable lower limit.
Example	:CALCulate2:LIMit2:LOWer?	

Command :CALCulate2:LIMitx:UPPer[:DATA] <n>

Function This Command is used to set the upper limits for LIMIT 2, LIMIT 3, and LIMIT 5 through LIMIT 12 tests. The actual limit depends on which measurement function is currently selected. For example, a limit value of 1μ is 1μA for the amps function and 1μV for the volts function. A limit value is not range sensitive. A limit of 2 for volts is 2V on all measurement ranges.

LIMitx x=2, 3, 5-12

<n> = -9.999999e20 to 9.999999e20 Specify limit value

DEFault	Set specified upper limit to 1
MINimum	Set specified limit to -9.999999e20
MAXimum	Set specified limit to +9.999999e20

Example :CALCulate2:LIMit2:UPPer DEFault

Command	:CALCulate2:LIMitx:UPPer?	
Function	:UPPer?	Query specified upper limit
	:UPPer? DEFault	Query *RST default upper limit
	:UPPer? MINimum	Query lowest allowable upper limit
	:UPPer? MAXimum	Query largest allowable upper limit.
Example	:CALCulate2:LIMit2:UPPer?	

Command :CALCulate2:LIMit[1]:COMPliance:SOURce2 <NRf> |<NDN>

Function This Command is used to define the LIMIT 1 failure pattern (0 to 7, 3-bit; 0 to 15, 4-bit).

Tests are performed in the following order:

1. Limit Test 1
2. Limit Test 2
   a. Lower Limit 2
   b. Upper Limit 2
3. Limit Test x, where x = 3, 5-12 in ascending numerical order.
   a. Lower Limit x
   b. Upper Limit x

The first failure in the test sequence determines the bit pattern for the digital output port. Subsequent failures in the test sequence will not change the defined digital output pattern. NOTE that the output value can be specified as a binary, octal, decimal, or hexadecimal value.

Use the following table to determine the parameter value for the desired decimal digital output pattern.

For non-decimal parameters, convert the decimal value to its binary, octal, or hexadecimal equivalent.

OUT4*	OUT3	OUT2	OUT1	Decimal value*
L	L	L	L	0
L	L	L	H	1
L	L	H	L	2
L	L	H	H	3
L	H	L	L	4
L	H	L	H	5
L	H	H	L	6
L	H	H	H	7
H	L	L	L	8
H	L	L	H	9
H	L	H	L	10
H	L	H	H	11
H	H	L	L	12
H	H	L	H	13
H	H	H	L	14
H	H	H	H	15

L = Low (Gnd)

H = High (>+3V)

* OUT 4 not used in 3-bit mode (values = 0 to 7)

The GSM can be configured to place the defined fail bit pattern on the digital output immediately when a fail condition occurs, or it can wait until all testing on a device package is completed (operation leaves trigger layer).

<NRf> = 0 to 7 (3-bit) Decimal value

0 to 15 (4-bit) Decimal value

	<NDN> = 0 to #b111 (3-bit)	Binary value
	0 to #b1111 (4-bit)	Binary value
	0 to #q7 (3-bit)	Octal value
	0 to #q17 (4-bit)	Octal value
	0 to #h7 (3-bit)	Hexadecimal value
	0 to #hF (4-bit)	Hexadecimal value
	END Update output after sweep is completed	
Example	:CALCulate2:LIMit:COMPliance:SOURce2 0	

Command	:CALCulate2:LIMit[1]:COMPliance:SOURce2?
Function	Query source value for specified limit.
Example	:CALCulate2:LIMit:COMPliance:SOURce2?

Command	:CALCulate2:LIMitx:LOWer:SOURce2 <NRf>|<NDN>
Function	This Command is used to define the digital output fail patterns for the specified tests (0 to 7, 3-bit; 0 to 15, 4-bit). NOTE that the fail patterns for Limits 2, 3, 5-12 apply only to the Grading mode. Please refer to the Command: CALCulate2:LIMit[1]:COMPliance:SOURce2 <NRf> |<NDN>
Example	:CALCulate2:LIMit2:LOWer:SOURce2 0

Command	:CALCulate2:LIMitx:LOWer:SOURce2?
Function	Query source value for specified limit.
Example	:CALCulate2:LIMit2:LOWer:SOURce2?

Command	:CALCulate2:LIMitx:UPPer:SOURce2 <NRf>|<NDN>

Function	This Command is used to define the digital output fail patterns for the specified tests (0 to 7, 3-bit; 0 to 15, 4-bit). NOTE that the fail patterns for Limits 2, 3, 5-12 apply only to the grading mode. Please refer to the Command: CALCulate2:LIMit[1]:COMPliance:SOURce2 <NRf> |<NDN>
Example	:CALCulate2:LIMit2:UPPer:SOURce2 0

Command	:CALCulate2:LIMitx:UPPer:SOURce2?
Function	Query source value for specified limit.
Example	:CALCulate2:LIMit2:UPPer:SOURce2?

Command	:CALCulate2:LIMitx:PASS:SOURce2 <NRf> | <NDN>
Function	This Command is used to define the 3-bit or 4-bit output pattern for the Digital I/O Port when a test (limit 2, 3, 5-12) for the sorting mode passes. NOTE that the output value can be specified in binary, octal, decimal, or hexadecimal format. Use the table provided in the "Description" for the :SOURce Command to determine the parameter value for the desired decimal digital output pattern. <NRf> = 0 to 7 (3-bit) Decimal value 0 to 15 (4-bit) Decimal value <NDN> = 0 to #b111 (3-bit) Binary value 0 to #b1111 (4-bit) Binary value 0 to #q7 (3-bit) Octal value 0 to #q17 (4-bit) Octal value 0 to #h7 (3-bit) Hexadecimal value 0 to #hF (4-bit) Hexadecimal value

Example	:CALCulate2:LIMit2:PASS:SOURce2 0

Command	:CALCulate2:LIMitx:PASS:SOURce2?
Function	Query programmed source value.
Example	:CALCulate2:LIMit2:PASS:SOURce2?

Command	:CALCulate2:LIMit[1]:STATe <b>
Function	This Command is used to enable or disable LIMIT 1. Any limit test not enabled is simply not performed. When a limit test is enabled, the Digital I/O port comes under control of limit tests. That is, the result of the testing process updates the output pattern on the I/O port. <b> = 1 or ON — Enable specified limit test 0 or OFF — Disable specified limit test
Example	:CALCulate2:LIMit:STATe 1

Command	:CALCulate2:LIMit[1]:STATe?
Function	Query state of specified limit test.
Example	:CALCulate2:LIMit:STATe?

Command	:CALCulate2:LIMitx:STATe <b>
Function	These Commands are used to enable or disable LIMIT 2, LIMIT 3, and LIMIT 5 to LIMIT 12 tests. Any limit test not enabled is simply not performed. When a limit test is enabled, the Digital I/O port comes under control of limit tests. That is, the result of the testing process updates the output pattern on the I/O port.

	<b> = 1 or ON	Enable specified limit test
	0 or OFF	Disable specified limit test
Example	:CALCulate2:LIMit2:STATe 1	

Command	:CALCulate2:LIMitx:STATe?
Function	Query state of specified limit test.
Example	:CALCulate2:LIMit2:STATe?

Command	:CALCulate2:LIMit[1]:FAIL?
Function	This Command is used to read the results of LIMIT 1: 0 = Limit test passed 1 = Limit test failed The response message (0 or 1) only tells you if a limit test has passed or failed. To determine which limit has failed, you will have to read the Measurement Event Register. Reading the results of a limit test does not clear the fail indication of the test. A failure can be cleared by using a :CLEar Command.
Example	:CALCulate2:LIMit:FAIL?

Command	:CALCulate2:LIMitx:FAIL?
Function	This Command is used to read the results of LIMIT 2, LIMIT 3, and LIMIT 5 to LIMIT 12 tests: 0 = Limit test passed 1 = Limit test failed The response message (0 or 1) only tells you if a limit test has passed or failed. For Limit 2, Limit 3, and Limit 5-12, it does not tell you which limit (upper or

	lower) has failed. To determine which limit has failed, you will have to read the Measurement Event Register. Reading the results of a limit test does not clear the fail indication of the test. A failure can be cleared by using a :CLEar Command.
Example	:CALCulate2:LIMit2:FAIL?

Command	:CALCulate2:CLIMits:PASS:SOURce2 <NRf> | <NDN>
Function	This Command is used to define the 3-bit or 4-bit output pattern for the Digital I/O Port when there are no failures. NOTE that the output value can be specified in binary, octal, decimal, or hexadecimal format. Use the table provided in the "Description" for the :SOURce Command to determine the parameter value for the desired decimal digital output pattern. The GSM can be configured to place the defined pass bit pattern on the digital output immediately when the pass condition occurs, or it can wait until all testing on a device package is completed (operation leaves trigger layer).

<NRf> = 0 to 7 (3-bit)	Decimal value
0 to 15 (4-bit)	Decimal value
<NDN> = 0 to #b111 (3-bit)	Binary value
0 to #b1111 (4-bit)	Binary value
0 to #q7 (3-bit)	Octal value
0 to #q17 (4-bit)	Octal value
0 to #h7 (3-bit)	Hexadecimal value
0 to #hF (4-bit)	Hexadecimal value

Example	:CALCulate2:CLIMits:PASS:SOURce2 0

Command	:CALCulate2:CLIMits:PASS:SOURce2?

Function	Query the 3-bit or 4-bit output pattern for the Digital I/O Port when there are no failures.
Example	:CALCulate2:CLIMits:PASS:SOURce2?

Command	:CALCulate2:CLIMits:FAIL:SOURce2 <NRf> | <NDN>
Function	For the sorting mode, this Command is used to define the 3-bit or 4-bit output pattern for the Digital I/O Port when there are failures. NOTE that the output value can be specified using binary, octal, decimal, or hexadecimal format. Use the table provided in the "Description" for the :SOURce Command to determine the decimal parameter value for the desired digital output pattern. <NRf> = 0 to 7 (3-bit) Decimal value 0 to 15 (4-bit) Decimal value <NDN> = 0 to #b111 (3-bit) Binary value 0 to #b1111 (4-bit) Binary value 0 to #q7 (3-bit) Octal value 0 to #q17 (4-bit) Octal value 0 to #h7 (3-bit) Hexadecimal value 0 to #hF (4-bit) Hexadecimal value
Example	:CALCulate2:CLIMits:FAIL:SOURce2 0

Command	:CALCulate2:CLIMits:FAIL:SOURce2?
Function	For the sorting mode, this command is used to query the 3-bit or 4-bit output pattern for the Digital I/O Port when there are failures.
Example	:CALCulate2:CLIMits:FAIL:SOURce2?

Command	:CALCulate2:CLIMits:FAIL:SMLocation <NRf> | NEXT
Function	While using a Source Memory Sweep when performing limit tests, the sweep can branch to a specified memory location point or proceed to the next memory location in the list. When a memory location is specified with FAIL, the sweep will branch to that location on a failure. If not (PASS condition), the sweep proceeds to the next memory location in the list. With NEXT selected (the default), the sweep proceeds to the next memory location (present location+1) in the list regardless of the outcome of the test (FAIL or PASS condition). NOTE that branch on FAIL is available only via remote. <NRf> = 1 to 100 — Specify memory location point NEXT — Next memory location point in list (present location + 1)
Example	:CALCulate2:CLIMits:FAIL:SMLocation 1

Command	:CALCulate2:CLIMits:FAIL:SMLocation?
Function	Query "fail" source memory Location.
Example	:CALCulate2:CLIMits:FAIL:SMLocation?

Command	:CALCulate2:CLIMits:PASS:SMLocation <NRf> | NEXT
Function	While using a Source Memory Sweep when performing limit tests, the sweep can branch to a specified memory location point or proceed to the next memory location in the list. When a memory location is specified with PASS, the sweep will branch to that memory location if the test is

	successful (PASS condition). If not successful (FAIL condition), the sweep proceeds to the next memory location in the list. With NEXT selected (the default), the sweep proceeds to the next memory location (present location + 1) in the list regardless of the outcome of the test (PASS or FAIL condition).	
	<NRf> = 1 to 100	Specify memory location point
	NEXT	Next memory location point in list (present location + 1)
Example	:CALCulate2:CLIMits:PASS:SMLocation 1	

Command	:CALCulate2:CLIMits:PASS:SMLocation?
Function	Query "pass" source memory location
Example	:CALCulate2:CLIMits:PASS:SMLocation?

Command	:CALCulate2:CLIMits:BCONtrol <name>
Function	This Command is used to control when the digital output will update to the pass or fail bit pattern. The pass or fail bit pattern tells the handler to stop the testing process and place the DUT in the appropriate bin. With IMMediate selected, the digital output will update immediately to the bit pattern for the first failure in the testing process. If all the tests pass, the output will update to the pass bit pattern. With END selected, the digital output will not update to the pass or fail bit pattern until the GSM completes the sweep or list operation. This allows multiple test cycles to be performed on DUT. With the use of a scanner card, multi-element devices (i.e., resistor networks) can be tested. If, for example, you did not use END and the first element in

the device package passed, the pass bit pattern will be output. The testing process will stop and the DUT will be binned. As a consequence, the other elements in the device package are not tested.

<name> = IMMediate	Update output when first failure occurs
END	Update output after sweep is completed

Example :CALCulate2:CLIMits:BCONtrol IMMediate

Command :CALCulate2:CLIMits:BCONtrol?

Function Query when digital output will update.

Example :CALCulate2:CLIMits:BCONtrol?

Command :CALCulate2:CLIMits:MODE <name>

Function This Command controls how limit calculations drive the Digital I/O lines. In GRADing mode, a reading passes if it is within all of the hi/low limit tolerances enabled, assuming that it has passed the LIMIT 1 compliance tests first. The Digital I/O lines will be driven with the first pattern of the compliance, hi, or low failure. Otherwise, the CALC2:CLIM:PASS:SOUR2 pattern will be output.

In SORTing mode, a reading will fail if it fails the compliance test, or is not within any of the Digital I/O Bands. If the tests pass and only LIMIT 1 is enabled, CALC2:CLIM:PASS:SOUR2 pattern will be output. Otherwise, the first limit test band that passes will output its LOW:SOUR2 pattern (UPP:SOUR2 patterns will be ignored).

If LIMIT1 fails, their SOUR2 patterns will be output. If no LIMIT2, 3, 5-12 limit passes, the

	CALC2:CLIM:FAIL:SOUR2 pattern will be output. <name> = GRADing Output graded pass/fail pattern SORTing Output sorted pass/fail pattern
Example	:CALCulate2:CLIMits:MODE GRADing

Command	:CALCulate2:CLIMits:MODE?
Function	Query Digital I/O pass/fail mode.
Example	:CALCulate2:CLIMits:MODE?

Command	:CALCulate2:CLIMits:CLEar[:IMMediate]
Function	This command clears the test results (pass or fail) of the limit tests and resets the output lines of the Digital I/O port back to the :SOURce2:TTL settings.
Example	:CALCulate2:CLIMits:CLEar

Command	:CALCulate2:CLIMits:CLEar:AUTO <b>
Function	With auto-clear enabled, test results will clear and the output lines of the Digital I/O port will reset when the :INITiate Command is sent to start a new test sequence. When disabled, you must use :IMMediate to perform the clear actions. <b> = 1 or ON Enable auto-clear 0 or OFF Disable auto-clear
Example	:CALCulate2:CLIMits:CLEar:AUTO 1

Command	:CALCulate2:CLIMits:CLEar:AUTO?
Function	Query state of auto-clear.
Example	:CALCulate2:CLIMits:CLEar:AUTO?

Command	:CALCulate3:FORMat <name>
Function	This Command is used to select the desired statistic on readings stored in the buffer. Readings stored in the buffer can be "raw" measured readings, the results of the CALC1 calculation, or CALC2 readings. The :TRACe:FEED command in the :TRACe Subsystem is used to select the type of readings to store. <name> = MEAN — Mean value of readings in buffer SDEViation — Standard deviation of readings in buffer MAXimum — Largest reading in buffer MINimum — Lowest reading in buffer PKPK — MAXimum - MINimum
Example	:CALCulate3:FORMat MAXimum

Command	:CALCulate3:FORMat?
Function	Query programmed math format.
Example	:CALCulate3:FORMat?

Command	:CALCulate3:DATA?
Function	This query command is used to perform the selected statistic operation and read the result(s). The result(s) is always returned in ASCII format. If the buffer is configured to store raw measured readings (:TRACe:FEED SENSe1) and multiple functions were measured, the selected statistic operation will be performed on all the measured readings.

For example, if voltage and current measurements were stored in the buffer, then the selected statistic operation will be performed on both readings. Statistics for multiple measurement functions are returned in the following order:

voltage statistic, current statistic, resistance statistic.

Statistic operations are not performed on TIME and STATus data elements that are stored in the buffer.

If the buffer is configured to store the result of CALC1 or CALC2 (:TRACe:FEED CALC1 or CALC2), only one result will be returned by this query Command.

NOTE:

1. If there is no data in the buffer, error -230, "Data corrupt or stale," will be generated.

2. If there are a lot of readings stored in the buffer, some statistic operations may take too long and cause a bus time-out error. To avoid this, send the :CALA3:DATA? command and then wait for the MAV (message available) bit in the Status Byte Register to set before addressing the GSM to talk.

Example	:CALCulate3:DATA?

Display Commands

Command	:DISPlay:DIGits <n>
Function	This Command is used to set the display resolution. NOTE that you can instead use rational numbers. For example, to select 4.5 digit resolution, you can send a parameter value of 4.5 (instead of 5). The GSM rounds the rational number to an integer.

<n> = 4	3.5 digit resolution
5	4.5 digit resolution
6	5.5 digit resolution
7	6.5 digit resolution
DEFault	5.5 digit resolution
MINimum	3.5 digit resolution
MAXimum	6.5 digit resolution

Example	:DISPlay:DIGits 4

Command	:DISPlay:DIGits?
Function	Used to query the display resolution.

:DIGits?	Query display resolution
:DIGits? DEFault	Query *RST default resolution
:DIGits? MINimum	Query lowest allowable display resolution
:DIGits? MAXimum	Query largest allowable display resolution

Example	:DISPlay:DIGits?

Command	:DISPlay:ENABle <b>

Function	This Command is used to enable and disable the front panel display circuitry. When disabled, the instrument operates at a higher speed. While disabled, the display is frozen with the following message: FRONT PANEL DISABLED Press Edit/Lock key to resume. As reported by the message, all front panel controls (except Output key) are disabled. Normal display operation can be resumed by using the :ENABle Command to enable the display or by pressing Edit/Lock key. <b> = 0 or OFF Disable display circuitry 1 or ON Enable display circuitry
Example	:DISPlay:ENABle 1

Command	:DISPlay:ENABle?
Function	Query state of display.
Example	:DISPlay:ENABle?

Data Format Commands

Command	:FORMat[:DATA] <type>[,<length>]
Function	This command is used to select the data format for transferring readings over the bus. Only the ASCII format is allowed over the RS-232 interface. This Command only affects the output of READ?, FETCh?, MEASure?, TRACe:DATA?, CALC1:DATA? and CALC2:DATA? over the GPIB. All other queries are returned in the ASCII format.
Description	<type>[,<length>] = ASCii ASCII format REAL,32 IEEE754 single precision format

SREal	IEEE754 single precision format

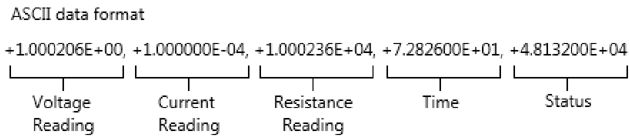
NOTE:

<length> is not used for the ASCii or SREal parameters. It is optional for the REAL parameter. If you do not use <length> with the REAL parameter, the <length> defaults to 32 (single precision format).

Regardless of which data format for output strings is selected, the GSM will only respond to input Commands using the ASCII format.

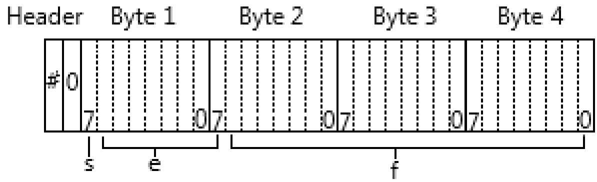
The ASCII data format is in a direct readable form for the operator. Most BASIC languages easily convert ASCII mantissa and exponent to other formats.

However, some speed is compromised to accommodate the conversion. Figure below shows an example ASCII string that includes all the data elements (also shows the byte order of the data string).



Data elements not specified by the :FORMat:ELEMents [SENSe[1]] <item list> Command are simply not included in the string. Keep in mind that the byte order can only be reversed for the binary format. (Please refer to :FORMat:BORDer <name>).

IEEE-754 single precision data format (32 data bits)



s=sign bit (0=positive, 1=negative)

e=exponent bits (8)

f=fraction bits (23)

Normal byte order shown.

For swapped byte order, bytes sent in reverse order: Header, Byte 4, Byte 3, Byte 2, Byte1

The header and terminator are sent only once for each READ?

During binary transfers, Do not release the communication from the GSM until the data is input to the computer. Also, to avoid erratic operation, the readings of the data string (and terminator) should be acquired in one segment. The header (#0) can be read separately before the rest of the string.
The number of bytes to be transferred can be calculated as follows:

Byte=2+(Rdgs×4) +1

where 2 is the number of bytes in the header (#0).

Rdgs is the product of the number of selected data elements, arm count, and trigger count.

4 is the number of bytes read each time.

1 is the byte of the terminator.

For example, suppose the GSM is configured to perform 10 source-measure operations and send 10 current measurement readings to the computer in binary format.

Byte=2+(10 x 4)+1=43

Example	:FORMat:DATA SREal

Command	:FORMat[:DATA]?
Function	Query data format.
Example	:FORMat:DATA?

Command :FORMat:ELEMents [SENSe[1]] <item list>

Function Specify data elements for data string

<item list> = VOLTage Includes voltage reading
CURRent Includes current reading
Resistance Includes resistance reading
TIME Includes timestamp
STATus Includes status information

⚠ **NOTE: Each element in the list must be separated by a comma (i.e. :ELEMents,VOLTage,CURRent,RESistance).**

This Command is used to specify the elements to be included in the data string in response to the following queries:
:FETCh?
:READ?
:MEASure?

:TRACe:DATA?
You can specify from one to all five elements. Each element in the list must be separated by a comma(,).These elements are explained as follows:

⚠ **NOTE: An overflow reading reads as +9.9E37.**

VOLTage — This element provides the voltage measurement or the programmed voltage source reading. If sourcing voltage and measuring voltage, this element will provide the voltage measurement (measure reading takes priority over source reading). If voltage is not sourced or measured, the NAN (not a number) value of +9.91e37 is used.
CURRent — This element provides the current measurement or the programmed current source reading. If sourcing current and measuring current, this element will provide the current measurement (measure reading takes priority over source reading). If current is not sourced or measured, the NAN (not a number) value of +9.91e37 is used.
RESistance — This element provides the resistance measurement. If resistance is not measured, the NAN (not a number) value of +9.91e37 is used.
TIME — A timestamp is available to reference each group of readings to a point in time. The relative timestamp operates as a timer that starts at zero seconds when the instrument is turned on or when the relative timestamp is reset (:SYSTem:TIME:RESet). The timestamp for each reading sent over the bus is referenced, in seconds, to the start time. After 99999.999 seconds, the timer resets to zero and starts over.
Timestamp values are approximate.
Timestamp is also available for buffer readings. Timestamp can be referenced to the first reading stored in the buffer (absolute format) which is timestamped at 0 seconds, or can provide the time between each reading (delta format). The :TRACe:TSTamp:FORMat Command is used to select the absolute or delta format.

STATus — A status word is available to provide status information concerning GSM operation. The 24-bit status word is sent in a decimal form and has to be converted by the user to the binary equivalent to determine the state of each bit in the word. For example, if the status value is 65, the binary equivalent is 000000000001000001. Bits 0 and 6 are set.
The significance of each status bit is explained as follows:
Bit 0 (OFLO) — Set to 1 if measurement was made while in over-range.
Bit 1 (Filter) — Set to 1 if measurement was made with the filter enabled.
Bit 2 (Front/Rear) — Set to 1 if FRONT terminals are selected.
Bit 3 (Compliance) — Set to 1 if in real compliance.
Bit 4 (OVP) — Set to 1 if the over voltage protection limit was reached.
Bit 5 (Math) — Set to 1 if math expression (calc1) is enabled.
Bit 6 (Null) — Set to 1 if Null is enabled.
Bit 7 (Limits) — Set to 1 if a limit test (calc2) is enabled.
Bits 8 and 9 (Limit Results) — Provides limit test results (see grading and sorting modes below).
Bit 10 (Auto-ohms) — Set to 1 if auto-ohms enabled.
Bit 11 (V-Meas) — Set to 1 if V-Measure is enabled.
Bit 12 (I-Meas) — Set to 1 if I-Measure is enabled.
Bit 13 (Ω-Meas) — Set to 1 if Ω-Measure is enabled.
Bit 14 (V-Sour) — Set to 1 if V-Source used.
Bit 15 (I-Sour) — Set to 1 if I-Source used.
Bit 16 (Range Compliance) — Set to 1 if in range compliance.
Bit 17 (Offset Compensation) — Set to 1 if Offset Compensated Ohms is enabled.
Bits 19, 20 and 21 (Limit Results) — Provides limit test results (see grading and sorting modes below).
Bit 22 (Remote Sense) — Set to 1 if 4-wire remote sense selected.

Limit test bits Bits 8, 9, and 19-21 flag pass/fail conditions for the various limits tests. The bit values for the grading and sorting modes are covered below.

Sorting mode status bit value:

Result Bit #:	21	20	19	9	8	Measure Event Status
Limit 1 pass and 2, 3 and 5-12 disabled	0	0	0	0	0	Bit 5 (LP)
Limit test 1 fail	0	0	0	0	1	Bit 0 (L1)
Limit test 2 pass	0	0	0	1	0	Bit 5 (LP)
Limit test 3 pass	0	0	0	1	1	Bit 4 (HL3)
Limit test 5 pass	0	0	1	0	0	Bit 5 (LP)
Limit test 6 pass	0	0	1	1	0	Bit 5 (LP)
Limit test 7 pass	0	0	1	1	1	Bit 5 (LP)
Limit test 8 pass	0	1	0	0	0	Bit 5 (LP)
Limit test 9 pass	0	1	0	0	0	Bit 5 (LP)
Limit test 10 pass	0	1	0	1	0	Bit 5 (LP)
Limit test 11 pass	0	1	0	1	1	Bit 5 (LP)
Limit test 12 pass	0	1	1	0	0	Bit 5 (LP)
Limit test 1 pass and 2, 3 and 5-12 fail	1	1	1	1	1	-

Grading mode status bit value:

Result Bit #:	21	20	19	9	8	Measure Event Status
All limits pass	0	0	0	0	0	Bit 5 (LP)
Limit test 1 fail	0	0	0	0	1	Bit 0 (L1)
Hi Limit test 2 fail	1	0	0	1	0	Bit 2 (HL2)
Lo Limit test 2 fail	0	0	0	1	0	Bit 1 (LL2)
Hi Limit test 3 fail	1	0	0	1	1	Bit 4 (HL3)
Lo Limit test 3 fail	0	0	0	1	1	Bit 3 (LL3)
Hi Limit test 5 fail	1	0	1	0	0	-
Lo Limit test 5 fail	0	0	1	0	0	-
Hi Limit test 6 fail	1	0	1	1	0	-
Lo Limit test 6 fail	0	0	1	1	0	-
Hi Limit test 7 fail	1	0	1	1	1	-
Lo Limit test 7 fail	0	0	1	1	1	-
Hi Limit test 8 fail	1	1	0	0	0	-
Lo Limit test 8 fail	0	1	0	0	0	-
Hi Limit test 9 fail	1	1	0	0	1	-
Lo Limit test 9 fail	0	1	0	0	1	-
Hi Limit test 10 fail	1	1	0	1	0	-
Lo Limit test 10 fail	0	1	0	1	0	-
Hi Limit test 11 fail	1	1	0	1	1	-
Lo Limit test 11 fail	0	1	0	1	1	-
Hi Limit test 12 fail	1	1	1	0	0	-
Lo Limit test 12 fail	0	1	1	0	0	-

The used bits of the Measurement Event Register are described as follows:

- Bit B0, Limit 1 Fail (L1) — Set bit indicates that the Limit 1 test has failed.
- Bit B1, Low Limit 2 Fail (LL2) — Set bit indicates that the Low Limit 2 test has failed.

- Bit B2, High Limit 2 Fail (HL2) — Set bit indicates that the High Limit 2 test has failed.
- Bit B3, Low Limit 3 Fail (LL3) — Set bit indicates that the Low Limit 3 test has failed.
- Bit B4, High Limit 3 Fail (HL3) — Set bit indicates that the High Limit 3 test has failed.
- Bit B5, Limits Pass (LP) — Set bit indicates that all limit tests passed.
- Bit B6, Reading Available (RAV) — Set bit indicates that a reading was taken and processed.
- Bit B7, Reading Overflow (ROF) — Set bit indicates that the volts or amps reading exceeds the selected measurement range of the Source Measure Unit.
- Bit B8, Buffer Available (BAV) — Set bit indicates that there are at least two readings in the buffer.
- Bit B9, Buffer Full (BFL) — Set bit indicates that the trace buffer is full.
- Bit B11, Output Enable Asserted (Int) — Set bit indicates that the output enable line is at digital low (asserted). The source output can be turned on.
- Bit B12, Over Temperature (OT) — Set bit indicates that an over temperature condition exists. The source output cannot be turned on.
- Bit B13, Over Voltage Protection (OVP) — Set bit indicates that the source is being limited at the programmed limit level.
- Bit B14, Compliance (Comp) — Set bit indicates that the source is in compliance.
- Bit B15 — Not used.

Example :FORMat:ELEMents VOLTage

Command	:FORMat:ELEMents?
Function	Query elements in the data string
Example	:FORMat:ELEMents?

Command	:FORMat:SOURce2 <name>
Function	This command controls the response format for all CALC2:XXXX:SOUR2 and SOUR2:TTL queries in a manner similar to formats set by the FORM:SREG command. <name> = ASCii — ASCII format HEX — Hex adecimal format OCTal — Octal format BINary — Binary format
Example	:FORMat:SOURce2 ASCii

Command	:FORMat:SOURce2?
Function	Query response format.
Example	:FORMat:SOURce2?

Command	:FORMat:ELEMents:CALCulate <item list>
Function	This command allows you to retrieve timestamp and status information with the CALC1:DATA? And CALC2:DATA? queries. It also allows you to retrieve timestamp and status information when TRACe:FEED is set to CALC1 or CALC2. <item list> = CALC — Include CALC1 or CALC2 data TIME — Include timestamp STATus — Include status information

Example	:FORMat:ELEMents:CALCulate CALC

Command	:FORMat:ELEMents:CALCulate?
Function	Query CALC data element list.
Example	:FORMat:ELEMents:CALCulate?

Command	:FORMat:BORDer <name>
Function	This Command is used to control the byte order for the IEEE-754 binary formats. For normal byte order, the data format for each element is sent as follows: Byte 1 Byte 2 Byte 3 Byte 4 (Single precision) For reverse byte order, the data format for each element is sent as follows: Byte 4 Byte 3 Byte 2 Byte 1 (Single precision) The “#0” Header is not affected by this Command. The Header is always sent at the beginning of the data string for each measurement conversion. The ASCII data format can only be sent in the normal byte order. The SWAPped selection is simply ignored when the ASCII format is selected. <name> =: NORMal: Normal byte order for binary formats SWAPped: Reverse byte order for binary formats
Example	:FORMat:BORDer NORMal

Command	:FORMat:BORDer?
Function	Query byte order.
Example	:FORMat:BORDer?

Command	:FORMat:SREGister <name>

Function	Query Commands are used to read the contents of the status event registers. This Command is used to set the response message format for those query Commands. When a status register is queried, the response message is a value that indicates which bits in the register are set. For example, if bits B5, B4, B2, B1, and B0 of a register are set (110111), the following values will be returned for the selected data format:
	ASCii 55 (decimal value)
	Hexadecimal #H37 (hexadecimal value)
	OCTal #Q67 (octal value)
	BINary #B110111 (binary value)
	<name> = ASCii Decimal format
	Hexadecimal Hexadecimal format
	OCTal Octal format
	BINary Binary format
Example	:FORMat:SREGister ASCii

Command	:FORMat:SREGister?
Function	Query format for reading status registers.
Example	:FORMat:SREGister?

Output Commands

Command	:OUTPut[1][:STATe] <b>
Function	This Command is used to turn the source output on or off. Measurements cannot be made while the source is off. Turning the source off to place the GSM in the idle state. The only exception to this is when source auto clear is enabled. In this mode, the source turns on during each source phase of the SDM cycle and turns off after each measurement. <b> = 0 or OFF Turn source off (standby) 1 or ON Turn source on (operate)
Example	:OUTPut 0

Command	:OUTPut?
Function	Query state of source.
Example	:OUTPut?

Command	:OUTPut[1]:ENABle[:STATe] <b>
Function	This Command is used to enable or disable the output enable function. When enabled, the Source Measure Unit cannot output unless the output enable line (pin 11 of the rear panel DIGITAL I/O interface) is pulled to a logic low state. When the output enable line goes to a logic high state, the Source Measure Unit can not output. When disabled, the logic level on the output enable line has no effect to the output state of the Source Measure Unit. <b> = 0 or OFF Disable output enable function 1 or ON Enable output enable function

Example	:OUTPut:ENABle 0

Command	:OUTPut[1]:ENABle:STATe?
Function	Query state of output enable line.
Example	:OUTPut:ENABle:STATe?

Command	:OUTPut[1]:ENABle:TRIPped?
Function	This query command is used to determine output enable has been tripped. The tripped condition (“1”) means that the GSM can output (output enable line at logic low level). A “0” will be returned if the GSM cannot output (output enable line at logic high level).
Example	:OUTPut:ENABle:TRIPped?

Command	:OUTPut[1]:SMODe <name>
Function	This Command is used to select the output-off mode of the GSM. With HIMPedance selected, the output relay opens when the source is turned off. This disconnects external circuitry from the GSM Input/ Output. To prevent excessive wear on the output relay, do not use the HIMPedance mode for tests that turn the output on and off frequently. With NORMal selected, the V-Source is selected and set to 0V when the output is turned off. Compliance is set to 0.5% full scale of the present current range. In the ZERO output-off state when the V-Source OUTPUT is turned off, the V-Source is set to 0V and current compliance is not changed. When the I-Source OUTPUT is turned off, the V-Source mode is selected and set to 0V. Current compliance is set to the programmed Source I value or to 0.5% full scale

	of the present current range, which is greater.The ZERO output-off state is typically used with the V-Source and Output Auto-On (see the :SOURce1:CLEar:AUTO Command) to generate voltage waveforms that alternate between 0V and the programmed output-on voltage. With GUARd selected, the I-Source is selected and set to 0A. Voltage compliance is set to 0.5% full scale of the present voltage range. This output-off state should be used when performing 6-wire guarded ohms measurements or for any other load that uses an active source. <name> = HIMPedance Disconnect Input/Output NORMal Normal output-off state ZERO Zero output-off state GUARd Guard output-off state
Example	:OUTPut:SMODe HIMPedance

Command	:OUTPut[1]:SMODe?
Function	Query output off mode.
Example	:OUTPut:SMODe?

Command	:ROUTe:TERMinals <name>
Function	This Command is used to select the front panel or the rear panel input/ output terminals. <name> = FRONt Front panel input/output terminals REAR Rear panel input/output terminals
Example	:ROUTe:TERMinals FRONt

Command	:ROUTe:TERMinals?
Function	Query state of front/rear output setting.

Example	:ROUTe:TERMinals?

Source Commands

Command	:SOURce[1]:CLEar[:IMMediate]
Function	This command is used to turn off the source output. The output will turn off after all programmed source-measure operations are completed and the instrument returns to the idle state. ⚠ **NOTE : if Auto off is enabled, the source output will automatically turn off.**
Example	:SOURce:CLEar

Command	:SOURce[1]:CLEar:AUTO <b>
Function	This command is used to control auto output-off for the source. With auto output-off enabled, an :INITiate (or :READ? or MEASure?) will start source-measure operation. The output will turn on at the beginning of each SDM (source-delay-measure) cycle and turn off after each measurement is completed. With auto output-off disabled, the source output must be on before an :INITiate or :READ? can be used to start source-measure operation. The :MEASure? Command will automatically turn on the source output. Once operation is started, the source output will stay on even after the instrument returns to the idle state. Auto output-off disabled is the *RST and :SYSTem:PRESet default. ⚠ **WARNING: With auto output-off disabled, the source output will remain on after all programmed source-measure operations are completed. Beware of hazardous voltage that may be present on the**

	output terminals.	
	<b> = 1 or ON	Enable auto output-off
	0 or OFF	Disable auto output-off
Example	:SOURce:CLEar:AUTO 0	

Command	:SOURce[1]:CLEar:AUTO?
Function	Query state of auto output-off.
Example	:SOURce:CLEar:AUTO?

Command	:SOURce[1]:CLEar:AUTO:MODE <name>	
Function	For the :MODE command, the source will turn off after every SDM cycle with the ALWAYS option selected. With the TCOunt option selected, the source will turn off when the trigger count has expired.	
	<name> = ALWAYS	On/off with each SDM cycle
	TCOunt	Off after trigger count
Example	:SOURce:CLEar:AUTO:MODE ALWAYS	

Command	:SOURce[1]:CLEar:AUTO:MODE?
Function	Query the mode of source output Auto off.
Example	:SOURce:CLEar:AUTO:MODE?

Command	:SOURce[1]:FUNCtion[:MODE] <name>
Function	This command is used to select the source mode. With VOLTage selected, the V-Source will be used, and with CURRent selected, the I-Source will be used.

With MEMory selected, a memory sequence can be performed. Operating setups (up to 100) saved in memory can be sequentially recalled. This allows multiple source/measure functions to be used in a sequence.

<name> =	VOLTage	Select V-Source mode
	CURRent	Select I-Source mode
	MEMory	Select memory mode

Example :SOURce:FUNCtion VOLTage

Command :SOURce[1]:FUNCtion[:MODE]?

Function Query the type of selected source.

Example :SOURce:FUNCtion?

Command :SOURce[1]:CURRent:MODE <name>

Function This command is used to select the DC sourcing mode for the I-source. The three modes are explained as follows:

FIXed — In this DC sourcing mode, the specified source will output a fixed level. Use the :RANGe and :AMPLitude commands to specify the fixed source level.

LIST — In this mode, the source will output levels that are specified in a list.

SWEep — In this mode, the source will perform a voltage, current or memory sweep.

<name> =	FIXed	Select fixed sourcing mode
	LIST	Select list sourcing mode
	SWEep	Select sequence sourcing mode

Example :SOURce:CURRent:MODE FIXed

Command	:SOURce[1]:CURRent:MODE?
Function	Query DC sourcing mode.
Example	:SOURce:CURRent:MODE?

Command	:SOURce[1]:VOLTage:MODE <name>
Function	This command is used to select the DC sourcing mode for the V-Source. The three modes are explained as follows: FIXed — In this DC sourcing mode, the specified source will output a fixed level. Use the :RANGe and :AMPLitude Commands to specify the fixed source level. LIST — In this mode, the source will output levels that are specified in a list. SWEep — In this mode, the source will perform a voltage, current or memory sweep. <name> = FIXed Select fixed sourcing mode LIST Select list sourcing mode SWEep Select sequence sourcing mode
Example	:SOURce:VOLTage:MODE FIXed

Command	:SOURce[1]:VOLTage:MODE?
Function	Query DC sourcing mode
Example	:SOURce:VOLTage:MODE?

Command	:SOURce[1]:CURRent:RANGe <n>

Function

This command is used to manually select the range for the I-Source. Range is selected by specifying the approximate source magnitude that you will be using. The instrument will then go to the lowest range that can accommodate that level.

As listed in the "Parameters," you can also use the MINimum, MAXimum and DEFault parameters to manually select the source range. The UP parameter selects the next higher source range, while DOWN selects the next lower source range.

NOTE that source range can be selected automatically by the instrument.

<n> = -1.05 to 1.05	Specify I-Source level (amps)
DEFault	100µA range (I-Source)
MINimum	1µA range (I-Source)
MAXimum	1A range (I-Source)
UP	Select next higher range
DOWN	Select next lower range

Example :SOURce:CURRent:RANGe DEFault

Command :SOURce[1]:CURRent:RANGe?

Function

:RANGe?	Query range for specified source.
:RANGe? DEFault	Query *RST default source range.
:RANGe? MINimum	Query lowest source range.
:RANGe? MAXimum	Query highest source range.

Example :SOURce:CURRent:RANGe?

Command :SOURce[1]:VOLTage:RANGe <n>

Function	This command is used to manually select the range for the V-Source. Range is selected by specifying the approximate source magnitude that you will be using. The instrument will then go to the lowest range that can accommodate that level. As listed in the "Parameters," you can also use the MINimum,MAXimum and DEFault parameters to manually select the source range. The UP parameter selects the next higher source range, while DOWN selects the next lower source range. **NOTE : source range can be selected automatically by the instrument.**

<n> = -210 to 210	Specify V-Source level
DEFault	20V range
MINimum	200mV range
MAXimum	200V range
UP	Select next higher range
DOWN	Select next lower range

Example :SOURce:VOLTage:RANGe DEFault

Command :SOURce[1]:VOLTage:RANGe?

Function	
:RANGe?	Query range for specified source
:RANGe? DEFault	Query *RST default source range.
:RANGe? MINimum	Query lowest source range
:RANGe? MAXimum	Query highest source range

Example :SOURce:VOLTage:RANGe?

Command	:SOURce[1]:CURRent:RANGe:AUTO <b>
Function	This command is used to enable or disable auto range for the specified source. When enabled, the instrument will automatically select the most sensitive range for the specified source level. When disabled, the instrument will use the range that the instrument is currently on. Auto range will be disabled if a fixed range is selected. Both *RST and :SYSTem:PREset enables source auto range. When the GSM goes into the local state, source auto range disables. <b> = 0 or OFF Disable auto range 1 or ON Enable auto range
Example	:SOURce:CURRent:RANGe:AUTO 1

Command	:SOURce[1]:CURRent:RANGe:AUTO?
Function	Query state of auto range
Example	:SOURce:CURRent:RANGe:AUTO?

Command	:SOURce[1]:VOLTage:RANGe:AUTO <b>
Function	This command is used to enable or disable auto range for the specified source. When enabled, the instrument will automatically select the most sensitive range for the specified source level. When disabled, the instrument will use the range that the instrument is currently on. Auto range will be disabled if a fixed range is selected (see previous Command). Both *RST and :SYSTem:PREset enables source auto range. When the GSM goes into the local state, source auto range disables.

	<b> = 0 or OFF	Disable auto range
	1 or ON	Enable auto range
Example	:SOURce:VOLTage:RANGe:AUTO 1	

Command	:SOURce[1]:VOLTage:RANGe:AUTO?
Function	Query state of auto range
Example	:SOURce:VOLTage:RANGe:AUTO?

Command	:SOURce[1]:CURRent[:LEVel][:IMMediate][:AMPLitude] <n>	
Function	This command is used to immediately update the amplitude of a fixed I-Source. This command is not valid if the list or sweep mode is selected.	
	<n> = -1.05 to 1.05	Set I-Source amplitude (amps)
	DEFault	0A
	MINimum	-1.05A
	MAXimum	+1.05A
Example	:SOURce:CURRent 0	

Command	:SOURce[1]:CURRent?	
Function	:CURRent?	Query programmed amplitude of I-Source.
	:CURRent? DEFault	Query *RST default amplitude of I-Source.
	:CURRent? MINimum	Query lowest allowable amplitude of I-Source.
	:CURRent? MAXimum	Query highest allowable amplitude of I-Source.

Example	:SOURce:CURRent?

Command	:SOURce[1]:VOLTage[:LEVel][:IMMediate][:AMPLitude] <n>
Function	This command is used to immediately update the amplitude of a fixed V-Source. This command is not valid if the list or sweep mode is selected. <n> =-210 to 210 Set V-Source amplitude (volts) DEFault 0V MINimum -210V MAXimum +210V
Example	:SOURce:VOLTage 0

Command	:SOURce[1]:VOLTage?	
Function	:VOLTage?	Query programmed amplitude of V-Source.
	:VOLTage? DEFault	Query *RST default amplitude of V-Source.
	:VOLTage? MINimum	Query lowest allowable amplitude of V-Source.
	:VOLTage? MAXimum	Query highest allowable amplitude of V-Source.
Example	:SOURce:VOLTage?	

Command	:SOURce[1]:CURRent[:LEVel]:TRIGgered[:AMPLitude] <n>
Function	This command performs the same as the [:IMMediate][:AMPLitude] command except that the amplitude is not updated immediately.

	With this command, the amplitude is updated when the GSM is triggered to perform a source-measure operation. For example, if the instrument is waiting in the trigger layer for an external trigger, the amplitude of the source will not update until that external trigger is received by the GSM. The MINimum and MAXimum parameters are only valid if the highest source range is presently selected. Sending the MINimum or MAXimum parameters on a lower source range will generate error -221 (Setting Conflict).	
	<n> = -1.05 to 1.05	Set I-Source amplitude (amps)
	DEFault	0A
	MINimum	-1.05A
	MAXimum	+1.05A
Example	:SOURce:CURRent:TRIGgered 0	

Command	:SOURce[1]:CURRent[:LEVel]:TRIGgered?	
Function	:TRIGgered?	Query triggered amplitude for fixedI-Source.
	:TRIGgered? DEFault	Query *RST default amplitude.
	:TRIGgered? MINimum	Query lowest allowable amplitude.
	:TRIGgered? MAXimum	Query highest allowable amplitude.
Example	:SOURce:CURRent:TRIGgered?	

Command	:SOURce[1]:VOLTage[:LEVel]:TRIGgered[:AMPLitude] <n>

Function	This command performs the same as the [:IMMediate][:AMPLitude] command except that the amplitude is not updated immediately. With this command, the amplitude is updated when the GSM is triggered to perform a source-measure operation. For example, if the instrument is waiting in the trigger layer for an external trigger, the amplitude of the source will not update until that external trigger is received by the GSM. The MINimum and MAXimum parameters are only valid if the highest source range is presently selected. Sending the MINimum or MAXimum parameters on a lower source range will generate error -221 (Setting Conflict). <n> = -210 to 210 Set V-Source amplitude (volts) DEFault 0V MINimum -210V MAXimum +210V
Example	:SOURce:VOLTage:TRIGgered 0

Command	:SOURce[1]:VOLTage[:LEVel]:TRIGgered?	
Function	:TRIGgered?	Query triggered amplitude for fixed V-Source.
	:TRIGgered? DEFault	Query *RST default amplitude.
	:TRIGgered? MINimum	Query lowest allowable amplitude.
	:TRIGgered? MAXimum	Query highest allowable amplitude.
Example	:SOURce:VOLTage:TRIGgered?	

Command	:SOURce[1]:VOLTage:PROTection[:LEVel] <n>
Function	This command is used to set the Over Voltage Protection (OVP) limit for the V-Source. The V-Source output will not exceed the selected limit. When Vsrc exceed the value of OVP, voltage of the input/output port will be the value of OVP. The OVP limit is also enforced when in the I-Source Mode. The limit parameter values are magnitudes and are in effect for both positive and negative output voltage. You can express the limit as a positive or negative value. <n> = -210 to 210 — Specify V-Source limit NONE — Disable OVP function DEFault — Set limit to 210V MINimum — Set limit to 20V MAXimum — Set limit to 210V
Example	:SOURce:VOLTage:PROTection 20

Command	:SOURce[1]:VOLTage:PROTection[:LEVel]?
Function	[:LEVel]? — Query voltage protection limit level [:LEVel]? DEFault — Query *RST default limit [:LEVel]? MINimum — Query lowest allowable limit [:LEVel]? MAXimum — Query highest allowable limit
Example	:SOURce:VOLTage:PROTection?

Command :SOURce[1]:DELay <n>

Function	This command is used to manually set a delay (settling time) for the source. After the programmed source is turned on, this delay occurs to allow the source level to settle before a measurement is taken.

NOTE : This delay is the same for both the I-Source and V-Source.

Do not confuse this source delay with the trigger delay. The source delay is part of the device action (SDM cycle) while the trigger delay occurs before the device action.
Auto delay can instead be used to automatically set the source delay.

<n> = 0 to 999.9999	Specify delay in seconds
MINimum	0 seconds
MAXimum	999.9999 seconds
DEFault	0.001seconds

Example	:SOURce:DELay 0

Command	:SOURce[1]:DELay?	
Function	:DELay?	Query delay.
	:DELay? DEFault	Query *RST default delay.
	:DELay? MINimum	Query lowest allowable delay.
	:DELay? MAXimum	Query highest allowable delay.
Example	:SOURce:DELay?	

Command	:SOURce[1]:DELay:AUTO <b>
Function	This command is used to enable or disable auto delay. When enabled, the instrument will automatically select a delay period that is appropriate

	for the present source/measure setup configuration. *RST and SYST:PRES default is ON.
	<b> = 0 or OFF — Disable auto delay 1 or ON — Enable auto delay
Example	:SOURce:DELay:AUTO 1

Command	:SOURce[1]:DELay:AUTO?
Function	Query state of auto delay
Example	:SOURce:DELay:AUTO?

Command	:SOURce[1]:SWEep:RANGing <name>
Function	This command is used to select the source ranging mode for sweeps. With BEST selected, the GSM will select a single fixed source range that will accommodate all the source levels in the sweep. With AUTO selected, the GSM will automatically go to the most sensitive source range for each source level in the sweep. With FIXed selected, the source remains on the range that it is presently on when the sweep is started. For sweep points that exceed the source range capability, the source will output the maximum level for that range. <name> = BEST — Use the best fixed mode AUTO — Use the most sensitive source range for each sweep level FIXed — Use the present source range for the entire sweep
Example	:SOURce:SWEep:RANGing BEST

Command	:SOURce[1]:SWEep:RANGing?
Function	Query source ranging mode
Example	:SOURce:SWEep:RANGing?

Command	:SOURce[1]:SWEep:SPACing <name>
Function	This command is used to select the scale for the sweep. With LINear selected, the source-measure points in the sweep will be performed on a linear scale. With LOGarithmic selected, the source-measure points will be performed on a logarithmic scale. <name> = LINear Linear scale LOGarithmic Logarithmic scale
Example	:SOURce:SWEep:SPACing LINear

Command	:SOURce[1]:SWEep:SPACing?
Function	Query scale for sweep
Example	:SOURce:SWEep:SPACing?

Command	:SOURce[1]:CURRent:STARt <n>
Function	This command is used to specify the start level for a sweep. If using a fixed (manual) source range, the sweep will be performed using a source range that will accommodate all source values (Best Fixed Range). You can use source auto range if sweeping through one or more source ranges. When the sweep is started, the source will output the specified start level and, after the delay period of the SDM cycle, a measurement is performed.

	<n> = -1.05 to 1.05	Specify start current level
	DEFault	0A
	MINimum	-1.05A
	MAXimum	+1.05A

The sweep continues until the source outputs the specified stop level. At this level, the instrument again performs another measurement (after the SDM delay) and then stops the sweep.

The source-measure points in a sweep can be set by specifying a step size, or by specifying the number of source-measure points in the sweep.

:STARt and :STOP are coupled to :CENTer and :SPAN. Thus, when start and stop values are changed, the values for center and span are affected as follows:
Center=(Start + Stop)/2
Span=Stop-Start

Example :SOURce:CURRent:STARt 0.02

Command :SOURce[1]:CURRent:STARt?

Function	:STARt?	Query start level for sweep.
	:STARt? DEFault	Query *RST default level.
	:STARt? MINimum	Query lowest allowable level.
	:STARt? MAXimum	Query highest allowable level .

Example :SOURce:CURRent:STARt?

Command :SOURce[1]:VOLTage:STARt <n>

Function This Command is used to specify the start levels for a sweep. If using a fixed (manual) source range, the sweep will be performed using a source range that will accommodate all source values (Best Fixed Range). You can use source auto range if sweeping through one or more source ranges.

When the sweep is started, the source will output the specified start level and, after the delay period of the SDM cycle, a measurement is performed.

<n> =-210 to 210	Specify start voltage level
DEFault	0V
MINimum	-210V
MAXimum	+210V

The sweep continues until the source outputs the specified stop level. At this level, the instrument again performs another measurement (after the SDM delay) and then stops the sweep.

The source-measure points in a sweep can be set by specifying a step size, or by specifying the number of source-measure points in the sweep.

:STARt and :STOP are coupled to :CENTer and :SPAN. Thus, when start and stop values are changed, the values for center and span are affected as follows:

Center=(Start + Stop)/2
Span=Stop-Start

Example	:SOURce:VOLTage:STARt DEFault

Command	:SOURce[1]:VOLTage:STARt?	
Function	:STARt?	Query start level for sweep.
	:STARt? DEFault	Query *RST default level.
	:STARt? MINimum	Query lowest allowable level.
	:STARt? MAXimum	Query highest allowable level .
Example	:SOURce:VOLTage:STARt?	

Command	:SOURce[1]:CURRent:STOP <n>
Function	This Command is used to specify the stop level for a sweep. If using a fixed (manual) source range, the sweep will be performed using a source range that will accommodate all source values (Best Fixed Range). You can use source auto range if sweeping through one or more source ranges.

When the sweep is started, the source will output the specified start level and, after the delay period of the SDM cycle, a measurement is performed.

<n> = -1.05 to 1.05	Specify stop current level
DEFault	0A
MINimum	-1.05A
MAXimum	+1.05A

The sweep continues until the source outputs the specified stop level. At this level, the instrument again performs another measurement (after the SDM delay) and then stops the sweep.

The source-measure points in a sweep can be set by specifying a step size, or by specifying the number of source-measure points in the sweep.

:STARt and :STOP are coupled to :CENTer and :SPAN. Thus, when start and stop values are changed, the values for center and span are affected as follows:

Center=(Start+Stop)/2

Span=Stop-Start

Example	:SOURce:CURRent:STOP 0.08

Command	:SOURce[1]:CURRent:STOP?

Function	:STOP?	Query stop level for sweep.
	:STOP? DEFault	Query *RST default level.
	:STOP? MINimum	Query lowest allowable level.
	:STOP? MAXimum	Query highest allowable level.
Example	:SOURce:CURRent:STOP?	

Command	:SOURce[1]:VOLTage:STOP <n>
Function	This Command is used to specify the stop level for a sweep. If using a fixed (manual) source range, the sweep will be performed using a source range that will accommodate all source values (Best Fixed Range). You can use source auto range if sweeping through one or more source ranges.

When the sweep is started, the source will output the specified start level and, after the delay period of the SDM cycle, a measurement is performed.

<n> =-210 to 210	Specify stop voltage level
DEFault	0V
MINimum	-210V
MAXimum	+210V

The sweep continues until the source outputs the specified stop level. At this level, the instrument again performs another measurement (after the SDM delay) and then stops the sweep.
The source-measure points in a sweep can be set by specifying a step size, or by specifying the number of source-measure points in the sweep.

:STARt and :STOP are coupled to :CENTer and :SPAN. Thus, when start and stop values are changed, the values for center and span are affected as follows:

	Center=(Start + Stop)/2	
	Span=Stop-Start	
Example	:SOURce:VOLTage:STOP 0	

Command	:SOURce[1]:VOLTage:STOP?	
Function	:STOP?	Query start level for sweep.
	:STOP? DEFault	Query *RST default level.
	:STOP? MINimum	Query lowest allowable level.
	:STOP? MAXimum	Query highest allowable level.
Example	:SOURce:VOLTage:STOP?	

Command :SOURce[1]:CURRent:CENTer <n>

Function

A sweep can be configured by specifying center and span parameters.

By specifying a center point, you can sweep through the operating point of a device. The span determines the sweep width with the operating point at the center of the sweep.

For example, assume you are testing a device that operates at 10V, and you want to sweep from 8 to 12 volts. To do this, you would specify the center to be 10V and the span to be 4 volts (12 - 8).

Use the :STEP or :POINts Command to specify the number of source-measure points in the sweep. :CENTer and :SPAN are coupled to :STARt and :STOP. Thus, when center and span values are changed, the values for start and stop are affected as follows:

Start=Center-(Span/2)

Stop=Center+(Span/2)

	<n> = -1.05 to 1.05	Set I-Source level (amps)
	DEFault	0A
	MINimum	-1.05A
	MAXimum	+1.05A
Example	:SOURce:CURRent:CENTer 0.1	

Command	:SOURce[1]:CURRent:CENTer?	
Function	:CENTer?	Query center point for sweep of I-Source
	:CENTer? DEFault	Query *RST default level of I-Source
	:CENTer? MINimum	Query lowest allowable level of I-Source
	:CENTER? MAXimum	Query highest allowable level of I-Source
Example	:SOURce:CURRent:CENTer?	

Command	:SOURce[1]:VOLTage:CENTer <n>
Function	A sweep can be configured by specifying center and span parameters. By specifying a center point, you can sweep through the operating point of a device. The span determines the sweep width with the operating point at the center of the sweep. For example, assume you are testing a device that operates at 10V, and you want to sweep from 8 to 12 volts. To do this, you would specify the center to be 10V and the span to be 4 volts (12v – 8v). Use the :STEP or :POINts Command to specify the number of sourcemeasure points in the sweep.

	:CENTer and :SPAN are coupled to :STARt and :STOP. Thus, when center and span values are changed, the values for start and stop are affected as follows: Start=Center-(Span/2) Stop=Center+(Span/2) <n> =-210 to 210 Set V-Source level (volts) DEFault 0V MINimum -210V MAXimum +210V
Example	:SOURce:VOLTage:CENTer 1

Command	:SOURce[1]:VOLTage:CENTer?	
Function	:CENTer?	Query center point for sweep of V-Source
	:CENTer? DEFault	Query *RST default level of V-Source
	:CENTer? MINimum	Query lowest allowable level of V-Source
	:CENTER? MAXimum	Query highest allowable level of V-Source
Example	:SOURce:VOLTage:CENTer?	

Command	:SOURce[1]:CURRent:SPAN <n>
Function	A sweep can be configured by specifying center and span parameters. By specifying a center point, you can sweep through the operating point of a device. The span determines the sweep width with the operating point at the center of the sweep.

For example, assume you are testing a device that operates at 10V, and you want to sweep from 8 to 12 volts. To do this, you would specify the center to be 10V and the span to be 4 volts (12v – 8v).

Use the :STEP or :POINts Command to specify the number of sourcemeasure points in the sweep.

:CENTer and :SPAN are coupled to :STARt and :STOP. Thus, when center and span values are changed, the values for start and stop are affected as follows:

Start=Center-(Span/2)

Stop=Center+(Span/2)

	<n> = -2.1 to 2.1	Set I-Source level (amps)
	DEFault	0A
	MINimum	-2.1A
	MAXimum	+2.1A
Example	:SOURce:CURRent:SPAN 0.05	

Command	:SOURce[1]:CURRent:SPAN?	
Function	:SPAN?	Query span for sweep of I-Source
	:SPAN? DEFault	Query *RST default level of I-Source
	:SPAN? MINimum	Query lowest allowable level of I-Source
	:SPAN? MAXimum	Query highest allowable level of I-Source
Example	:SOURce:CURRent:SPAN?	

Command	:SOURce[1]:VOLTage:SPAN <n>
Function	A sweep can be configured by specifying center and span parameters. By specifying a center point, you can sweep through the operating point of a device. The span determines the sweep width with the operating point at the center of the sweep. For example, assume you are testing a device that operates at 10V, and you want to sweep from 8 to 12 volts. To do this, you would specify the center to be 10V and the span to be 4 volts (12 - 8). Use the :STEP or :POINts Command to specify the number of sourcemeasure points in the sweep. :CENTer and :SPAN are coupled to :STARt and :STOP. Thus, when center and span values are changed, the values for start and stop are affected as follows: Start=Center-(Span/2) Stop=Center+(Span/2)

	<n> =-420 to 420	Set V-Source level (volts)
	DEFault	0V
	MINimum	-420V
	MAXimum	+420V

Example	:SOURce:VOLTage:SPAN 0

Command	:SOURce[1]:VOLTage:SPAN?	
Function	:SPAN?	Query span for sweep of V-Source
	:SPAN? DEFault	Query *RST default level of V-Source

	:SPAN? MINimum	Query lowest allowable level of V-Source
	:SPAN? MAXimum	Query highest allowable level of V-Source
Example	:SOURce:VOLTage:SPAN?	

Command	:SOURce[1]:CURRent:STEP <n>
Function	This Command is used to specify a step size for a linear sweep. When the sweep is started, the source level changes in equal steps from the start level to the stop level. A measurement is performed at each source step (including the start and stop levels).

<n> = -2.1 to 2.1	Set I-Source level (amps)
DEFault	0A
MINimum	-2.1A
MAXimum	+2.1A

This Command cannot be used for a logarithmic sweep. Use the :POINTs Command to set the source-measure points for a log sweep.

To avoid a setting conflicts error, make sure the step size is greater than the start value and less than the stop value.

The number of source-measure points in a linear sweep can be calculated as follows:

Points=[(Stop-Start)/Step]+1 or

Points=(Span/Step)+1

An alternate way to set the source-measure points in a linear sweep is to simply specify the number of source-measure points in the sweep using the :POINts Command.

	NOTE that the :STEP and :POINts Commands are coupled. Changing the step size also changes the number of source-measure points. Conversely, changing the number of source-measure points changes the step size.
Example	:SOURce:CURRent:STEP 0.1

Command	:SOURce[1]:CURRent:STEP?	
Function	:STEP	Query step size for sweep of I-Source
	:STEP? DEFault	Query *RST default level of I-Source
	:STEP? MINimum	Query lowest allowable level of I-Source
	:STEP? MAXimum	Query highest allowable level of I-Source
Example	:SOURce:CURRent:STEP?	

Command :SOURce[1]:VOLTage:STEP <n>

Function This Command is used to specify a step size for a linear sweep. When the sweep is started, the source level changes in equal steps from the start level to the stop level. A measurement is performed at each source step (including the start and stop levels).

<n> =-420 to 420	Set V-Source level (volts)
DEFault	0V
MINimum	-420V
MAXimum	+420V

This Command cannot be used for a logarithmic sweep. Use the :POINTs Command to set the source-

	measure points for a log sweep. To avoid a setting conflicts error, make sure the step size is greater than the start value and less than the stop value. The number of source-measure points in a linear sweep can be calculated as follows: Points=[(Stop-Start)/Step]+1 or Points=(Span/Step)+1 An alternate way to set the source-measure points in a linear sweep is to simply specify the number of source-measure points in the sweep using the :POINts Command. NOTE that the :STEP and :POINts Commands are coupled. Changing the step size also changes the number of source-measure points. Conversely, changing the number of source-measure points changes the step size.
Example	:SOURce:VOLTage:STEP 0.1

Command	:SOURce[1]:VOLTage:STEP?	
Function	:STEP	Query step size for sweep of V-Source
	:STEP? DEFault	Query *RST default level of V-Source
	:STEP? MINimum	Query lowest allowable level of V-Source
	:STEP? MAXimum	Query highest allowable level of V-Source
Example	:SOURce:VOLTage:STEP?	

Command	:SOURce[1]:SWEep:POINts <n>
Function	The :POINts Command specifies the total number of source-measure points in a sweep. For a linear sweep, the source-measure points are equally spaced (stepped) between the start level and the stop level. For a log sweep, the source-measure points are equally spaced on a logarithmic scale. NOTE that the start and stop levels are source-measure points. Step size for a linear sweep can be calculated as follows: Step Size = (Stop - Start) / (Points - 1) Step Size = Span / (Points -1) Step size for a logarithmic sweep can be calculated as follows: Log Step Size=[log10(Stop)-log10(Start)]/(Points-1) An alternate way to set the source-measure points in a sweep is to specify the step size using the :STEP Command. NOTE that the :POINts and :STEP Commands are coupled. Changing the number of source-measure points also changes the step size. Conversely, changing the step size changes the number of source-measure points. <n> = 1 to 2500 Specify number of source-measure points MINimum 1 MAXimum 2500 DEFault 2500
Example	:SOURce:SWEep:POINts 1

Command	:SOURce[1]:SWEep:POINts?	
Function	:POINts?	Query number of sweep points
	:POINts? DEFault	Query *RST default number of sweep points
	:POINts? MINimum	Query lowest allowable number of sweep points
	:POINts? MAXimum	Query highest allowable number of sweep points
Example	:SOURce:SWEep:POINts?	

Command	:SOURce[1]:SWEep:DIRection <name>	
Function	Normally, a sweep is run from the start level to the stop level. The :STARt and :STOP, or :CENTer and :SPAN Commands are used to set these levels. This Command lets you change the execution direction of the sweep. With DOWn selected, the sweep will begin at the stop level and end at the start level. Selecting UP restores sweep operation to the normal start to stop direction.	
	<name> = UP	Run sweep from start to stop
	DOWn	Run sweep from stop to start
Example	:SOURce:SWEep:DIRection UP	

Command	:SOURce[1]:SWEep:DIRection?
Function	Query direction of sweep.
Example	:SOURce:SWEep:DIRection?

Command	:SOURce[1]:SWEep:CABort <name>
Function	This feature aborts a sweep in progress if compliance is detected. There are three modes: NEVer, EARLy, and LATE. NEVer turns off the feature, EARLy will abort when compliance is detected at the beginning of the SDM cycle, and LATE aborts if the compliance is detected at the end of the SDM cycle. <name> = NEVer — Disable abort on compliance EARLy — Abort at start of SDM cycle LATE — Abort at end of SDM cycle
Example	:SOURce:SWEep:CABort NEVer

Command	:SOURce[1]:SWEep:CABort?
Function	Query abort on compliance
Example	:SOURce:SWEep:CABort?

Command	:SOURce[1]:LIST:CURRent <NRf list>
Function	This Command is used to define a list of source values (up to 100) for the list sourcing mode of operation. When operation is started, the instrument will sequentially source each current value in the list. A measurement is performed at each source level. The following Command shows the proper format for defining an I-Source list using current source values of 10mA, 130mA and 5mA: :SOURce[1]:LIST:CURRent 0.01, 0.13, 0.005 <NRf list>= NRf, NRf … NRf NRf = -1.05 to 1.05 — I-Source value

	In order to execute a source list, the selected source must be in the list sourcing mode, and the product of the arm and trigger count should be at least the same as the number of source points in the list. Use the :FUNCtion:MODE Command to select the current or voltage source function. Use the :CURRent:MODE or VOLTage:MODE Command to select the LIST sourcing mode. The trigger count is set using the TRIGger:COUNt Command.
Example	:SOURce:LIST:CURRent 0.01,0.013

Command	:SOURce[1]:LIST:CURRent?
Function	Query I-Source list
Example	:SOURce:LIST:CURRent?

Command	:SOURce[1]:LIST:VOLTage <NRf list>
Function	This Command is used to define a list of source values (up to 100) for the list sourcing mode of operation. When operation is started, the instrument will sequentially source each voltage value in the list. A measurement is performed at each source level. The following Command shows the proper format for defining an V-Source list using current source values of 10mV, 130mV and 5mV: :SOURce[1]:LIST: VOLTage 0.01, 0.13, 0.005 <NRf list>= NRf, NRf … NRf NRf = -210 to 210 V-Source value In order to execute a source list, the selected source must be in the list sourcing mode, and the product of the arm and trigger count should be at least the same as the number of source points in the list.

	Use the :FUNCtion:MODE Command to select the current or voltage source function. Use the :CURRent:MODE or VOLTage:MODE Command to select the LIST sourcing mode. The trigger count is set using the TRIGger:COUNt Command.
Example	:SOURce:LIST:VOLTage 0.01,0.13,0.005

Command	:SOURce[1]:LIST:VOLTage?
Function	Query V-Source list
Example	:SOURce:LIST:VOLTage?

Command	:SOURce[1]:LIST:CURRent:APPend <NRf list>
Function	This Command is used to add one or more values (up to 100) to a source list that already exists. The source values are appended to the end of the list. (By using multiple appended lists, up to 2500 points can be in a list.) <NRf list>=NRf,NRf … NRf NRf = -1.05 to 1.05 I-Source value
Example	:SOURce:LIST:CURRent:APPend 0.0003,0.0005

Command	:SOURce[1]:LIST:VOLTage:APPend <NRf list>
Function	This Command is used to add one or more values (up to 100) to a source list that already exists. The source values are appended to the end of the list. (By using multiple appended lists, up to 2500 points can be in a list.) <NRf list>=NRf,NRf … NRf NRf = -210 to 210 V-Source value
Example	:SOURce:LIST:VOLTage:APPend 4,3

Command	:SOURce[1]:LIST:CURRent:POINts?
Function	Query length of I-Source lis
Example	:SOURce:LIST:CURRent:POINts?

Command	:SOURce[1]:LIST:VOLTage:POINts?
Function	Query length of V-Source list
Example	:SOURce:LIST:VOLTage:POINts?

Command	:SOURce[1]:LIST:CURRent:STARt <n>	
Function	This Command sets the starting point in the current list sweep. The <n> parameter is 1-based, and it must be less than or equal to the number of points in the sweep. The new starting location will only be used when the direction of the sweep is up (:SOUR:LIST:CURR:DIR UP, for example). Changing the direction to down will make the sweep start at the last point in the list, but the starting point will be restored when the direction is changed to up. If the sweep reaches the end of the list, the sweep will continue from the first point in the list. The starting points for voltage and current sweeps are saved separately, and are part of a user-saved setup.	
	<n> = 1 to 100	Set start point of list sweep
	MINimum	1
	MAXimum	100
	DEFault	1
Example	:SOURce:LIST:CURRent:STARt 1	

Command	:SOURce[1]:LIST:VOLTage:STARt <n>

Function	These Commands set the starting point in the voltage list sweep. The <n> parameter is 1-based, and it must be less than or equal to the number of points in the sweep. The new starting location will only be used when the direction of the sweep is up (:SOUR:LIST:CURR:DIR UP, for example). Changing the direction to down will make the sweep start at the last point in the list, but the starting point will be restored when the direction is changed to up. If the sweep reaches the end of the list, the sweep will continue from the first point in the list. The starting points for voltage and current sweeps are saved separately, and are part of a user-saved setup.
	<n> = 1 to 100 — Set start point of list sweep
	MINimum — 1
	MAXimum — 100
	DEFault — 1
Example	:SOURce:LIST:VOLTage:STARt 1

Command	:SOURce[1]:MEMory:SAVE <NRf>
Function	This Command is used to save the present instrument setup in specified memory location. Up to 100 setups can be saved. The following settings are saved in each source memory location: SENSe[1]:CURRent:NPLCycles SENSe[1]:Resistance:NPLCycles SENSe[1]:VOLTage:NPLCycles SENSe[1]:FUNCtion:CONCurrent SENSe[1]:FUNCtion:ON SENSe[1]:FUNCtion:OFF SENSe[1]:Resistance:MODE

SENSe[1]:Resistance:OCOMpensated

SENSe[1]:AVERage:STATe

SENSe[1]:AVERage:TCONtrol

SENSe[1]:AVERage:COUNt

SOURce[1]:FUNCtion:MODE

SOURce[1]:DELay

SOURce[1]:DELay:AUTO

SOURce[1]...X...:TRIGgered:SFACtor

SOURce[1]...X...:TRIGgered:SFACtor:STATe

where: ...X... = :CURRent or :VOLTage (based on source mode)

Source Value, Range, Auto Range

Sense Protection, Range, Auto Range

SYSTem:GUARd

SYSTem:RSENse

ROUTe:TERMinals

CALCulate1:STATe

CALCulate1:MATH[:EXPRession]:NAME

CALCulate2:FEED

CALCulate2:NULL:OFFSet

CALCulate2:NULL:STATe

CALCulate2:LIMit[1]:STATe

CALCulate2:LIMit[1]:COMPliance:FAIL

CALCulate2:LIMit[1]:COMPliance:SOURce2

CALCulate2:LIMitX:STATe

CALCulate2:LIMitX:UPPer[:DATA]

CALCulate2:LIMitX:UPPer:SOURce2

CALCulate2:LIMitX:LOWer[:DATA]

CALCulate2:LIMitX: LOWer:SOURce2

CALCulate2:LIMitX: PASS:SOURce2

where: X=2, 3 and 5 through 12

After saving the desired setups in consecutive memory locations, use the :POINts Command to specify how many sweep points to perform and the :STARt Command to specify where to start from.

<NRf>=1 to 100	Specify memory location

Example :SOURce:MEMory:SAVE 1

Command :SOURCe:MEMory:POINts <NRf>

Function This Command is used to specify the number of points for the sweep.

For example, if you saved setups in memory locations 1 through 12 for a sweep, specify a 12-point sweep using this Command.

<NRf> = 1 to 100	Number of sweep points

Example :SOURCe:MEMory:POINts 1

Command :SOURCe:MEMory:RECall <NRf>

Function This Command is used to return the GSM to the setup stored at the specified memory location.

<NRf> = 1 to 100	Specify memory location

Example :SOURCe:MEMory:RECall 1

Command :SOURce[1]:CURRent[:LEVel]:TRIGgered:SFACtor <n>

Function :SFAC instructs the GSM to source the scaling factor times the previous source memory location value. For

	example, if 10.0V is stored in the first source memory (Source I, Measure V Mode), and the unit is in the Source V, Measure I mode with :SFAC set to 0.1 and enabled, the unit will output 1.0V for the second source memory location.
	<n> = -999.9999e+18 to 999.9999e+18 Scaling factor
Example	:SOURce:CURRent:TRIGgered:SFACtor 0

Command	:SOURce[1]: CURRent [:LEVel]:TRIGgered:SFACtor?
Function	Query scaling factor
Example	:SOURce: CURRent:TRIGgered:SFACtor？

Command	:SOURce[1]:VOLTage[:LEVel]:TRIGgered:SFACtor <n>
Function	:SFAC instructs the GSM to source the scaling factor times the previous source memory location value. For example, if 10.0V is stored in the first source memory (Source I, Measure V Mode), and the unit is in the Source V, Measure I mode with :SFAC set to 0.1 and enabled, the unit will output 1.0V for the second source memory location.
	<n> = -999.9999e+18 to 999.9999e+18 Scaling factor
Example	:SOURce:VOLTage:TRIGgered:SFACtor 0

Command	:SOURce[1]:VOLTage[:LEVel]:TRIGgered:SFACtor <n>?
Function	Query scaling factor
Example	:SOURce:VOLTage:TRIGgered:SFACtor？

Command	:SOURce[1]:CURRent[:LEVel]:TRIGgered:SFACtor:STATe <b>

Function	:SFAC:STAT enables or disables current scaling.	
	<b> = 1 or ON	Enable scaling
	0 or OFF	Disable scaling
Example	:SOURce:CURRent:TRIGgered:SFACtor:STATe 0	

Command	:SOURce[1]:CURRent[:LEVel]:TRIGgered:SFACtor:STATe?
Function	Query enabled/disabled scaling state
Example	:SOURce:CURRent:TRIGgered:SFACtor:STATe?

Command	:SOURce[1]:VOLTage[:LEVel]:TRIGgered:SFACtor:STATe <b>	
Function	:SFAC:STAT enables or disables voltage scaling.	
	<b> = 1 or ON	Enable scaling
	0 or OFF	Disable scaling
Example	:SOURce:VOLTage:TRIGgered:SFACtor:STATe 0	

Command	:SOURce[1]:VOLTage[:LEVel]:TRIGgered:SFACtor:STATe?
Function	Query enabled/disabled scaling state
Example	:SOURce:VOLTage:TRIGgered:SFACtor:STATe?

Command	:SOURce[1]:SOAK <NRf>
Function	With SYST:RCMode set to MULTiple, SOUR:SOAK specifies the amount of time after the first point of a sweep that the unit will sit in a loop actively autoranging up and down to allow a multiple GSM configuration to settle. This process will be done only once per INIT, READ?, or MEAS? Command.

	The soak time is especially useful for low current measurements when multiple down-range changes from the higher ranges are required. <NRf> = soak time (s) 0.000 to 9999.999s	
Example	:SOURce:SOAK 0	

Command	:SOURce[1]:SOAK?
Function	Query multiple mode soak time.
Example	:SOURce:SOAK?

Command	:SOURce2:TTL:[LEVel] [:DEFault] <NRf> | <NDN>
Function	This Command is used to set the logic levels of the output lines of the Digital I/O port. When set high, the specified output line will be at approximately +5V. When set low, the output line will be at 0V. Use the following table to determine the parameter value for the desired decimal digital output pattern:

OUT4	OUT3	OUT2	OUT1	Decimal value*
L	L	L	L	0
L	L	L	H	1
L	L	H	L	2
L	L	H	H	3
L	H	L	L	4
L	H	L	H	5
L	H	H	L	6
L	H	H	H	7
H	L	L	L	8
H	L	L	H	9
H	L	H	L	10
H	L	H	H	11
H	H	L	L	12
H	H	L	H	13
H	H	H	L	14
H	H	H	H	15

L = Low (Gnd)

H = High (>+3V)

*0-7 in 3-bit mode, 0-65535 in 16-bit mode

<NRf> | <NDN> = 0 to 7 3-bit

0 to 15 4-bit

Example	:SOURce2:TTL 0

Command	:SOURce2:TTL?
Function	Query default digital output value
Example	:SOURce2:TTL?

Command	:SOURce2:TTL:[LEVel]:ACTual?
Function	Query actual digital output value
Example	:SOURce2:TTL:ACTual?

Command	:SOURce2:TTL4:MODE <name>
Function	This Command controls the operation of Digital I/O line 4 to act as either an End-of-Test or Busy signal in the 3-bit output mode. EOT is not automatically controlled in 4-bit mode. Likewise, with BUSY enabled in the 4-bit mode, the unit behaves if it were in 3-bit mode by ignoring all attempts to drive Digital I/O line 4. <name> = EOTest Use line 4 as EOT signal BUSY Use line 4 as BUSY signal
Example	:SOURce2:TTL4:MODE EOTest

Command	:SOURce2:TTL4:MODE?
Function	Query Digital I/O line 4 mode
Example	:SOURce2:TTL4:MODE?

Command	:SOURce2:TTL4:BSTate <b>
Function	This Command sets the polarity of the EOT or BUSY signal in the 3-bit mode. <b> = 1 Set EOT/BUSY polarity high 0 Set EOT/BUSY polarity low
Example	:SOURce2:TTL4:BSTate 0

Command	:SOURce2:TTL4:BSTate?
Function	Query EOT/BUSY polarity

Example	:SOURce2:TTL4:BSTate?

Command	:SOURce2:BSIZe <n>
Function	This Command sets the Digital I/O bit size to 3 or 4. In the 3-bit mode, Digital I/O line 4 becomes EOT, /EOT, Busy, or /Busy based on the SOUR2:TTL4:MODE and SOUR2:TTL4:BST Commands above. In 4-bit mode, Digital I/O line 4 is controlled manually if SOUR2:TTL4:MODE is set to EOT. If SOUR2:TTL4:MODE is set to BUSY, operation is identical to the 3-bit mode.
	<n> = 3 Set 3-bit size
	4 Set 4-bit size
Example	:SOURce2:BSIZe 3

Command	:SOURce2:BSIZe?
Function	Query Digital I/O port bit size
Example	:SOURce2:BSIZe?

Command	:SOURce2:CLEar[:IMMediate]
Function	This action Command is used to immediately restore the digital output lines to the output pattern defined by the :TTL:LEVel Command.
Example	:SOURce2:CLEar

Command	:SOURce2:CLEar:AUTO <b>
Function	This Command is used to enable or disable auto-clear for the digital output lines. When enabled, the output pattern will clear automatically after the “pass or fail” output bit pattern of a limit test is sent to a handler

	via the digital output lines. The :DELay Command specifies the pulse width of the limit test bit pattern. After the delay period times out, the digital output clears back to the output pattern programmed by the :TTL:LEVel Command. When auto-clear is disabled, the digital output pattern can only be cleared by the :IMMediate Command.On power-up, auto clear is enabled. <b> = 0 or OFF Disable auto-clear 1 or ON Enable auto-clear
Example	:SOURce2:CLEar:AUTO 0

Command	:SOURce2:CLEar:AUTO?
Function	Query auto-clear
Example	:SOURce2:CLEar:AUTO?

Command	:SOURce2:CLEar:AUTO:DELay <n>
Function	This Command is used to set the delay for digital output auto-clear. This delay determines the pulse width of the limit test output pattern as required by the handler. After the delay, the output returns (clears) to the pattern programmed by the :TTL:LEVel Command. The delay actually defines the pulse width for line 4, which is used by category register component handlers as the end-of-test (EOT) strobe. The pulse width of the other three lines are 20µsec longer (10µsec before line 4 is toggled, and 10µsec after line 4 is cleared). Skewing the timing on line 4 provides setup and hold time for category register component handlers. <n> = 0 to 60 Specify delay (in seconds)

	DEFault	100µsec delay
	MINimum	0 sec
	MAXimum	60 sec

Example :SOURce2:CLEar:AUTO:DELay 0

Command	:SOURce2:CLEar:AUTO:DELay?	
Function	:DELay?	Query delay
	:DELay? DEFault	Query *RST default delay
	:DELay? MINimum	Query lowest allowable delay
	:DELay? MAXimum	Query maximum allowable delay

Example :SOURce2:CLEar:AUTO:DELay?

Measurement Commands

Command :CONFigure:<function>

Function This Command configures the instrument to a specific setup for measurements on the specified function.

When this Command is sent, the GSM will be configured as follows:

- Select specified function.
- All controls related to the selected function are defaulted to the *RST values.
- The event control source of the Trigger Model is set to Immediate.
- The count values of the Trigger Model are set to one.
- The Delay of the Trigger Model is set to zero.
- All math calculations are disabled.

	• Buffer operation is disabled. • The source output will turn on. When :CONFigure is sent, the output will turn on. Beware of hazardous voltage that may be present on the output terminals. <function> = CURRent[:DC] Amps function VOLTage[:DC] Volts function RESistance Ohms function
Example	:CONFigure:RESistance

Command	:CONFigure?
Function	Returns active function(s).
Example	:CONFigure?

Command	:FETCh?
Function	This query Command requests the latest post-processed readings stored in the sample buffer. After sending this Command and addressing the GSM to talk, the readings are sent to the computer. This Command does not affect the instrument setup. This Command does not trigger source-measure operations; it simply requests the last available readings. NOTE that this Command can repeatedly return the same readings. Until there are new readings, this Command continues to return the old readings. For example, assume that the GSM performed 20 source-measure operations. The :FETCh? Command will request the readings for those 20 source-measure operations. If :FETCh? is sent while performing source-measure operations (ARM annunciator on), it will not be executed until

	the GSM goes back into idle. The readings that are acquired depend on which data elements are selected, and what the instrument is presently programmed to source-measure. Measure readings take priority over source readings, and functions not sourced or measured are assigned the NAN (not a number) value of +9.91e37. For example, assume that voltage, current and resistance readings are selected as data elements, and the instrument is programmed to Source V and Measure I. A reading string acquired by :FETch? will include the programmed V-Source value and the I-Measure reading. The reading for resistance will be NAN since resistance was not measured. The :FETCh? Command is automatically asserted when the :READ? or:MEASure? Command is sent.
Example	:FETCh?

Command	:READ?
Function	This Command is used to trigger and acquire readings. The number of readings depends on how the trigger model is configured. For example, if configured for 20 source-measure operations (arm count 1, trigger count 20), then 20 sets of readings will be acquired after the GSM returns to the idle state. When this Command is sent, the following Commands execute in the order that they are presented: • :INITiate • :FETCh? The :INITiate Command starts operation by taking the instrument out of idle. After all source-measure operations are completed, the GSM goes back into idle at which time the :FETCh? Command is executed.

	The readings are sent to the computer and displayed when the GSM is addressed to talk. NOTE that if auto output-off is disabled (:SOURce1:CLEar:AUTO OFF), then the output must be turned on before you can perform a :READ?. The output will then remain on after all source-measure operations are completed. If auto output-off is enabled (:SOURce1:CLEar:AUTO ON), then the output will automatically turn on at the beginning of each SDM (source-delay-measure) cycle and turn off after each measurement.
Example	:READ?

Command	:MEASure[:<function>]?
Function	This Command combines other signal oriented measurement Commands to perform a “one-shot” measurement and acquire the reading. NOTE that if a function is not specified, the measurement will be done on the function that is presently selected. When this Command is sent, the following Commands execute in the order that they are presented. • :CONFigure:<function> • :READ? When :CONFigure is executed, the instrument goes into a “one-shot” measurement mode. See :CONFigure for more details. When :READ? is executed, its operations will then be performed. In general, another :ABORt is performed, then an :INITiate, and finally a FETCh? to acquire the readings. See :READ? for more details. When :MEASure? is sent, the source turns on and a single measurement is performed. If auto output-off is enabled (:SOURce1:CLEar:AUTO ON), then the output will turn off after the measurement is completed. If auto output-off is disabled (:SOURce1:CLEar:AUTO OFF), then the output will

	remain on after the measurement is completed. <function> = CURRent[:DC] Amps function VOLTage[:DC] Volts function RESistance Ohms function
Example	:MEASure?

Command	[:SENSe[1]]:FUNCtion:CONCurrent <b>
Function	This Command is used to enable or disable the ability of the instrument to measure more than one function simultaneously. When enabled, the instrument will measure the functions that are selected. When disabled, only one measurement function can be enabled. When making the transition from :CONCurrent ON to :CONCurrent OFF, the voltage (VOLT:DC) measurement function will be selected. All other measurement functions will be disabled. Use the :FUNCTion[:ON] Command to select one of the other measurement functions. The function selected with the SENSE:FUNC Command will not be displayed on the front panel if concurrent measurements are enabled. <b> = 0 or OFF Disable concurrent measurements 1 or ON Enable concurrent measurements
Example	:SENSe1:FUNCtion:CONCurrent 0

Command	[:SENSe[1]]:FUNCtion:CONCurrent?
Function	Query state of concurrent measurements
Example	:SENSe1:FUNCtion:CONCurrent?

Command	[:SENSe[1]]:FUNCtion[:ON] <function list>

Function	When concurrent measurements are disabled, this command is used to enable function to be measured. The [:ON] command is used to include (enable) one or more measurement functions in the list. NOTE that each function specified in the list must be enclosed in single or double quotes, and functions must be separated by commas (,).
	Examples: :FUNCtion “VOLTage”, “CURRent” enable volts and amps functions. NOTE that there is a stand-alone Command that can be used to enable or disable all three measurement functions. If concurrent measurements are disabled, the :ON Command can only turn on one function at a time.
	<function list> = “CURRent[:DC]” Amps measurement function “VOLTage[:DC]” Volts measurement function “RESistance” Ohms measurement function
	The function selected with the SENSE:FUNC Command will not be displayed on the front panel if concurrent measurements are enabled.
Example	:SENSe1:FUNCtion:ON "VOLT"

Command	[:SENSe[1]]:FUNCtion[:ON]?
Function	Query functions that are enabled
Example	:SENSe1:FUNCtion:ON?

Command	[:SENSe[1]]:FUNCtion[:ON]:ALL

Function	This Command is used to enable all measurement functions. When enabled (:ON:ALL), amps, volts, and ohms measurements will be performed simultaneously if concurrent measurements are enabled. If concurrent measurements are disabled, only the ohms function will be enabled. The :OFF:ALL Command disables all measurements.
Example	:SENSe1:FUNCtion:ON:ALL

Command	[:SENSe[1]]:FUNCtion:OFF <function list>
Function	When concurrent measurements are enabled, this Command is used to disable functions to be measured. The :OFF Command is used to remove (disable) one or more functions from the list. NOTE that each function specified in the list must be enclosed in single or double quotes, and functions must be separated by commas (,). Examples: :FUNCtion:OFF 'VOLTage', 'CURRent' disable volts and amps functions. NOTE that there is a stand-alone Command that can be used to enable or disable all three measurement functions. If concurrent measurements are disabled, the :ON Command can only turn on one function at a time. <function list> = "CURRent[:DC]" Amps measurement function "VOLTage[:DC]" Volts measurement function "RESistance" Ohms measurement function The function selected with the SENSE:FUNC Command will not be displayed on the front panel if concurrent measurements are enabled.
Example	:SENSe1:FUNCtion:OFF "RESistance"

Command	[:SENSe[1]]:FUNCtion:OFF?
Function	Query functions that are disabled
Example	:SENSe1:FUNCtion:OFF?

Command	[:SENSe[1]]:FUNCtion:OFF:ALL
Function	This Command is used to disable all measurement functions. When enabled (:ON:ALL), amps, volts, and ohms measurements will be performed simultaneously if concurrent measurements are enabled. If concurrent measurements are disabled, only the ohms function will be enabled. The :OFF:ALL Command disables all measurements.
Example	:SENSe1:FUNCtion:OFF:ALL

Command	[:SENSe[1]]:FUNCtion[:ON]:COUNt?
Function	This query Command is used to determine the number of functions that are enabled. When :ON:COUNt? is sent, the response message will indicate the number of functions that are enabled.
Example	:SENSe1:FUNCtion:ON:COUNt?

Command	[:SENSe[1]]:FUNCtion:OFF:COUNt?
Function	This query Command is used to determine the number of functions that are disabled. When :OFF:COUNt? is sent, the response message will indicate the number of functions that are disabled.
Example	:SENSe1:FUNCtion:OFF:COUNt?

Command	[:SENSe[1]]:FUNCtion:STATe? <name>

Function	This Command is used to query the state of the specified measurement function. A returned response message of "0" indicates that the specified function is disabled, while a "1" indicates that the function is enabled. <name> = "CURRent:DC" Amps measurement function "VOLTage:DC" Volts measurement function "RESistance" Ohms measurement function
Example	:SENSe1:FUNCtion:STATe? "RESistance"

Command	[:SENSe[1]]:Resistance:MODE <name>
Function	This Command is used to select the ohms measurement mode. With MANual ohms selected, the user must configure the source and measure aspects of the operation. When the ohms function is selected, the ohms reading is simply the result of the V/I calculation. Range changes cannot be made in manual ohms. With AUTO ohms selected, the GSM will be configured to Source I Measure V when the ohms function is selected. The I-Source value and voltage measurement range used depends on the ohms measurement range that is selected. <name> = MANual Manual ohms mode AUTO Auto ohms mode
Example	:SENSe1:Resistance:MODE MANual

Command	[:SENSe[1]]:Resistance:MODE?
Function	Query ohms mode

Example	:SENSe1:Resistance:MODE?

Command	[:SENSe[1]]:RESistance:OCOMpensated <b>
Function	This Command is used to enable or disable offset-compensated ohms. When using the auto ohms measurement mode, the current source level is automatically set. When using the manual ohms measurement mode, you must set the source (V or I) output level.

Offset-compensated ohms will disable when the :MEASure? Command (for the resistance function) or the :CONFigure:RESistance Command is sent.

⚠ **NOTE:**

1. You cannot select a current measurement range if sourcing current. Conversely, you cannot select a voltage measurement range if sourcing voltage. Also, autorange cannot be enabled for those source-measure configurations. The programmed source range determines measurement range.

2. You cannot select an ohms measurement range if in manual ohms (you must be in auto ohms).

3. The highest current measurement range that can be selected is limited by the current compliance range. For example, if current compliance is set for 50mA (100mA range), then the highest available current measurement range is 100mA. Similarly, the highest voltage measurement range is limited by the voltage compliance range.

4. Measurement range limitations: With the 200V source range selected, the highest current measurement range is 100mA. With the 1A source range selected, the highest voltage measurement range is 20V.

	<b> = 1 or ON	Enable offset compensation
	0 or OFF	Disable offset compensation
Example	:SENSe1:RESistance:OCOMpensated 0	

Command	[:SENSe[1]]: RESistance:OCOMpensated?
Function	Query state of offset compensation
Example	:SENSe1:RESistance:OCOMpensated?

Command	[:SENSe[1]]:CURRent[:DC]:RANGe[:UPPer] <n>|UP|DOWN	
Function	This Command is used to manually select the measurement range for the specified measurement function. The range is selected by specifying the expected reading. The instrument will then go to the most sensitive reading that will accommodate that reading. For example, if you expect a reading of approximately 50mV, then simply let <n>= 0.05 (or 50e-3) in order to select the 200mV range. You can also use the UP and DOWN parameters to select range. Each time UP or DOWN is sent, the next higher or lower measurement range is selected. When on the maximum range, sending UP is a No-Op (no operation). When on the lowest range, sending DOWN is a NO-Op. Measurement ranges can instead be automatically selected by the instrument.	
	<n> = 0 to 1.05	Expected reading in amps
	DEFault	1.05e-4 (amps)
	MINimum	1.05e-6 (amps)
	MAXimum	1.05 (amps)

	UP	Select next higher measurement range
	DOWN	Select next lower measurement range
Example	:SENSe1:CURRent:DC:RANGe:UPPer 0	

Command	[:SENSe[1]]:CURRent[:DC]:RANGe?	
Function	:RANGe?	Query measurement range.
	:RANGe? DEFault	Query *RST default range.
	:RANGe? MINimum	Query lowest range (returns 0).
	:RANGe? MAXimum	Query highest range.
Example	:SENSe:CURRent:DC:RANGe?	

Command	[:SENSe[1]]:VOLTage[:DC]:RANGe[:UPPer] <n>|UP|DOWN
Function	This Command is used to manually select the measurement range for the specified measurement function. The range is selected by specifying the expected reading. The instrument will then go to the most sensitive reading that will accommodate that reading. For example, if you expect a reading of approximately 50mV, then simply let <n>= 0.05 (or 50e-3) in order to select the 200mV range. You can also use the UP and DOWN parameters to select range. Each time UP or DOWN is sent, the next higher or lower measurement range is selected. When on the maximum range, sending UP is a No-Op (no operation). When on the lowest range, sending DOWN is a NO-Op. Measurement ranges can instead be automatically selected by the instrument.

	<n> = 0 to 210	Expected reading in volts
	DEFault	21V
	MINimum	210mV
	MAXimum	210V
	UP	Select next higher measurement range
	DOWN	Select next lower measurement range
Example	:SENSe1:VOLTage:DC:RANGe:UPPer DEFault	

Command	[:SENSe[1]]:VOLTage[:DC]:RANGe?	
Function	:RANGe?	Query measurement range.
	:RANGe? DEFault	Query *RST default range.
	:RANGe? MINimum	Query lowest range (returns 0).
	:RANGe? MAXimum	Query highest range.
Example	:SENSe1:VOLTage:DC:RANGe?	

Command [:SENSe[1]]:RESistance:RANGe[:UPPer] <n>|UP|DOWN

Function This Command is used to manually select the measurement range for the specified measurement function. The range is selected by specifying the expected reading. The instrument will then go to the most sensitive reading that will accommodate that reading. For example, if you expect a reading of approximately 50mV, then simply let <n>= 0.05 (or 50e-3) in order to select the 200mV range. You can also use the UP and DOWN parameters to select range. Each time UP or DOWN is sent, the next higher or lower measurement range is selected.

When on the maximum range, sending UP is no operation. When on the lowest range, sending DOWN is a NO-Op. Measurement ranges can instead be automatically selected by the instrument.

<n> =0 to 2.1e8	Expected reading in ohms
DEFault	2.1e5 (ohms)
MINimum	20 (ohms)
MAXimum	2.1e8 (ohms)
UP	Select next higher measurement range
DOWN	Select next lower measurement range

Example :SENSe1:RESistance:RANGe:UPPer MAXimum

Command [:SENSe[1]]: RESistance:RANGe?

Function

:RANGe?	Query measurement range
:RANGe? DEFault	Query *RST default range
:RANGe? MINimum	Query lowest range (returns 0)
:RANGe? MAXimum	Query highest range

Example :SENSe1:RESistance:RANGe?

Command [:SENSe[1]]:CURRent[:DC]:RANGe:AUTO <b>

Function This Command is used to control auto ranging of I-Source. With auto ranging enabled, the instrument automatically goes to the most sensitive range to perform the measurement. When this Command is used to disable auto range, the instrument remains at the automatically selected range. When a range is manually selected, auto range is disabled.

	<b> = 0 or OFF	Disable auto range
	1 or ON	Enable auto range
Example	:SENSe1:CURRent:DC:RANGe:AUTO 0	

Command	[:SENSe[1]]:CURRent[:DC]:RANGe:AUTO?
Function	Query state of auto range
Example	:SENSe1:CURRent:DC:RANGe:AUTO?

Command	[:SENSe[1]]:VOLTage[:DC]:RANGe:AUTO <b>	
Function	This Command is used to control auto ranging of V-Source. With auto ranging enabled, the instrument automatically goes to the most sensitive range to perform the measurement. When this Command is used to disable auto range, the instrument remains at the automatically selected range. When a range is manually selected, auto range is disabled.	
	<b> = 0 or OFF	Disable auto range
	1 or ON	Enable auto range
Example	:SENSe1:VOLTage:DC:RANGe:AUTO 0	

Command	[:SENSe[1]]:VOLTage[:DC]:RANGe:AUTO?
Function	Query state of auto range
Example	:SENSe1:VOLTage:DC:RANGe:AUTO?

Command	[:SENSe[1]]:RESistance:RANGe:AUTO <b>
Function	This Command is used to control auto ranging. With auto ranging enabled, the instrument automatically goes to the most sensitive range to perform the measurement. When this Command is used to disable auto range, the instrument remains at the automatically selected range. When a range is

	manually selected, auto range is disabled. <b> = 0 or OFF Disable auto range 1 or ON Enable auto range
Example	:SENSe1:RESistance:RANGe:AUTO 0

Command	[:SENSe[1]]:RESistance:RANGe:AUTO?
Function	Query state of auto range
Example	:SENSe1:RESistance:RANGe:AUTO?

Command	[:SENSe[1]]:CURRent[:DC]:RANGe:AUTO:LLIMit <n>
Function	Auto range lower limits are intended primarily for SYST:RCM MULT support. The lower limit for all three functions is programmable and must be less than or equal to the upper limit. If the lower limit is equal to the upper limit, auto ranging is effectively disabled. When autoranging is disabled, you can manually program the unit for any range below the lower limit. NOTE also that the maximum volts lower limit depends on the compliance setting. <n> = 0 to 1.05 Amps lower limit
Example	:SENSe1:CURRent:DC:RANGe:AUTO:LLIMit 0

Command	[:SENSe[1]]:CURRent[:DC]:RANGe:AUTO:LLIMit?
Function	Query auto range lower limit
Example	:SENSe1:CURRent:DC:RANGe:AUTO:LLIMit?

Command	[:SENSe[1]]:VOLTage[:DC]:RANGe:AUTO:LLIMit <n>

Function	Auto range lower limits are intended primarily for SYST:RCM MULT support. The lower limit for all three functions is programmable and must be less than or equal to the upper limit. If the lower limit is equal to the upper limit, auto ranging is effectively disabled. When autoranging is disabled, you can manually program the unit for any range below the lower limit. NOTE also that the maximum volts lower limit depends on the compliance setting. <n> = 0 to 210 Volts lower limit
Example	:SENSe1:VOLTage:DC:RANGe:AUTO:LLIMit 0

Command	[:SENSe[1]]:VOLTage[:DC]:RANGe:AUTO:LLIMit?
Function	Query auto range lower limit
Example	:SENSe1:VOLTage:DC:RANGe:AUTO:LLIMit?

Command	[:SENSe[1]]:RESistance:RANGe:AUTO:LLIMit <n>
Function	Auto range lower limits are intended primarily for SYST:RCM MULT support. The lower limit for all three functions is programmable and must be less than or equal to the upper limit. If the lower limit is equal to the upper limit, auto ranging is effectively disabled. When autoranging is disabled, you can manually program the unit for any range below the lower limit. NOTE also that the maximum volts lower limit depends on the compliance setting. <n> =0 to 2.1e8 Ohms lower limit
Example	:SENSe1:RESistance:RANGe:AUTO:LLIMit 0

Command	[:SENSe[1]]:RESistance:RANGe:AUTO:LLIMit?
Function	Query auto range lower limit
Example	:SENSe1:RESistance:RANGe:AUTO:LLIMit?

Command	[:SENSe[1]]:CURRent[:DC]:RANGe:AUTO:ULIMit?
Function	Query auto range upper limit
Example	:SENSe1:CURRent:DC:RANGe:AUTO:ULIMit?

Command	[:SENSe[1]]:VOLTage[:DC]:RANGe:AUTO:ULIMit?
Function	Query auto range upper limit
Example	:SENSe1:VOLTage:DC:RANGe:AUTO:ULIMit?

Command	[:SENSe[1]]:RESistance:RANGe:AUTO:ULIMit <n>	
Function	Auto range upper limits are intended primarily for SYST:RCM MULT support. For voltage and current, the upper limit is controlled by the compliance range and, therefore, is available only as a query. When autoranging is disabled, you can manually program the unit for any range above the upper limit (ohms only).	
	<n> = 0 to 2.1e8	Ohms upper limit
Example	:SENSe1:RESistance:RANGe:AUTO:ULIMit 0	

Command	[:SENSe[1]]:RESistance:RANGe:AUTO:ULIMit?
Function	Query auto range upper limit
Example	:SENSe1:RESistance:RANGe:AUTO:ULIMit?

Command	[:SENSe[1]]:CURRent[:DC]:RANGe:HOLDoff <b>
Function	Current range holdoff adds the ability to speed up low-current measurements when sourcing voltage and measuring current. This feature is only available when doing source memory sweeps. It will momentarily set the measure range to the compliance range to overcome the effects of capacitance by charging any capacitance on the

	higher compliance range, but return to the lower measure range to obtain a good low current measurement. This avoids being limited by range compliance, which would require either a longer delay time or having to take the current measurement on a higher current range. This feature is available only by remote, but parameters are saved for each source memory location. <b> = ON or OFF
Example	:SENSe1:CURRent:DC:RANGe:HOLDoff ON

Command	[:SENSe[1]]:CURRent[:DC]:RANGe:HOLDoff?
Function	Query holdoff state
Example	:SENSe1:CURRent:DC:RANGe:HOLDoff?

Command	[:SENSe[1]]:CURRent[:DC]:RANGe:HOLDoff:DELay <NRf>
Function	Current range holdoff adds the ability to speed up low-current measurements when sourcing voltage and measurement current. This feature is only available when doing source memory sweeps. It will momentarily set the measure range to the compliance range to overcome the effects of capacitance by charging any capacitance on the higher compliance range, but return to the lower measure range to obtain a good low current measurement. This avoids being limited by range compliance, which would require either a longer delay time or having to take the current measurement on a higher current range. This feature is available only by remote, but parameters are saved for each source memory location. <NRf> = Delay in seconds (0 to 999.9999)
Example	:SENSe1:CURRent:DC:RANGe:HOLDoff:DELay 0

Command	[:SENSe[1]]:CURRent[:DC]:RANGe:HOLDoff:DELay ?
Function	Query holdoff delay
Example	:SENSe1:CURRent:DC:RANGe:HOLDoff:DELay?

Command	[:SENSe[1]]:CURRent[:DC]:PROTection[:LEVel] <n>	
Function	This Command is used to set compliance limits. A current compliance limit is set for the V-Source, and a voltage compliance limit is set for the I-Source. The GSM cannot source levels that exceed these specified limits. The :SENSe:CURRent:PROTection[:LIMit] Command is used to set the current compliance for the V-Source and the :SENSe:VOLTage: PROTection[:LIMit] Command is used to set the voltage compliance for the I-Source.	
	<n> = -1.05 to 1.05	Current compliance limit
	DEFault	105uA
	MINimum	-1.05A
	MAXimum	1.05A
Example	:SENSe1:CURRent:DC:PROTection:LEVel 1	

Command	[:SENSe[1]]:CURRent[:DC]:PROTection:LEVel?	
Function	:LEVel?	Query compliance value.
	:LEVel? DEFault	Query *RST default compliance.
	:LEVel? MINimum	Query minimum allowable compliance.
	:LEVel? MAXimum	Query maximum allowable compliance.
Example	:SENSe1:CURRent:DC:PROTection:LEVel?	

Command	[:SENSe[1]]:VOLTage[:DC]:PROTection[:LEVel] <n>
Function	This Command is used to set compliance limits. A current compliance limit is set for the V-Source, and a voltage compliance limit is set for the I-Source. The GSM cannot source levels that exceed these specified limits. The :SENSe:CURRent:PROTection[:LIMit] Command is used to set the current compliance for the V-Source and the :SENSe:VOLTage: PROTection[:LIMit] Command is used to set the voltage compliance for the I-Source.
	<n> = -210 to 210 — Voltage compliance limit
	DEFault — 21V
	MINimum — -210V
	MAXimum — 210V
Example	:SENSe1:VOLTage:DC:PROTection:LEVel 23

Command	[:SENSe[1]]:VOLTage[:DC]:PROTection:LEVel?	
Function	:LEVel?	Query compliance value.
	:LEVel? DEFault	Query *RST default compliance.
	:LEVel? MINimum	Query minimum allowable compliance.
	:LEVel? MAXimum	Query maximum allowable compliance.
Example	:SENSe1:VOLTage:DC:PROTection:LEVel?	

Command	[:SENSe[1]]:CURRent[:DC]:PROTection:RSYNchronize <b>
Function	Turning this feature on will make the measurement range follow the compliance range setting when autoranging is off. When the compliance value is set,

	the measurement range will be on the same range as the compliance setting.	
	<b> = OFF	Disable range sync
	ON	Enable range sync
Example	:SENSe1:CURRent:DC:PROTection:RSYNchronize ON	

Command	[:SENSe[1]]:VOLTage[:DC]:PROTection:RSYNchronize <b>
Function	Turning this feature on will make the measurement range follow the compliance range setting when autoranging is off. When the compliance value is set, the measurement range will be on the same range as the compliance setting. The [:SENSe[1]]:CURRent[:DC]:PROTection:RSYNchronize <b> Command and the [:SENSe[1]]:VOLTage[:DC]:PROTection:RSYNchronize <b> Command change one setting; changing the state of one will automatically change the other.
	<b> = OFF — Disable range sync
	ON — Enable range sync
Example	:SENSe1:VOLTage:DC:PROTection:RSYNchronize ON

Command	[:SENSe[1]]:CURRent[:DC]:PROTection:TRIPped?
Function	This Command is used to determine if the source is in compliance. If a “1” is returned, then the source is in compliance. A “0” indicates that the source is not in compliance. The :CURRent:PROTection:TRIPped? Command is used to check the compliance state of the V-Source, and the :VOLTage:PROTection:TRIPped? Command is used to check the compliance state of the I-Source.
Example	:SENSe1:CURRent:DC:PROTection:TRIPped?

Command	[:SENSe[1]]:VOLTage[:DC]:PROTection:TRIPped?
Function	This Command is used to determine if the source is in compliance. If a "1" is returned, then the source is in compliance. A "0" indicates that the source is not in compliance. The :CURRent:PROTection:TRIPped? Command is used to check the compliance state of the V-Source, and the :VOLTage:PROTection:TRIPped? Command is used to check the compliance state of the I-Source.
Example	:SENSe1:VOLTage:DC:PROTection:TRIPped?

Command	[:SENSe[1]]:CURRent[:DC]:NPLCycles <n>
Function	This Command is used to set the integration period (speed) for measurements. NPLC (Number of Power Line Cycles) expresses the integration period by basing it on the power line frequency. For example, for a PLC of 1, the integration period would be 1/60 (for 60Hz line power) which is 16.67 msec. NOTE that this is a global Command. Thus, if you set the speed for voltage measurements to 10 PLC, then current and resistance will also set to 10 PLC. <n> = 0.01 to 10 Power-line cycles per integration DEFault 1 MINimum 0.01 MAXimum 10
Example	:SENSe1:CURRent:DC:NPLCycles 0.01

Command	[:SENSe[1]]:CURRent[:DC]:NPLCycles?
Function	:NPLCycles? Query programmed PLC value. :NPLCycles? DEFault Query *RST default PLC. :NPLCycles? MINimum Query minimum PLC. :NPLCycles? MAXimum Query maximum PLC.

Example	:SENSe1:CURRent:DC:NPLCycles?

Command	[:SENSe[1]]:VOLTage[:DC]:NPLCycles <n>
Function	This Command is used to set the integration period (speed) for measurements. NPLC (Number of Power Line Cycles) expresses the integration period by basing it on the power line frequency. For example, for a PLC of 1, the integration period would be 1/60 (for 60Hz line power) which is 16.67 msec. NOTE that this is a global Command. Thus, if you set the speed for voltage measurements to 10 PLC, then current and resistance will also set to 10 PLC.
	<n> = 0.01 to 10 Power-line cycles per integration
	DEFault 1
	MINimum 0.01
	MAXimum 10
Example	:SENSe1:VOLTage:DC:NPLCycles 0.01

Command	[:SENSe[1]]:VOLTage[:DC]:NPLCycles?
Function	:NPLCycles? Query programmed PLC value.
	:NPLCycles? DEFault Query *RST default PLC.
	:NPLCycles? MINimum Query minimum PLC.
	:NPLCycles? MAXimum Query maximum PLC.
Example	:SENSe1:VOLTage:DC:NPLCycles?

Command	[:SENSe[1]]:RESistance:NPLCycles <n>
Function	This Command is used to set the integration period (speed) for measurements. NPLC (Number of Power Line Cycles) expresses the integration period by basing it on the power line frequency. For example, for a PLC of 1, the integration period would be 1/60

	(for 60Hz line power) which is 16.67 msec. NOTE that this is a global Command. Thus, if you set thespeed for voltage measurements to 10 PLC, then current and resistance will also set to 10 PLC. <n> = 0.01 to 10 Power-line cycles per integration DEFault 1 MINimum 0.01 MAXimum 10
Example	:SENSe1:RESistance:NPLCycles 0.01

Command	[:SENSe[1]]:RESistance:NPLCycles?
Function	:NPLCycles? Query programmed PLC value. :NPLCycles? DEFault Query *RST default PLC. :NPLCycles? MINimum Query minimum PLC. :NPLCycles? MAXimum Query maximum PLC.
Example	:SENSe1:RESistance:NPLCycles?

Command	[:SENSe[1]]:AVERage:TCONtrol <name>
Function	This Command is used to select the type of averaging filter (REPeat or MOVing). The number of readings that are averaged by the filter is set with the :AVERage:COUNt Command. The :AVERage:STATe Command is used to enable or disable the filter. <name> = REPeat Repeating filter MOVing Moving filter
Example	:SENSe1:AVERage:TCONtrol REPeat

Command	[:SENSe[1]]:AVERage:TCONtrol?
Function	Query filter type

Example	:SENSe1:AVERage:TCONtrol?

Command	[:SENSe[1]]:AVERage:COUNt <n>
Function	These Commands are used to specify the filter count. In general, the filter count is the number of readings that are acquired and stored in the filter buffer for the averaging calculation. The larger the filter count, the more filtering that is performed.
	<n> = 1 to 100 — Specify filter count
	DEFault — 10
	MINimum — 1
	MAXimum — 100
Example	:SENSe1:AVERage:COUNt 1

Command	[:SENSe[1]]:AVERage:COUNt?
Function	:COUNt? — Query filter count.
	:COUNt? DEFault — Query the *RST default filter count.
	:COUNt? MINimum — Query the lowest allowable filter count.
	:COUNt? MAXimum — Query the largest allowable filter count.
Example	:SENSe1:AVERage:COUNt?

Command	[:SENSe[1]]:AVERage[:STATe] <b>
Function	This Command is used to enable or disable the digital averaging filter. When enabled, voltage, current, and resistance readings are filtered according to how the filter is configured.

	<b> = 0 or OFF	Disable digital filter
	1 or ON	Enable digital filter
Example	:SENSe1:AVERage:STATe 0	

Command	[:SENSe[1]]:AVERage:STATe?
Function	Query state of digital filter
Example	:SENSe1:AVERage:STATe?

Status Commands

Command	:STATus:PRESet
Function	Clears the operation event enable registers, the measurement event enable registers and the questionable event register, The unit will then return to the default settings status. When this Command is sent, the following SCPI event registers are cleared to zero (0): 1. Operation Event Enable Register. 2. Event Enable Register. 3. Measurement Event Enable Register
Example	:STATus:PRESet

Command	:STATus:MEASurement[:EVENt]?
Function	Reads the measurement event status register.
Example	:STATus:MEASurement?
Command	:STATus:QUEStionable[:EVENt]?
Function	Read the questionable event status register.
Example	:STATus:QUEStionable?

Command	:STATus:OPERation[:EVENt]?
Function	Read the operation event register.
Example	:STATus:OPERation?

Command	:STATus:MEASurement:ENABle <NDN> or <NRf>
Function	Program Measurement Event Enable Register. <NDN>= #Bxx…x Binary format (each x = 1 or 0) = #Hx Hexadecimal format (x = 0 to 7FFF) = #Qx Octal format (x = 0 to 77777) <NRf>= 0 to 32767 Decimal format
Example	:STATus:MEASurement:ENABle 8

Command	:STATus:QUEStionable:ENABle <NDN> or <NRf>
Function	Programs Questionable Event Enable Register. <NDN>= #Bxx…x Binary format (each x = 1 or 0) = #Hx Hexadecimal format (x = 0 to 7FFF) = #Qx Octal format (x = 0 to 77777) <NRf>= 0 to 32767 Decimal format
Example	:STATus:QUEStionable:ENABle 256

Command	:STATus:OPERation:ENABle <NDN> or <NRf>
Function	Programs Operation Event Enable Register. <NDN>= #Bxx…x Binary format (each x = 1 or 0) = #Hx Hexadecimal format (x = 0 to 7FFF) = #Qx Octal format (x = 0 to 77777) <NRf>= 0 to 32767 Decimal format
Example	:STATus:OPERation:ENABle 64

Command	:STATus:MEASurement:CONDition?
Function	Read the Measurement Condition Register.
Example	:STATus:MEASurement:CONDition?

Command	:STATus:QUEStionable:CONDition?
Function	Read the Questionable Condition Register.
Example	:STATus:QUEStionable:CONDition?

Command	:STATus:OPERation:CONDition?
Function	Read the Operation Condition Register.
Example	:STATus:OPERation:CONDition?

Command	:STATus:QUEue[:NEXT]?
Function	Read the next message in the error queue. As error and status messages occur, they are placed into the Error Queue. This query Command is used to read those messages. The :STATus:QUEue[:NEXT]? query Command performs the same function as the :SYSTem:ERRor? query Command.
Example	:STATus:QUEue?

Command	:STATus:QUEue:ENABle <list>
Function	On power-up, all error messages are enabled and will go into the Error Queue as they occur. Status messages are not enabled and will not go into the queue. This Command is used to specify which messages you want enabled. Messages not specified will be disabled and prevented from entering the queue.

	<list> = (numlist) where numlist is a specified list of messages that you wish to enable for the Error. Example: :STATus:QUEue:ENABle (-110:-222) Enable errors -110 through -222
Description	<list> (-440:+900) Full range error messages. (-110) Single error message. (-110:-222) A specific range of error messages. (-110:-222, -220) A specific range of error messages and a single error message (separated by a comma.).
Example	:STATus:QUEue:ENABle (-110:-222)

Command	:STATus:QUEue:ENABle?
Function	Read the error and status messages that have been enabled.
Example	:STATus:QUEue:ENABle?

Command	:STATus:QUEue:DISable <list>
Function	On power-up, all error messages are enabled and will go into the Error Queue as they occur. Status messages are not enabled and will not go into the queue. This Command is used to specify which messages you want disabled. Disabled messages are prevented from going into the Error Queue. <list> = (numlist) where numlist is a specified list of messages that you wish to disable for the Error Queue.

	Example: :STATus:QUEue:DISable (-110:-222) Disable errors -110 through -222 <list>=(-440:+900) Full range error messages. (-110) Single error message. (-110:-222) A specific range of error messages. (-110:-222, -220) A specific range of error messages and a single error message (separated by a comma.).
Example	:STATus:QUEue:DISable (-110:-222)

Command	:STATus:QUEue:DISable?
Function	Reads the disabled messages.
Example	:STATus:QUEue:DISable?

Command	:STATus:QUEue:CLEar
Function	Empty all the messages from the error queue.
Example	:STATus:QUEue:CLEar

System Commands

Command	:SYSTem:PRESet
Function	This Command returns the instrument to states optimized for front panel operation. :SYSTem:PRESet defaults are listed in the SCPI tables.
Example	:SYSTem:PRESet

Command	:SYSTem:POSetup <name>	
Function	This Command is used to select the power-on defaults. With RST selected, the instrument powers up to the *RST default conditions. With PRES selected, the instrument powers up to the :SYStem:PRESet default conditions. Default conditions are listed in the SCPI tables. With the SAV0-3 parameters specified, the instrument powers-on to the setup that is saved in the specified location using the *SAV Command.	
	<name> = RST	Power-up to *RST defaults
	PRESet	Power-up to :SYSTem:PRESet defaults
	SAV0	Power-up to setup stored at memory location 0
	SAV1	Power-up to setup stored at memory location 1
	SAV2	Power-up to setup stored at memory location 2
	SAV3	Power-up to setup stored at memory location 3
Example	:SYSTem:POSetup SAV0	

Command	:SYSTem:POSetup?
Function	Query power-on setup
Example	:SYSTem:POSetup?

Command	:SYSTem:RSENse <b>
Function	This Command is used to enable or disable remote sensing. When using remote sensing, 4-wire connections to the DUT are required. Sourcing voltage—With remote sensing enabled, the output voltage is sensed (measured) at the DUT. If the sensed voltage is lower than the programmed amplitude, then the V-Source increases the voltage until the sensed voltage is the same as the programmed amplitude. This compensates for IR drop in the OUTPUT test leads. With remote sensing disabled, the output voltage is sensed at the output connectors. Measuring voltage — With remote sensing enabled, voltage measurements are made at DUT. This eliminates any voltage drops that may be in the test leads between the GSM and the DUT. With remote sensing disabled, voltage measurements are performed at the output connectors of the instrument. Measuring resistance — With remote sense enabled, 4-wire resistance measurements can be made. <b> = 0 or OFF Disable remote sensing 1 or ON Enable remote sensing
Example	:SYSTem:RSENse 0

Command	:SYSTem:RSENse?
Function	Query state of remote sensing.

Example	:SYSTem:RSENse?

Command	:SYSTem:GUARd <name>
Function	This Command is used to select the guard mode. OHMS guard is a lowimpedance guard drive used for in-circuit resistance measurements. Ohms guard is not available 1A range (source or measure). CABLE guard provides a highimpedance guard drive that is used to eliminate leakage currents in cabling and test fixtures. When performing 6-wire ohms guard measurements, use the GUARD out-put state. The OUTPut [1]:SMODe GUARd Command is used to select the GUARD output-off state. <name> = OHMS Ohms guard mode CABLe Cable guard mode
Example	:SYSTem:GUARd OHMS

Command	:SYSTem:GUARd?
Function	Query guard mode.
Example	:SYSTem:GUARd?

Command	:SYSTem:MEMory:INITialize
Function	When this Command is used, the following actions to initialize battery backed RAM occur: • TRACe (data store) data is lost, buffer size is reset to 100, and timestamp is set to the absolute format. • SOURce1:LIST:CURR and VOLT are reset to 0A and 0V, respectively. • Deletes all user-defined math expressions.

• All 100 memory locations for a memory sweep are initialized to the present setup configuration of the GSM with CALC 1 disabled. User-defined math expressions are replaced with the "Power" math expression.

• The four standard save setups (*SAV0 - *SAV3) are initialized to the present setup configuration of the GSM.

• All CALCulate1 user-defined math expressions are deleted.

Example	:SYSTem:MEMory:INITialize

Command	:SYSTem:BEEPer[:IMMediate] <freq, time>
Function	The beeper of the GSM can be used to provide an audible signal at a specified frequency and time duration (up to 7.9 seconds @ 65Hz). This beeper can, for example, be used to signal the end of a lengthy sweep. Example: :SYSTem:BEEPer500, 1 Beep at 500Hz for 1 second ,The correlation between the duration and frequency of the beep is expressed as follows: Maximum Time = 512/ Frequency For example, at a frequency of 512Hz, the maximum beep time is one second. You can set the time greater than one (1) second, but it will only beep for one second. NOTE that in order to use this Command, the beeper must be enabled. freq = 65 to 2e6 Specify frequency in Hz time = 0 to 7.9 Specify time duration The frequency and time values must be separated by a comma.
Example	:SYSTem:BEEPer:IMMediate 65,0

Command	:SYSTem:BEEPer:STATe <b>
Function	This Command is used to enable or disable the beeper. When enabled, a short beep is provided to signal that a front panel key has been pressed. <b> = 1 or ON — Enable beeper 0 or OFF — Disable beeper
Example	:SYSTem:BEEPer:STATe 0

Command	:SYSTem:BEEPer:STATe?
Function	Query state of beeper.
Example	:SYSTem:BEEPer:STATe?

Command	:SYSTem:LFRequency <freq>
Function	Use this Command to manually select the line frequency setting (50 or 60Hz). <freq> = 50 — 50Hz setting 60 — 60Hz setting
Example	:SYSTem:LFRequency 50

Command	:SYSTem:LFRequency?
Function	Query line frequency selection.
Example	:SYSTem:LFRequency?

Command	:SYSTem:LFRequency:AUTO <b>
Function	This Command is used to enable or disable auto line frequency detection. When enabled, the GSM will sense the line frequency on power-up and select the appropriate line frequency setting.

Manually setting the line frequency disables auto frequency.

<b> = 1 or ON Enable and line frequency selection

0 or OFF Disable auto line frequency selection

Example :SYSTem:LFRequency:AUTO 0

Command :SYSTem:LFRequency:AUTO?

Function Query state of auto line frequency selection.

Example :SYSTem:LFRequency:AUTO?

Command :SYSTem:ERRor[:NEXT]?

Function As error and status messages occur, they are placed in the Error Queue.
The Error Queue is a first-in, first-out (FIFO) register that can hold up to 10 messages. After sending this Command and addressing the GSM to talk, the oldest message is sent to the computer and is then removed from the queue.

Example :SYSTem:ERRor:NEXT?

Command :SYSTem:ERRor:ALL?

Function This query Command is similar to the [:NEXT]? Command except that all messages in the Error Queue are sent to the computer when the GSM is addressed to talk. All messages are removed from the queue.

Example :SYSTem:ERRor:ALL?

Command :SYSTem:ERRor:COUNt?

Function	After sending this Command and addressing the GSM to talk, a decimal number will be sent to the computer. That is the number of messages in the Error Queue.
Example	:SYSTem:ERRor:COUNt?

Command	:SYSTem:ERRor:CODE[:NEXT]?
Function	This Command is identical to the [:NEXT]? Command, except only the code is returned. The message itself is not returned. The error is cleared from the queue.
Example	:SYSTem:ERRor:CODE:NEXT?

Command	SYSTem:ERRor:CODE:ALL?
Function	Read all errors (code only)
Example	SYSTem:ERRor:CODE:ALL?

Command	:SYSTem:CLEar
Function	This action Command is used to clear the Error Queue of messages.
Example	:SYSTem:CLEar

Command	:SYSTem:VERSion?
Function	Read SCPI version.
Example	:SYSTem:VERSion?

Command	:SYSTem:LOCal

Function	Normally, during RS-232 communications, front panel keys are operational. However, the user may wish to lock out front panel keys during RS-232 communications. This action Command is used to remove the GSM from the remote state and enables the operation of front panel keys. NOTE that this Command can only be sent over the RS-232 interface.
Example	:SYSTem:LOCal

Command	:SYSTem:RWLock <b>
Function	This Command is used to enable or disable local lockout. When enabled, the front panel keys are locked out (not operational) when the instrument is in remote. When disabled, the front panel keys are operational in remote. Removing the instrument from remote restores front panel keys operation but does not change the status of the :RWLock Command. NOTE that this Command can only be sent over the RS-232 interface. <b> = 0 or OFF Disable local lockout 1 or ON Enable local lockout
Example	:SYSTem:RWLock 0

Command	:SYSTem:RWLock?
Function	Query state of local lockout
Example	:SYSTem:RWLock?

Command	:SYSTem:TIME?
Function	This query returns the current timestamp value

Example	:SYSTem:TIME?

Command	:SYSTem:TIME:RESet
Function	This action Command is used to reset the absolute timestamp to 0 seconds. The timestamp also resets to 0 seconds every time the GSM is turned on.
Example	:SYSTem:TIME:RESet

Command	:SYSTem:TIME:RESet:AUTO <b>	
Function	:RES:AUTO enables or disables auto timestamp reset. When enabled, the timestamp will be automatically reset when exiting the idle layer of the trigger model. This Command is intended for use with READ?/INIT when taking more than one reading.	
	<b> = 1 or ON	Enable auto timestamp reset
	0 or OFF	Disable auto timestamp reset
Example	:SYSTem:TIME:RESet:AUTO 0	

Command	:SYSTem:TIME:RESet:AUTO?
Function	Query enabled/disabled auto timestamp reset state
Example	:SYSTem:TIME:RESet:AUTO?

Command	:SYSTem:RCMode <name>
Function	This Command controls the auto range change mode. In the SINGle mode, the GSM will auto range only after first taking a reading.

In the MULTiple mode, the GSM will auto range up on compliance in the Delay phase of the Source-Delay-Measure cycle, thereby minimizing the chance of a GSM being in compliance in a multiple-GSM system. A GSM can downrange only once a reading has been taken. In the MULTiple mode, you can control the soak time using the :SOUR:SOAK Command. NOTE that you can use the LLIMIT and ULIMIT Commands to control auto range limits.

<name> = SINGle	Single mode
MULTiple	Multiple mode

Example	:SYSTem:RCMode SINGle

Command	:SYSTem:RCMode?
Function	Query auto range change mode.
Example	:SYSTem:RCMode?

Trigger Commands

NOTE::TRACe or :DATA can be used as the root Command for this subsystem. From this point on, the documentation in this manual uses :TRACe. If you prefer to use :DATA, simply replace all the :TRACe Command words with :DATA.

Command	:TRACe:DATA?
Function	Read contents of buffer
Example	:TRACe:DATA?

Command	:TRACe:CLEar

Function	This action Command is used to clear the buffer of readings. If you do not clear the buffer, a subsequent store will overwrite the old readings.
Example	:TRACe:CLEar

Command	:TRACe:FREE?
Function	This Command is used to read the status of storage memory. After sending this Command and addressing the GSM to talk, two values separated by commas are sent to the computer. The first value indicates how many bytes of memory are available, and the second value indicates how many bytes are reserved to store readings.
Example	:TRACe:FREE?

Command	:TRACe:POINts <n>	
Function	This Command is used to specify the size of the buffer.	
	<n> = 1 to 2500	Specify buffer size
	MINimum	1
	MAXimum	2500
	DEFault	100
Example	:TRACe:POINts 1	

Command	:TRACe:POINts?

Function	:POINts?	Query buffer size.
	:POINts? DEFault	Query *RST default buffer size.
	:POINts? MINimum	Query smallest allowable buffer size.
	:POINts? MAXimum	Query largest allowable buffer size.
Example	:TRACe:POINts?	

Command	:TRACe:POINts:ACTual?
Function	This query Command is used to determine how many stored readings are in the buffer. After sending this Command and addressing the unit to talk, the number of readings stored in the buffer will be sent to the computer.
Example	:TRACe:POINts:ACTual?

Command	:TRACe:FEED <name>	
Function	This Command is used to select the source of readings to be placed in the buffer. With SENSe[1] selected, raw readings are placed in the buffer when storage is performed. With CALCulate[1] selected, math expression results (Calc1) are placed in the buffer. With CALCulate2 selected, Calc2 readings are placed in the buffer. TRACe:FEED cannot be changed while buffer storage is active.	
	<name> = SENSe1	Put raw readings in buffer
	CALCulate1	Put Calc1 readings in buffer
	CALCulate2	Put Calc2 readings in buffer
Example	:TRACe:FEED SENSe1	

Command	:TRACe:FEED?
Function	Query buffer feed
Example	:TRACe:FEED?

Command	:TRACe:FEED:CONTrol <name>	
Function	This Command is used to select the buffer control. When NEXT is selected, the asterisk (*) annunciator turns on to indicate that the buffer is enabled. The storage process starts when GSM is taken out of idle to perform source-measure operations. After the buffer stores the specified number of reading arrays (as set by the :POINTs Command), the asterisk annunciator turns off to indicate that storage is done. With NEVer selected, storage into the buffer is disabled.	
	<name> = NEXT	Fills buffer and stops
	NEVer	Disables buffer storage
Example	:TRACe:FEED:CONTrol NEXT	

Command	:TRACe:FEED:CONTrol?
Function	Query buffer control.
Example	:TRACe:FEED:CONTrol?

Command	:TRACe:TSTamp:FORMat <name>

Function	This Command is used to select the timestamp format for buffer readings. With ABSolute selected, each timestamp is referenced to the first reading stored in the buffer. With DELTa selected, timestamps provide the time between each buffer reading. <name> = ABSolute Reference to first buffer reading DELTa Time between buffer readings
Example	:TRACe:TSTamp:FORMat ABSolute

Command	:TRACe:TSTamp:FORMat?
Function	Query timestamp format.
Example	:TRACe:TSTamp:FORMat?

Command	:TRIGger:CLEar
Function	When this action command is sent, any pending (latched) input triggers are cleared immediately. When the GSM is being triggered by another instrument, it may inadvertently receive and latch input triggers that do not get executed. These pending triggers could adversely affect subsequent operation. When using external triggering, it is recommended that TRIGger:CLEar be sent after sending the ABORt command and at the beginning of a program before sending an initiate Command.
Example	:TRIGger:CLEar

Command	:INITiate[:IMMediate]
Function	This Command is used to initiate source-measure operation by taking the GSM out of idle. The :READ? and :MEASure? Commands also perform an initiation. NOTE that if auto output-off is disabled (SOURce1:CLEar:AUTO OFF), the source output must first be turned on before an initiation can be performed. The :MEASure? Command automatically turns the output source on before performing the initiation.
Example	:INITiate

Command	:ARM[:SEQuence[1]][LAYer[1]]:COUNt <n>	
Function	This Command is used to specify how many times an operation is performed in the arm layer of the trigger model.	
	<n> = 1 to 2500	Specify arm count
	DEFault	Sets arm count to 1
	MINimum	Sets arm count to 1
	MAXimum	Sets arm count to 2500
	INFinite	(ARM:COUNt only)
Example	:ARM:COUNt 1	

Command	:TRIGger[:SEQuence[1]]:COUNt <n>
Function	This Command is used to specify how many times an operation is performed in the specified layer of the trigger model.

For example, assume the arm count is set to 2 and the trigger counter is set to 10, the Source Measure Unit is configured to perform 10 source-measure operations twice for a total of 20 source-measure operations. The product of the arm count and trigger count cannot exceed 2500. If, for example, the arm count is 2, then the maximum trigger count is 1250.

NOTE: INFinite can be used only with ARM:COUNt, and FETCh?, READ?, MEAS?, CALC1:DATA?, or CALC2:DATA? cannot be used with infinite arm count. Only INIT will start measurements, and only output enable line, over-temperature, SDC, DCL, or ABORt should be used to stop the sweep. ARM:COUNt INFinite can be used for repetitive source waveforms or for long tests where only the last reading is important. For example, the limits could be used to drive the output enable to abort a test when some condition is met. DATA? would then give the answer to the test.

<n> = 1 to 2500	Specify trigger count
DEFault	Sets trigger count to 1
MINimum	Sets trigger count to 1
MAXimum	Sets trigger count to 2500

Example :TRIGger:COUNt 1

Command :ARM[:SEQuence[1]][LAYer[1]]:COUNt?

Function	:COUNt?	Queries programmed arm count.
	:COUNt? DEFault	Queries *RST default arm count.
	:COUNt? MINimum	Queries lowest allowable arm count.
	:COUNt? MAXimum	Queries largest allowable arm count.
Example	:ARM:COUNt?	

Command	:TRIGger[:SEQuence[1]]:COUNt?	
Function	:COUNt?	Queries programmed trigger count.
	:COUNt? DEFault	Queries *RST default trigger count.
	:COUNt? MINimum	Queries lowest allowable trigger count.
	:COUNt? MAXimum	Queries largest allowable trigger count.
Example	:TRIGger:COUNt?	

Command	:TRIGger[:SEQuence[1]]:DELay <n>
Function	The delay is used to delay operation in the trigger layer. After the programmed trigger event occurs, the instrument waits until the delay period expires before performing the Device Action.

	<n> = 0 to 999.99999	Specify delay in seconds
	DEFault	0 second delay
	MINimum	0 second delay
	MAXimum	999.99999 second delay
Example	:TRIGger:DELay 0	

Command	:TRIGger[:SEQuence[1]]:DELay?	
Function	:COUNt?	Query the programmed delay
	:COUNt? DEFault	Query the *RST default delay
	:COUNt? MINimum	Query the lowest allowable delay
	:COUNt? MAXimum	Query the largest allowable delay
Example	:TRIGger:DELay?	

Command :ARM[:SEQuence[1]][LAYer[1]]:SOURce <name>

Function This Command is used to select the arm event control source.

With IMMediate, selected operation immediately continues.

With TLINk selected, operation continues when a trigger pulse is received via the Trigger Link.

With TIMer selected, the event occurs at the beginning of the timer interval, and every time it times out. For example, if the timer is programmed for a 30 second interval, the first pass through the control source occurs immediately. Subsequent arm events will then occur every 30 seconds. The interval for the timer is set using the :TIMer Command.

With MANual selected, the event occurs when the TRIG key is pressed.
With BUS selected, the event occurs when a GET or *TRG Command is sent over the bus.
With NSTESt selected, the event occurs when the start-of-test (SOT) low pulse is received from a component handler via the Digital I/O port. This is used for limit testing.

With PSTest selected, the event occurs when start-of-test (SOT) high pulse is received from a component handler via the Digital I/O port. This is used for limit testing.

<name> =	IMMediate	Pass operation through immediately
	TLINk	Select Trigger Link trigger as event
	TIMer	Select timer as event
	MANual	Select manual event
	BUS	Select bus trigger as event
	NSTest	Select low SOT pulse as event
	PSTest	Select high SOT pulse as event
	BSTest	Select high or low SOT pulse as event

Example	:ARM:SOURce IMMediate

Command	:ARM[:SEQuence[1]][LAYer[1]]:SOURce?
Function	Query programmed arm control source.
Example	:ARM:SOURce?

Command	:TRIGger[:SEQuence[1]]:SOURce <name>
Function	Specify trigger event control source. This Command is used to select the trigger event control source. With IMMediate, selected operation immediately continues. With TLINk selected, operation continues when a trigger pulse is received via the Trigger Link. <name> = IMMediate — Pass operation through immediately TLINk — Select Trigger Link trigger as event
Example	:TRIGger:SOURce IMMediate

Command	:TRIGger[:SEQuence[1]]:SOURce?
Function	Query programmed trigger event control source
Example	:TRIGger:SOURce?

Command	:ARM[:SEQuence[1]][:LAYer[1]]:TIMer <n>
Function	This Command is used to set the interval for the timer. NOTE that the timer is in effect only if the timer is the selected arm event control source. <n> = 0.001 to 9999.999 — Specify timer interval in seconds 10000.00 to 99999.99 — Specify timer interval in seconds
Example	:ARM:TIMer 0.001

Command	:ARM[:SEQuence[1]][:LAYer[1]]:TIMer?

Function	Query programmed timer interval
Example	:ARM:TIMer?

Command	:ARM[:SEQuence[1]][LAYer[1]][:TCONfigure]:DIRection <name>
Function	This Command is used to enable (SOURce) or disable (ACCeptor) control source bypass. When enabled, operation will loop around the control source on the first pass in the layer. After that, repeat passes in the layer are held up and will wait for the programmed control source event. <name> = SOURce Enable control source bypass ACCeptor Disable control source bypass
Example	:ARM:DIRection SOURce

Command	:ARM[:SEQuence[1]][LAYer[1]][:TCONfigure]:DIRection?
Function	Query state of bypass
Example	:ARM:DIRection?

Command	:TRIGger[:SEQuence[1]][:TCONfigure]:DIRection <name>
Function	This Command is used to enable (SOURce) or disable (ACCeptor) control source bypass. When enabled, operation will loop around the control source on the first pass in the layer. After that, repeat passes in the layer are held up and will wait for the programmed control source event. <name> = SOURce Enable control source bypass ACCeptor Disable control source bypass
Example	:TRIGger:DIRection SOURce

Command	:TRIGger[:SEQuence[1]][:TCONfigure]:DIRection?
Function	Query state of bypass
Example	:TRIGger:DIRection?

Command	:TRIGger[:SEQuence[1]][:TCONfigure][:ASYNchronous]:INPut <event list>
Function	When TLINk is the selected Trigger Layer control source, and an event detector in the Trigger Layer is enabled, operation will hold up at that detector until an input trigger is received via the Trigger Link. When the event detector is disabled, operation will not hold up. It continues and performs the appropriate action. A Trigger Layer event detector is enabled by including the parameter name in the event list for the INPut Command. For example, to enable the Source Event Detector and Measure Event Detector, send the following Command: :TRIGger:INPut SOURce, SENSe The Delay Event Detector will be disabled since the DELay parameter is not included in the above event list. <event list> = SOURce Enable Source Event Detector DELay Enable Delay Event Detector SENSe Enable Measure Event Detector NONE Disable all event detectors in Trigger Layer
Example	:TRIGger:INPut SOURce

Command	:TRIGger[:SEQuence[1]][:TCONfigure][:ASYNchronous]:INPut?
Function	Query enabled event detectors in Trigger Layer
Example	:TRIGger:INPut?

Command	:ARM[:SEQuence[1]][LAYer[1]][:TCONfigure]:ILINe <NRf>
Function	Select input line; arm layer This Command is used to select input lines for the Trigger Link. For normal operation, Trigger Link input and output should not share the same line. <NRf> = 1 Line #1 2 Line #2 3 Line #3 4 Line #4
Example	:ARM:ILINe 1

Command	:ARM[:SEQuence[1]][LAYer[1]][:TCONfigure]:ILINe ?
Function	Query input trigger line
Example	:ARM:ILINe?

Command	:TRIGger[:SEQuence[1]][:TCONfigure]:ILINe <NRf>
Function	Select input line; arm layer This Command is used to select input lines for the Trigger Link. For normal operation, Trigger Link input and output should not share the same line. <NRf> = 1 Line #1 2 Line #2

	3	Line #3
	4	Line #4

Example	:TRIGger:ILINe 1

Command	:TRIGger[:SEQuence[1]][:TCONfigure]:ILINe?
Function	Query input trigger line
Example	:TRIGger:ILINe?

Command	:ARM[:SEQuence[1]][LAYer[1]][:TCONfigure]:OLINe <NRf>
Function	Select output line; arm layer This Command is used to select output lines for the Trigger Link. For normal operation, Trigger Link input and output should not share the same line. <NRf> = 1 Line #1 2 Line #2 3 Line #3 4 Line #4
Example	:ARM:OLINe 1

Command	:ARM[:SEQuence[1]][LAYer[1]][:TCONfigure]:OLINe?
Function	Query output trigger line
Example	:ARM:OLINe?

Command	:TRIGger[:SEQuence[1]][:TCONfigure]:OLINe <NRf>
Function	Select output line; trigger layer

	This Command is used to select output lines for the Trigger Link. For normal operation, Trigger Link input and output should not share the same line. <NRf> = 1 Line #1 2 Line #2 3 Line #3 4 Line #4
Example	:TRIGger:OLINe 1

Command	:TRIGger[:SEQuence[1]][:TCONfigure]:OLINe?
Function	Query output trigger line
Example	:TRIGger:OLINe?

Command	:ARM[:SEQuence[1]][LAYer[1]][:TCONfigure]:OUTPut <event list>
Function	This Command is used to specify when trigger pulses occur on the specified output trigger line of the Trigger Link. ARM Layer Triggers — You can specify from one to two events. Each event in the list must be separated by a comma (,). Arm Layer Triggers — With TEXit selected, an output trigger will occur when exiting the trigger layer. With TENTer selected, an output trigger will occur when entering the trigger layer. With NONE selected, the arm layer output trigger is disabled. The NONE option must be set alone. It will be ignored if it is listed with other options.

	Arm Layer Triggers		
	<event list >:	TENTer	Trigger on entering trigger layer
		TEXit	Trigger on exiting trigger layer
		NONE	Disable arm layer output trigger
Example	:ARM:OUTPut TENTer		

Command	:ARM[:SEQuence[1]][LAYer[1]][:TCONfigure]:OUTPut?
Function	Query output trigger event(s)
Example	:ARM:OUTPut?

Command	:TRIGger[:SEQuence[1]][:TCONfigure]:OUTPut <event list>
Function	This Command is used to specify when trigger pulses occur on the specified output trigger line of the Trigger Link. Trigger Layer Triggers — You can specify from one to all three events. Each event in the list must be separated by a comma (,). The SOURce, DELay, and MEASure events refer to the Source-DelayMeasure (SDM) cycle. This is the Device Action in the Trigger Model. With SOURce specified, an output trigger occurs after the source is set. With DELay specified, an output trigger occurs after the delay period. With MEASure specified, an output trigger occurs after the measurement.

	The NONE option must be set alone. It will be ignored if it is listed with other options.
	Trigger Layer Triggers
	<event list>: SOURce — Output trigger after source level is set
	DELay — Output trigger after delay period
	SENSe — Output Trigger after measurement
	NONE — Disable trigger layer triggers
Example	:TRIGger:OUTPut SOURce

Command	:TRIGger[:SEQuence[1]][:TCONfigure]:OUTPut?
Function	Query output trigger event(s)
Example	:TRIGger:OUTPut?

IEEE488.2 Common Command

Command	*CLS
Function	Clears all event registers and Error Queue.
Example	*CLS Reset all bits of the following event registers to 0: Standard Event Register Operation Event Register Measurement Event Register Questionable Event Register

Command	*ESE <NRf>
Function	Program the Standard Event Enable Register, The allowed value range is 0～32767 Examples to send the decimal value 36 in the non-decimal formats: <NRf>= 0 to 32767 Decimal format
Example	*ESE 32

Command	*ESE?
Function	Read the Standard Event Enable Register.
Example	*ESE?

Command	*ESR?
Function	Read and clear the Standard Event Enable Register.
Example	*ESR?

Command	*IDN?
Function	Returns the manufacturer, model number, serial number, and firmware version number of the unit.
Example	*IDN? return"GW,GSM-20H10,XXXXXXXX,V1.00" GW: manufacturer GSM-20H10: model number XXXXXXXX: serial number V1.00: firmware version number

Command	*OPC
Function	After all the pending operations are complete, set the operation complete bit in the standard event status register.

Example	*OPC

Command	*OPC?
Function	Places an ASCII "1" into the Output Queue when all pending selected device operations have been completed.
Example	*OPC?

Command	*OPT?
Function	Queries installed options. Response message indicates the prescence or absence of options. For example, if response message reads "0", then no options are present.
Example	*OPT?

Command	*RCL <NRf>	
Function	Returns the GSM to the user-saved setup.	
	<NRf>= 0	Memory location 0
	1	Memory location 1
	2	Memory location 2
	3	Memory location 3
Example	*RCL 1	

Command	*RST
Function	Returns the GSM to the *RST default conditions, i.e. restore GPIB default settings.
Example	*RST

Command	*SAV <NRf>		
Function	Saves the present setup as the user-saved setup.		
	<NRf>= 0	Memory location 0	
	1	Memory location 1	
	2	Memory location 2	
	3	Memory location 3	
Example	*SAV 1		

Command	*SRE <NRf>	
Function	Programs the Service Request Enable Register.	
	<NRf> = 0 to 255	Decimal format
Example	*SRE 7	

Command	*SRE?
Function	Reads the Service Request Enable Register.
Example	*SRE?

Command	*STB?
Function	Reads the Status Byte Register.
Example	*STB?

Command	*TRG
Function	Sends a bus trigger to the GSM.
Example	*TRG

Command	*TST?
Function	Performs a checksum test on ROM and returns the result.

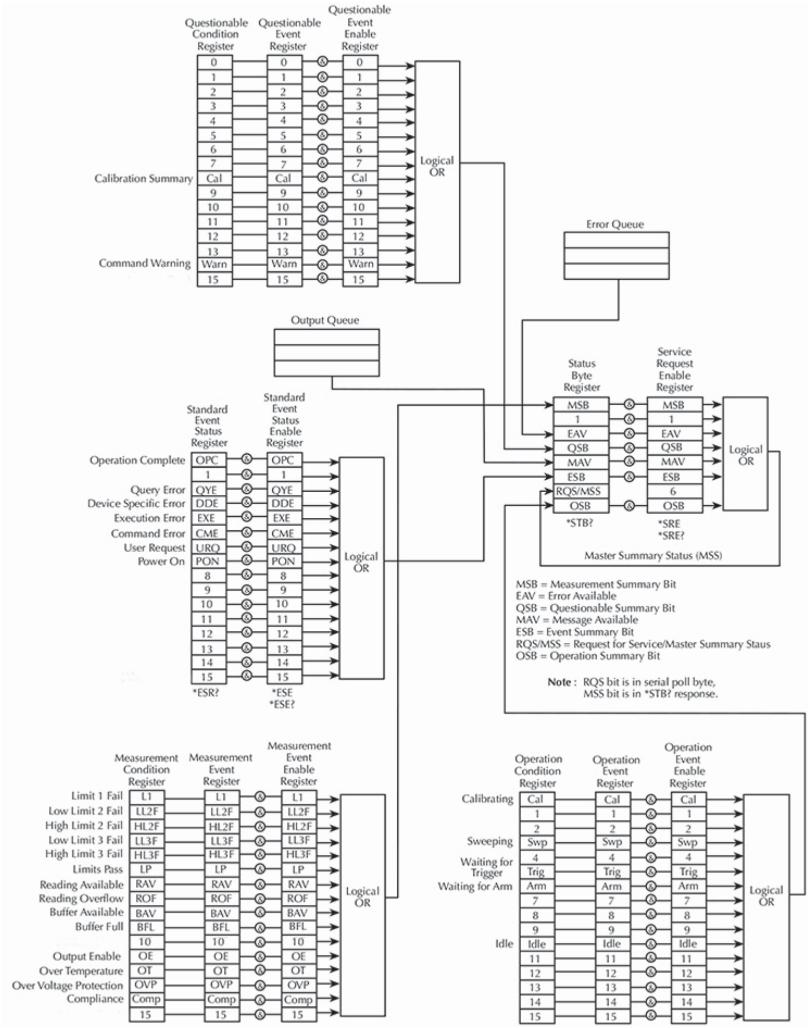
Example	*TST?

Command	*WAI
Function	Wait until all previous Commands are executed.
Example	*WAI

Status Registers

The GSM provides a series of status registers and queues allowing the operator to monitor and manipulate the various instrument events. The status structure is shown as below. The heart of the status structure is the Status Byte Register. This register can be read by the user's test program to determine if a service request (SRQ) has occurred, and what event caused it. The figure below is the structure of status registers.

The Structure Of Status Registers



NOTE: URQ indicates that the "Lock" key on the panel has been used. (Entering lock from unlock or Entering unlock from lock).

- Status byte and SRQ

The Status Byte Register receives the summary bits of four status register sets and two queues. The register sets and queues monitor the various instrument events. When an enabled event occurs, it sets a summary bit in the Status Byte Register. When a summary bit of the Status Byte is set and its corresponding enable bit is set (as programmed by the user), the RQS/MSS bit will set to indicate that an SRQ has occurred.

- Status register sets

A typical status register set is made up of a condition register, an event register and an event enable register. A condition register is a read-only register that constantly updates to reflect the present operating conditions of the instrument. When an event occurs, the appropriate event register bit sets to 1. The bit remains latched to 1 until the register is reset. When an event register bit is set and its corresponding enable bit is set (as programmed by the user), the output (summary) of the register will set to 1, which in turn sets the summary bit of the Status Byte Register.

- Queues

The GSM uses an Output Queue and an Error Queue. The response messages to query Commands are placed in the Output Queue. As various programming errors and status messages occur, they are placed in the Error Queue. When a queue contains data, it sets the appropriate summary bit of the Status Byte Register.

Programming And Reading Registers

- Programming enable registers

  The only register that can be programmed by the user are the enable register. All other registers in the status structure are read-only registers. A Command to program an event enable register is sent with a parameter value that determines the desired state (0 or 1) of each bit in the appropriate register. An enable register can be programmed using any of the data formats for the parameter value: binary, decimal, hexadecimal, or octal.

- Reading registers

  Any register in the status structure can be read by using the appropriate query (?) Command. The following explains how to interpret the returned value (response message). The response message will be a value that indicates which bits in the register are set. That value (if not already binary) will have to be converted to its binary equivalent. For example, for a binary value of 100101, bits B5, B2, and B0 are set. The returned value can be in the binary, decimal, hexadecimal, or octal format. The FORMat:SREGister command is used to select the data format for the returned value. For non-decimal formats, one of the following headers will accompany the returned value to indicate which format is selected:

  #B = Header for binary values

  #H = Header for hexadecimal values

  #Q = Header for octal values

Status Byte And Service Request (SRQ)

Service request is controlled by two 8-bit registers; the Status Byte Register and the Service Request Enable Register.

- Status byte register

  The summary messages from the status registers and queues are used to set or clear the appropriate bits (B0, B2, B3, B4, B5, and B7) of the Status Byte Register. These summary bits do not latch, and their states (0 or 1) are solely dependent on the summary messages (0 or 1). For example, if the Standard Event Register is read, its register will clear. As a result, its summary message will reset to 0, which in turn will reset the ESB bit in the Status Byte Register. The bits of the Status Byte Register are described as follows:

- Bit B0, Measurement Summary Bit (MSB) — Set summary bit indicates that an enabled measurement event has occurred.
- Bit B1 — Not used.
- Bit B2, Error Available (EAV) — Set summary bit indicates that an error or status message is present in the Error Queue.
- Bit B3, Questionable Summary Bit (QSB) — Set summary bit indicates that an enabled questionable event has occurred.
- Bit B4, Message Available (MAV) — Set summary bit indicates that a response message is present in the Output Queue.
- Bit B5, Event Summary Bit (ESB) — Set summary bit indicates that an enabled standard event has occurred.
- Bit B6, Request Service (RQS)/Master Summary Status (MSS) — Set bit indicates that an enabled summary bit of the Status Byte Register is set.
- Bit B7, Operation Summary (OSB) — Set summary bit indicates that an enabled operation event has occurred.

- Service request enable register

  The generation of a service request is controlled by the Service Request Enable Register. This register is programmed by you and is used to enable or disable the setting of bit B6 (RQS/MSS) by the Status Summary Message bits (B0, B2, B3, B4, B5, and B7) of the Status Byte Register. The individual bits of the Service Request Enable Register can be set or cleared by using the *SRE common command. To read the Service Request Enable Register, use the *SRE? query command. The Service Request Enable Register clears when power is cycled or a parameter value of 0 is sent with the *SRE command (i.e. *SRE 0).

Status Register Sets

There are four status register sets in the status structure of the GSM; Standard Event Status, Operation Event Status, Measurement Event Status, and Questionable Event Status.

- Standard Event Register

  The used bits of the Standard Event Register are described as follows:

  - Bit B0, Operation Complete — Set bit indicates that all pending selected device operations are completed and the GSM is ready to accept new commands. This bit only sets in response to the *OPC? query command. See page 346 for details on *OPC and *OPC?.
  - Bit B1 — Not used.
  - Bit B2, Query Error (QYE) — Set bit indicates that you attempted to read data from an empty Output Queue.
  - Bit B3, Device-Dependent Error (DDE) — Set bit indicates that an instrument operation did not execute properly due to some internal condition.
  - Bit B4, Execution Error (EXE) — Set bit indicates that the GSM detected an error while trying to execute a command.
  - Bit B5, Command Error (CME) — Set bit indicates that a command error has occurred.

    Command errors include:

    - IEEE-488.2 syntax error — GSM received a message that does not follow the defined syntax of the IEEE-488.2 standard.
    - Semantic error — GSM received a command that was misspelled or received an optional IEEE-488.2 command that is not implemented.
    - The instrument received a Group Execute Trigger (GET) inside a program message.

- Bit B6, User Request (URQ) — Set bit indicates that the Edit/Lock key on the GSM front panel was pressed.
- Bit B7, Power ON (PON) — Set bit indicates that the GSM has been turned off and turned back on since the last time this register has been read.

- Operation Event Register

  The used bits of the Operation Event Register are described as follows:

  - Bit B0, Calibrating (Cal) — Set bit indicates that the GSM is calibrating.
  - Bits B1 and B2 — Not used.
  - Bit B3, Sweeping (Swp) — Set bit indicates the instrument is performing a sweep operation.
  - Bit B4 — Not used.
  - Bit B5, Waiting for Trigger Event (Trig) — Set bit indicates that the GSM is in the trigger layer waiting for a TLINK trigger event to occur.
  - Bit B6, Waiting for Arm Event (Arm) — Set bit indicates that the GSM is in the arm layer waiting for an arm event to occur.
  - Bits B7 through B9 — Not used.
  - Bit B10, Idle State (Idle) — Set bit indicates the GSM is in the idle state.
  - Bits B11 through B15 — Not used.

- Measurement Event Register

  The used bits of the Measurement Event Register are described as follows:

  - Bit B0, Limit 1 Fail (L1) — Set bit indicates that the Limit 1 test has failed.
  - Bit B1, Low Limit 2 Fail (LL2) — Set bit indicates that the Low Limit 2 test has failed.

- Bit B2, High Limit 2 Fail (HL2) — Set bit indicates that the High Limit 2 test has failed.
- Bit B3, Low Limit 3 Fail (LL3) — Set bit indicates that the Low Limit 3 test has failed.
- Bit B4, High Limit 3 Fail (HL3) — Set bit indicates that the High Limit 3 test has failed.
- Bit B5, Limits Pass (LP) — Set bit indicates that all limit tests passed.
- Bit B6, Reading Available (RAV) — Set bit indicates that a reading was taken and processed.
- Bit B7, Reading Overflow (ROF) — Set bit indicates that the volts or amps reading exceeds the selected measurement range of the GSM.
- Bit B8, Buffer Available (BAV) — Set bit indicates that there are at least two readings in the buffer.
- Bit B9, Buffer Full (BFL) — Set bit indicates that the trace buffer is full.
- Bit B11, Output Enable Asserted (Int) — Set bit indicates that the output enable line is at digital low (asserted). The source output can be turned on.
- Bit B12, Over Temperature (OT) — Set bit indicates that an over temperature condition exists. The source output cannot be turned on.
- Bit B13, Over Voltage Protection (OVP) — Set bit indicates that the source is being limited at the programmed limit level.
- Bit B14, Compliance (Comp) — Set bit indicates that the source is in compliance.
- Bit B15 — Not used.

- Questionable Event Register

  The used bits of the Questionable Event Register are described as follows:

- Bits B0 through B7 — Not used.
- Bit B8, Calibration Summary (Cal) — Set bit indicates that an invalid calibration constant was detected during the power-up sequence. This error will clear after successful calibration of the instrument.
- Bits B9 through B13 — Not used.
- Bit B14, Command WARNING (Warn) — Set bit indicates that a Signal Oriented Measurement Command parameter has been ignored.
- Bit B15 — Not used.

Condition registers

Each status register set (except the Standard Event Register set) has a condition register. A condition register is a real-time, read-only register that constantly updates to reflect the present operating conditions of the instrument. For example, while the Source Measure Unit is in the idle state, bit B10 (Idle) of the Operation Condition Register will be set. When the instrument is taken out of idle, bit B10 clears.

Event registers

Each status register set has an event register. When an event occurs, the appropriate event register bit sets to 1. The bit remains latched to 1 until the register is reset. Reading an event register clears the bits of that register. *CLS resets all four event registers.

Event enable registers

Each status register set has an enable register. Each event register bit is logically ANDed (&) to a corresponding enable bit of an enable register. Therefore, when an event bit is set and the corresponding enable bit is set (as programmed by the user), the output (summary) of the register will set to 1, which in turn sets the summary bit of the Status Byte Register.

Queues

The Source Measure Unit uses two queues, which are first-in, first-out (FIFO) registers:

- Output Queue — Used to hold reading and response messages.

  The output queue holds data that pertains to the normal operation of the instrument. For example, when a query command is sent, the response message is placed in the Output Queue. When data is placed in the Output Queue, the Message Available (MAV) bit in the Status Byte Register sets. A data message is cleared from the Output Queue when it is read. The Output Queue is considered cleared when it is empty. An empty Output Queue clears the MAV bit in the Status Byte Register. A message is read from the Output Queue by addressing the GSM to talk after the appropriate query is sent.

- Error Queue — Used to hold error and status messages.

  The Error Queue holds error and status messages. When an error or status event occurs, a message that defines the error/status is placed in the Error Queue. When a message is placed in the Error Queue, the Error Available (EAV) bit in the Status Byte Register is set. An error/status message is cleared from the Error Queue when it is read. The Error Queue is considered cleared when it is empty. An empty Error Queue clears the EAV bit in the Status Byte Register. The Error Queue holds up to 10 error/status messages. When you read a single message in the Error Queue, the “oldest” message is read and then removed from the queue. If the queue becomes full, the message “350, ‘Queue Overflow’” will occupy the last memory location. On power-up, the Error Queue is empty. When empty, the message “0, No Error” is placed in the queue. Messages in the Error Queue are preceded by a code number. On power-up, all error messages are enabled and will go into the Error Queue as they occur. Status messages are not enabled and will not go into the queue.

Errors

Error Message

•Errors are stored in a first in-first out (FIFO) order. The first error message that is returned is the first error message that was stored. When an error is read it is also cleared from the queue.

• If there are more than 10 errors produced the last error in the queue is replaced with "Queue overflow". Unless the error queue is cleared, no more errors can be written to the error queue. If there are no errors in the error queue, the instrument will return "No error".

• To clear the error queue, you can use the :SYSTem:CLEar Command or cycle the power. When you read a message from the error queue that message will be cleared from the error queue. Using the *RST Command to reset the instrument does not clear the error queue.

• Remote control instructions can be used to clear the error queue. See the instructions listed in the previous chapter for details.

Command Errors

Number	Error message
-440	Query UNTERMINATED after indefinite response
-430	Query DEADLOCKED
-420	Query UNTERMINATED
-410	Query INTERRUPTED
-363	Input buffer overrun
-362	Framing error in program message
-361	Parity error in program message
-360	Communications error
-350	Queue overflow
-330	Self-test failed Save/recall
-314	memory lost Configuration
-315	memory lost Program
-285	syntax error Program
-284	currently running Illegal
-282	program name Cannot
-281	create program Expression
-260	error
-241	Hardware missing
-230	Data corrupt or stale
-225	Out of memory
-224	Illegal parameter value
-223	Too much data
-222	Parameter data out of range
-221	Settings conflict
-220	Parameter error
-215	Arm deadlock
-214	Trigger deadlock
-213	Init ignored
-212	Arm ignored
-211	Trigger ignored
-210	Trigger error
-202	Settings lost due to rtl
-201	Invalid while in local
-200	Execution error

-178	Expression data not allowed
-171	Invalid expression
-170	Expression error
-168	Block data not allowed
-161	Invalid block data
-160	Block data error
-158	String data not allowed
-154	String too long
-151	Invalid string data
-150	String data error
-148	Character data not allowed
-144	Character data too long
-141	Invalid character data
-140	Character data error
-128	Numeric data not allowed
-124	Too many digits
-123	Exponent too large
-121	Invalid character in number
-120	Numeric data error
-114	Header suffix out of range
-113	Undefined header
-112	Program mnemonic too long
-111	Header separator error
-110	Command header error
-109	Missing parameter
-108	Parameter not allowed
-105	GET not allowed
-104	Data type error
-103	Invalid separator
-102	Syntax error
-101	Invalid character
-100	Command error
+000	No error

	Measurement events:
+100	Limit 1 failed
+101	Low limit 2 failed
+102	High limit 2 failed
+103	Low limit 3 failed
+104	High limit 3 failed
+105	Active limit tests passed
+106	Reading available
+107	Reading overflow
+108	Buffer available
+109	Buffer full
+111	OUTPUT enable asserted
+112	Temperature limit exceeded
+113	Voltage limit exceeded
+114	Source in compliance
	Standard events:
+200	Operation complete
	Operation events:
+300	Device calibrating
+303	Device sweeping
+305	Waiting in trigger layer
+306	Waiting in arm layer
+310	Entering idle layer
	Questionable events:
+408	Questionable Calibration
+414	Command WARNING

	Calibration errors:
+500	Date of calibration not set
+501	Next date of calibration not set
+502	Calibration data invalid
+503	DAC calibration overflow
+504	DAC calibration underflow
+505	Source offset data invalid
+506	Source gain data invalid
+507	Measurement offset data invalid
+508	Measurement gain data invalid
+509	Not permitted with cal locked
+510	Not permitted with cal un-locked
	Lost data errors:
+601	Reading buffer data lost
+602	GPIB address lost
+603	Power-on state lost
+604	DC calibration data lost
+605	Calibration dates lost
+606	GPIB communication language lost
	Communication errors:
+700	Invalid system communication
+701	ASCII only with RS-232
	Additional Command execution errors:
+800	Illegal with storage active
+801	Insufficient vector data
+802	OUTPUT blocked by output enable
+803	Not permitted with OUTPUT off
+804	Expression list full
+805	Undefined expression exists
+806	Expression not found
+807	Definition not allowed
+808	Expression cannot be deleted
+809	Source memory location revised
+810	OUTPUT blocked by Over Temp

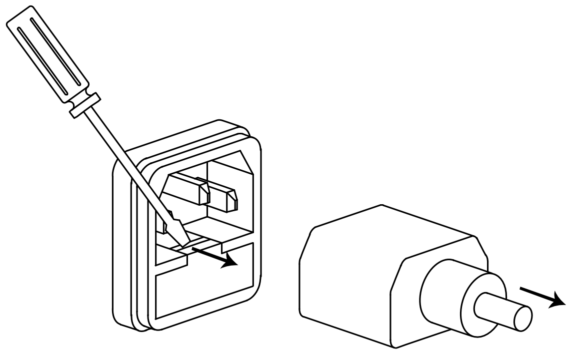
+811	Not an operator or number
+812	Mismatched parenthesis
+813	Not a number of data handle
+814	Mismatched brackets
+815	Too many parenthesis
+816	Entire expression not parsed
+817	Unknown token
+818	Error parsing mantissa
+819	Error parsing exponent
+820	Error parsing value
+821	Invalid data handle index
+822	Too small for sense range
+823	Invalid with source read-back on
+824	Cannot exceed compliance range
+825	Invalid with auto-ohms on
+826	Attempt to exceed power limit
+827	Invalid with ohms guard on
+828	Invalid on 1 amp range
+829	Invalid on 1kV range
+830	Invalid with INF ARM:COUNT
+900	Internal System Error

APPENDIX

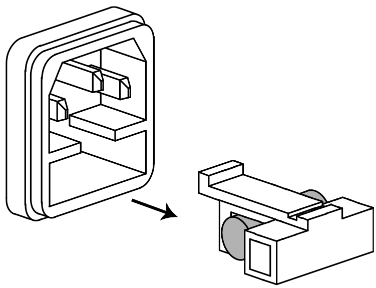
Replacing The Fuse

Steps

Remove the power cord and then take out the box using a small screw driver.



The fuse is stored in the housing.

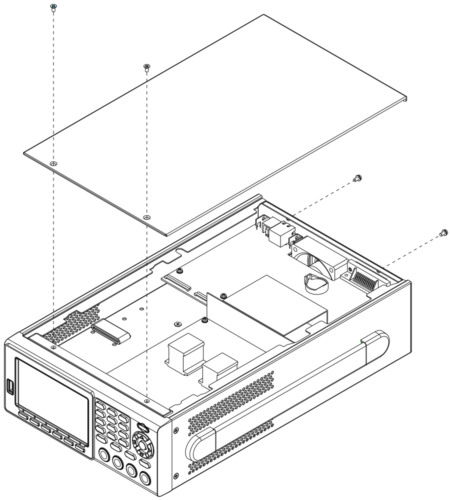


Rating

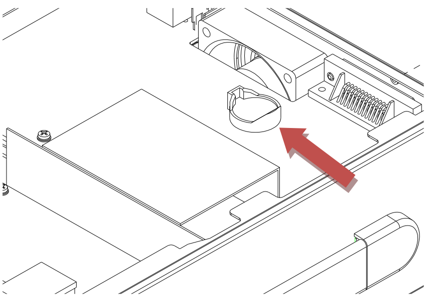
- T2.0A/250V

Battery Replacement

Step 1. Remove the four screws on top and rear sides, and the four screws on the rear.



2. Move the top cover back slightly to release the buckle, and then lift the top cover up. Find the location indicated by the arrow in the figure shown below(close to the fan) and then replace the battery with a new one.



Specification

The specification of GSM-20H10 is applied to the temperature of +18°C ~ +28°C after 60 minutes of warm-up.

Maximum	Voltage	±210V
	Current	±1.05A
	Power	22W
	Voltage Resolution	1uV
	Current Resolution	10pA
DC Voltage Source	Output Voltage	±21V/ ±1.05A, ±210V/±105 mA
	Current Limit	Min. 0.1% of range
	Programming Resolution	1uV, ±200.000mV range 10uV, ±2.00000V range 100uV, ±20.0000V range 1mV, ±200.000V range
	Programming Accuracy	±(0.02%+600uV), ±200.000mV range ±(0.02%+600uV), ±2.00000V range ±(0.02%+2.4mV), ±20.0000V range ±(0.02%+24mV), ±200.000V range
	Load Regulation	0.01% of range + 100uV
	Line Regulation	0.01% of range
	Overshoot	<0.1% typical (full scale step,resistive load,10mA range)
	Recovery Time(1000%Load Change)	<250us (within 0.1% plus load regulation errors, 1A and 100mA compliance.)
	Ripple and Noise	4mV rms(20Hz~ 1MHz) 10mVpp(20Hz~ 1MHz)
	Temperature Coefficient (0°–18°C & 28°–50°C)	±(0.15 × accuracy specification)/°C
DC Current Source	Output Current	±1.05A /±21V, ±105 mA /±210V
	Voltage Limit	Min. 0.1% of range
	Programmed Source Resolution	10pA, ±1.00000uA range 100pA, ±10.0000uA range 1nA, ±100.000uA range 10nA, ±1.00000mA range 100nA, ±10.00000mA range 1uA, ±100.000mA range 10uA, ±1.00000A range

	Programmed Source Accuracy	±(0.035%+600pA), ±1.00000uA range ±(0.033%+2nA), ±10.0000uA range ±(0.031%+20nA), ±100.000uA range ±(0.034%+200nA), ±1.00000mA range ±(0.045%+2uA), ±10.00000mA range ±(0.066%+20uA), ±100.000mA range ±(0.27%+900uA), ±1.00000A range
	Load Regulation	0 0.01% of range + 100pA
	Line Regulation	0.01% of range
	Overshoot	<0.1% typical (1mA step, RL = 10kΩ, 20V range).
	Temperature Coefficient (0°–18°C & 28°–50°C	±(0.15 × accuracy specification)/°C
Source General	Output Settling Time[1]	100µs typical Time
	Output Rise Time (±30%)	300µs, 200V range, 100mA compliance. 150µs, 20V range, 100mA compliance.
	DC Floating Voltage	Output can be floated up to ±250VDC
	Remote Sense	Up to 1V drop per load lead.
	Compliance Accuracy	Add 0.3% of range and ±0.02% of reading to base specification.
	Range Change Overshoot [2]	Adjacent range changes between 200mV, 2V and 20V ranges, 100mV typical.
	Minimum Compliance value	0.1% of range
	Command Processing Time[3]	Autorange On:10ms.Autorange Off:7ms.
Measurement Voltage	Input Resistance	>10 GΩ
	Measurement Resolution	1uV, ±200.000mV range 10uV, ±2.00000V range 100uV, ±20.0000V range 1mV, ±200.000V range
	Measurement Accuracy[4]	±(0.012%+300uV), ±200.000mV range ±(0.012%+300uV), ±2.00000V range ±(0.015%+1.5mV), ±20.0000V range ±(0.015%+10mV), ±200.000V range
	Temperature Coefficient (0°–18°C & 28°–50°C)	±(0.15 × accuracy specification)/°C
Measurement Current	Voltage Burden (4-wire mode)	< 1mV

Measurement Resolution	10pA, ±1.00000uA range 100pA, ±10.0000uA range 1nA, ±100.000uA range 10nA, ±1.00000mA range 100nA, ±10.00000mA range 1uA, ±100.000mA range 10uA, ±1.00000A range
Measurement Accuracy [4]	±(0.029%+300pA)), ±1.00000uA range ±(0.027%+700pA), ±10.0000uA range ±(0.025%+6nA), ±100.000uA range ±(0.027%+60nA), ±1.00000mA range ±(0.035%+600nA), ±10.00000mA range ±(0.055%+6uA), ±100.000mA range ±(0.22%+570uA), ±1.00000A range
Temperature Coefficient (0°–18°C & 28°–50°C	±(0.1 × accuracy specification) / °C

Measurement Resistance

Range	Resolution	Test current	Accuracy
<2.00000Ω	---	---	Source I_{Acc}+Meas.V_{Acc}
2.00000Ω	10uΩ	---	Source I_{Acc}+Meas.V_{Acc}
20.0000Ω	100uΩ	100mA	±(0.1%+0.003 Ω), Normal ±(0.07%+0.001 Ω), Enhanced[5]
200.000Ω	1mΩ	10mA	±(0.08%+0.03 Ω), Normal ±(0.05%+0.01 Ω), Enhanced
2.00000kΩ	10mΩ	1mA	±(0.07%+0.3 Ω), Normal ±(0.05%+0.1 Ω), Enhanced
20.0000kΩ	100mΩ	100uA	±(0.06%+3 Ω), Normal ±(0.04%+1 Ω), Enhanced
200.000kΩ	1Ω	10uA	±(0.07%+30 Ω), Normal ±(0.05%+10 Ω), Enhanced
2.00000MΩ	10Ω	1uA	±(0.11%+300 Ω), Normal ±(0.05%+100 Ω), Enhanced
20.0000MΩ	100Ω	1uA	±(0.11%+1k Ω), Normal ±(0.05%+500 Ω), Enhanced
200.000MΩ	1kΩ	100nA	±(0.66%+10k Ω), Normal ±(0.35%+5k Ω), Enhanced
>200.000M Ω	---	---	Source I_{Acc}+Meas.V_{Acc}

Temperature Coefficient (0°–18°C & 28°–50°C)	±(0.15 × accuracy specification)/°C
Source I mode,Manual OHMS	Total uncertainty = I source accuracy + V measure accuracy (4-wire remote sense).
Source V mode, Manual OHMS	Total uncertainty = V source accuracy + I measure accuracy (4-wire remote sense).

	6-wire OHMS mode	Available using active ohms guard and guard sense. Max. Guard Output Current: 50mA (except 1A range). Accuracy is load dependent.
	Guard Output Impedance	<0.1Ω in ohms mode
System Speed[6]	Maximum Measure Auto Range Time	40ms (fixed source)[7]

Sequence reading rates[8](rdg./second) for 60Hz (50Hz)

Speed	NPLC/ Trig Origin	Measure TO MEM.	Measure TO GPIB	Source-Measure[10] TO MEM.	Source-Measure[10] TO GPIB
Fast 488.2	0.01 / internal	2081 (2030)	1198 (1210)	1551 (1515)	1000 (900)
	0.01 / external	1239 (1200)	1079 (1050)	1018 (990)	916 (835)
Medium 488.2	0.1 / internal	510 (433)	509 (433)	470 (405)	470 (410)
	0.1 / external	438 (380)	438 (380)	409 (360)	409 (365)
Normal 488.2	1 / internal	59 (49)	59 (49)	58 (48)	58 (48)
	1 / external	57 (48)	57 (48)	57 (48)	57 (47)

Speed	NPLC/ Trig Origin	Source-Measure Pass/Fail test[9,10] TO MEM.	Source-Measure Pass/Fail test[9,10] TO GPIB	Source-Memory[9,10] TO MEM.	Source-Memory[9,10] TO GPIB
Fast 488.2	0.01 / internal	902 (900)	809 (840)	165 (162)	164 (162)
	0.01 / external	830 (830)	756 (780)	163 (160)	162 (160)
Medium 488.2	0.1 / internal	389 (343)	388 (343)	133 (126)	132 (126)
	0.1 / external	374 (333)	374 (333)	131 (125)	131 (125)
Normal 488.2	1 / internal	56 (47)	56 (47)	44 (38)	44 (38)
	1 / external	56 (47)	56 (47)	44 (38)	44 (38)

Single Reading Operation Rates (rdg./second) for 60Hz (50Hz)

Speed	NPLC/ Trig Origin	Measure TO GPIB	Source-Measure TO GPIB[10]	Source-Measure Pass/Fail test[9,10] TO GPIB
Fast(488.2)	0.01 / internal	256 (256)	79 (83)	79 (83)
Medium(488.2)	0.1 / internal	167 (166)	72 (70)	69 (70)
Normal(488.2)	1 / internal	49 (42)	34 (31)	35 (30)

Component Interface Handler Time for 60Hz (50Hz):[9, 11]

Speed	NPLC/ Trig Origin	Measure TO GPIB	Source Pass/Fail test TO GPIB	Source-Measure Pass/Fail test[10,12] TO GPIB
Fast	0.01 / external	1.04 ms (1.08 ms)	0.5 ms (0.5 ms)	4.82 ms (5.3 ms)
Medium	0.1 / external	2.55 ms (2.9 ms)	0.5 ms (0.5 ms)	6.27 ms (7.1 ms)
Normal	1 / external	17.53 ms (20.9 ms)	0.5 ms (0.5 ms)	21.31 ms (25.0 ms)

System General	Load Impedance	Stable into 20,000pF typical
	Differential mode Voltage	250 V Pk
	Common mode Voltage	250V DC
	Common mode Isolation	>10GΩ, <1000pF
	Over Range	105% of range, source and measure.
	Max. Voltage drop	5V
	Max. Sense lead Resistance	1MΩ
	Sense input Impedance	>100G Ω
	Guard offset Voltage	<150µV, typical

	Source output modes	Fixed DC level, Memory List (mixed function), Stair (linear and log)
	Source memory list	100 points max.
	Memory buffer	5,000 readings @ 5 digits (two 2,500 point buffers). Includes selected measured value(s) and time stamp. Lithium battery backup(3 yr+ battery life).
	Power on settings	5 user-definable power-up states plus factory default and *RST.
	Digital I/O Connector	Active low input. Start of test, end of test, 3 category bits. +5V@ 300mA supply. 1 trigger input, 4 TTL/Relay Drive outputs (33V @ 500mA, diode
	Remote Interface	USB/GPIB[13]/LAN/RS-232
Insulation	Chassis and Terminal	20MΩ or above (DC 500V)
	Chassis and AC cord	30MΩ or above (DC 500V)
Operation Environment	Indoor use, Altitude: ≤ 2000m	
	Ambient temperature: 0 ~ 40°C	
	Relative humidity: ≤ 80%	
	Installation category: II, Pollution degree: 2	
Storage Environment	Temperature: -20˚C ~ 70˚C	
	Humidity: < 80%	
Real-Time Clock	Set and read, year, month, day, hour, minute, seconds	
	Battery CR-2032 coin-type, replaceable	
Input Power	100~240VAC(±10%), 50/60Hz	
Power Consumption	80W	
Accessories	CD User manual x1, Quick Start manual x1 Test lead GTL-207A x 1, ALLIGATOR CLIP x 2	
Dimensions	214 (W) x 86 (H) x 356.5 (D) mm	
Weight	Approx. 4.8kg	
Remarks		

[1] Required to reach 0.1% of final value after Command is processed. Resistive load. 10μA to 100mA range.

[2] Overshoot into a fully resistive 100kΩ load, 10Hz to 1MHz BW, adjacent ranges: 100mV typical, except 20V/200V.

[3] Maximum time required for the output to begin to change following the receipt of :SOURce:VOLTage|CURRent <nrf> Command.

[4] Speed = Normal (1 PLC). For 0.1 PLC, add 0.005% of range to offset specifications, except 200mV, 1A ranges, add 0.05%. For 0.01 PLC, add 0.05% of range to offset specifications, except 200mV, 1A ranges, add 0.5%.

[5] Enhanced mode is Source readback ON, offset compensation ON, add system noise but don't include offsets.

[6] Reading rates applicable for voltage or current measurements, autorange off, filter off, display off, trigger delay = 0, and binary reading forma.

[7] Purely resistive lead. 1μA and 10μA ranges <65ms.

[8] 1000 point sweep was characterized with the source on a fixed range.
[9] Pass/Fail test performed using one high limit and one low math limit.
[10] Includes time to re-program source to a new level before making measurement.
[11] Time from falling edge of START OF TEST signal to falling edge of END OF TEST signal.
[12] Command processing time of :SOURce:VOLTage|CURRent: TRIGgered<nrf> Command not included.
[13] Optional accessory

Optional Accessories

GTL-246	USB 2.0, A-B type
GTL-108A	4-wire banana plug bridge clip
SM-01	Convert DB15 to DB9 + 8-pin micro-DIN
SM-02	Convert DB15 to DB37 + 8-pin micro-DIN

Certificate Of Compliance

We

GOOD WILL INSTRUMENT CO., LTD.

declare that the CE marking mentioned product satisfies all the technical relations application to the product within the scope of council:

Directive: EMC; LVD; WEEE; RoHS

The product is in conformity with the following standards or other normative documents:

◎ **EMC**

EN 61326-1 :	Electrical equipment for measurement, control and laboratory use — EMC requirements
Conducted & Radiated Emission EN 55011 / EN 55032	Electrical Fast Transients EN 61000-4-4
Current Harmonics EN 61000-3-2 / EN 61000-3-12	Surge Immunity EN 61000-4-5
Voltage Fluctuations EN 61000-3-3 / EN 61000-3-11	Conducted Susceptibility EN 61000-4-6
Electrostatic Discharge EN 61000-4-2	Power Frequency Magnetic Field EN 61000-4-8
Radiated Immunity EN 61000-4-3	Voltage Dip/ Interruption EN 61000-4-11 / EN 61000-4-34

◎**Safety**

EN 61010-1 :	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

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