

SCPI Programming Reference

PCS Isolated Output High Precision Current Shunt Meter

Version: 1.0

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SCPI Programming Reference

This section contains information to help you program PCS series Isolated Output High Precision Current Shunt Meters using the SCPI programming language through a remote interface.

This document includes the following contents:

Introduction to the SCPI language

The CALibration subsystem

The CONFigure subsystem

Introduction to the Sense subsystem

General protocol

Introduction to the SCPI language

SCPI (Standard Command for Programmable Instruments) is an ASCII-based instrument programming language for testing and measuring instruments. SCPI commands have a hierarchical structure, also known as the tree

system. Related commands are grouped into a common node or root, thus forming a subsystem. The following Sense subsystem illustrates this.

SENSe:

VOLTage:

DC:RANGe {<range>|MIN|MAX|DEF}

DC:RANGe? [MINimum|MAXimum|DEFault]

Sense is the root keyword for the command, VOLTage is the second level keyword, and DC is the third level keyword. Colons (:) is to separate consecutive keywords.

Syntactic conventions:

The command syntax format is shown below:

VOLTage:DC:RANGe {<range>|MIN|MAX|DEF}

Most commands (and some parameters) are a mixture of uppercase and lowercase letters. Capital letters represent abbreviations for commands and make the program lines shorter.

If you want better program readability, you can use long-form commands.

For example, consider the keyword VOLTage in the preceding paragraph. You can type VOLT or VOLTage and mix the upper and lower letters arbitrarily. Therefore, VoLTaGe, volt, and volt are all acceptable. Other forms, such as VOL and VOLTAG, will generate errors.

Braces ({}) contain parameter options. They are not sent with the command string.

Vertical line (|) separate parameter selection. For example, the above command {< range > | MIN | | MAX DEF} indicates you can specify a number range parameter or "MIN", "MAX" or "DEF". The bar graph is not sent with the command string.

The Angle brackets (< >) indicate that you must assign a value to the parameters inside the brackets. For example, the above syntax statement indicates the < range > parameter in Angle brackets. Angle brackets are not sent with the command string. You must specify a value for this parameter (for example, "VOLT:DC:RANG 10"), unless you select one of the other options shown in the syntax (for example, "VOLT:DC:RANG MIN").

Optional parameters are enclosed in square brackets ([]). Square brackets are not sent with the command string. If you do not specify a value for an optional parameter, the instrument will use the default value.

Command separator

Colons (:) separate consecutive keywords. Spaces must be inserted to separate the argument from the command key. If a command requires more than one parameter, separate the adjacent parameters with a

comma: CONF:VOLT:DC 10,0.003

Semicolon (;) Separate two commands within the same subsystem and minimize input.

Use the MIN, MAX, and DEF parameters

You can replace parameters to many commands with "MIN" or "MAX". In some cases, you can also use "DEF" instead. For example,

VOLTage:DC:RANGe {<range>|MIN|MAX|DEF}

Instead of selecting a specific value for the < range > parameter, the range is set to the minimum with the MIN parameter, the maximum with the MAX parameter, or the default with the DEF parameter.

Query parameter setting

To query for the current values of most parameters, you can place the question mark (?) to the command. For example, the following example sets the DMM to DCV model:

CONFigure:VOLTage:DC

Then, you can query the model by sending:

CONFigure?

Calibration subsystem:

TEST:ALL?

CALibration:FUNCTion

CALibration:VOLTage:{AC|DC}:RANGe

CALibration:CURREnt:{AC|DC}:RANGe

CALibration:{RESistance}:RANGe

CALibration:CAPacitance:RANGe

CALibration:SIGN

CALibration:VALue

CALibration:COUNt?

CALibration:DATE?

CALibration:TIME?

CALibration:STRing

CALibration:TEMPerature?

CALibration:STATus?

TEST:ALL?

Run instrument self-check and return a pass/fail indication. The same with *TST?.

CAUTION Before running a full self-check, all input connections to the instrument must be disconnected.

Parameters	Typical Returns
none	none
Run self-check: TEST:ALL? Typical responses: +0(pass) or +1(one or more tests fail)	

- If one or more tests fail, the query returns +1 and stores an error in the error queue.

After completing the test, the instrument returns to the state it was before the self-test.

CALibration:FUNCTion "<function>" CALibration:FUNCTion?

Select the calibration measurement function.

Parameters	Typical returns
"VOLTage[:DC]" "CURRent[:DC]", "RESistance" "CAPacitance" "VOLTage:AC" "CURRent:AC" "FREQuency" Default to Voltage [:DC].	Enclose the abbreviated format of the selected function in quotes, with no optional keywords: "CURR:AC", "CURR", and so on.
Select the AC voltage calibration function: CALibration:FUNCTion "VOLT:AC"	

CALibration:VOLTage:{AC|DC}:RANGe {<range>|MIN|MAX|DEF}

CALibration:VOLTage:{AC|DC}:RANGe? [{MIN|MAX|DEF}]

Select calibration ranges for the AC and DC voltage measurement.

Parameters	Typical returns
< Range > : {100 mV 1 V 10 V 100 V 1000 V } Default: 100mV	+ 1.00000000 E+01

- If the input signal is greater than the value that can be measured at the specified fixed range, the word "overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface.

CALibration:CURRENT:{AC|DC}:RANGE{<range>|MIN|MAX|DEF}

CALibration:CURRENT:{AC|DC}:RANGE? [{MIN|MAX|DEF}]

Select calibration ranges for the AC and DC current measurement.

Parameters	Typical returns
< Range > : PCS1000I : {30mA 300mA 3A 30A 300A} PCS2000I : {30mA 300mA 3A 30A 1000A} Default: 30mA	+ 30.00000000 E-03

CALibration:{RESistance}:RANGE {<range>|MIN|MAX|DEF}

CALibration:{RESistance}:RANGE? [{MAX MIN | | DEF}]

Select calibration ranges for the 2- wire resistance measurement.

Parameters	Typical returns
< Range > : {100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ }. Default value: 100 Ω	+ 1.00000000 E+02

- If the input signal is greater than the value that can be measured at the specified fixed range, the word "overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface.

CALibration:CAPacitance:RANGE {<range>|MIN|MAX|DEF}

CALibration:CAPacitance:RANGE? [{MIN|MAX|DEF}]

Select calibration ranges for the capacitance measurement.

Parameters	Typical returns
< Range > : {1 nF 10 nF 100 nF 1 μF 10 μF 100 μF }. Default: 1 NF	+ 1.00000000 E-09

- If the input signal is greater than the value that can be measured at the specified fixed range, the word "overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface.

CALibration:SIGN{"+" | "-"}

CALibration: SIGN?

Select the calibration value symbol for the calibration measurement function.

Parameters	Typical returns
{"+" "-"}, default to be "+"	"+"
Configure the symbol for the calibration value. CALibration: SIGN? Typical response: "+"	

CALibration:VALue<value>

CALibration: VALue?

Sets a calibration value for the current calibration measurement function.

Parameters	Typical returns
Default: 0	+ 0.00000E+00
Set the calibration value: CALibration: VALue 1.0	

CALibration:COUNt?

Return the calibration count. Upon receipt of the instrument, read and record the initial count.

Parameters	Typical returns
none	+ 117
Return the calibration count: CAL:COUN?	

- Since the value of the stored calibration constant is increased each time, a complete calibration can add many counts.

- You can perform this query regardless of whether the instrument is encrypted.

This setting is non-volatile; It does not change because of the power-up cycle or *RST or SYSTem:PRESet.

CALibration:DATE?

Returns the date of the last calibration in “yyyy,mm,dd” format.

Parameters	Typical returns
none	2014,4,26
Return the calibration date: CAL:DATE?	

- You can perform this query regardless of whether the instrument is encrypted.
- The date is based on the real-time clock. Use SYSTem:DATE and SYSTem:TIME to set the DATE of the instrument's real-time clock.

This setting is non-volatile; It does not change because of the power-up cycle or *RST or SYSTem:PRESet.

CALibration:TIME?

Returns the last calibration time in “hh,mm,ss” format.

Parameters	Typical returns
none	20,15,30
Return the calibration time: CAL:TIME?	

- You can perform this query regardless of whether the instrument is encrypted.
- The date is based on the real-time clock. Use SYSTem:DATE and SYSTem:TIME to set the DATE of the instrument's real-time clock.

This setting is non-volatile; It does not change because of the power-up cycle or *RST or SYSTem:PRESet.

CALibration:STRing "<string>"

CALibration:STRing?

Store a message in the calibration store. Common messages include the last calibration date, calibration due date, or calibration department contact information. You can perform this query regardless of whether the instrument is encrypted.

The string can only be stored from the remote interface, but messages can be read from the front panel or the remote interface.

Storing the calibration message overrides the previous message.

This setting is non-volatile; It does not change because of the power-up cycle or *RST or SYSTem:PRESet.

CALibration:TEMPerature?

Return the temperature of the last calibration in ° C.

Parameters	Typical returns
none	+ 2.42850208 E+001
Return the calibration temperature: CAL:TEMP?	

- You can perform this query regardless of whether the instrument is encrypted.

This setting is non-volatile; It does not change because of the power-up cycle or *RST or SYSTem:PRESet.

CALibration:STATus?

Get the result of the last calibration.

Parameters	Typical returns
none	+0(successful calibration, no error)
0x00: Calibration is successful. 0x8000: Calibration in progress. Other: Error code.	

Configure subsystem:

The CONFigure command is the easiest way to configuration measurements. These commands use the default measuring configuration values. However, these commands do not automatically start the measurement, so you can modify the measurement properties before starting the measurement.

NOTE Use the READ? to start the measurement.

Command profile

CONFigure?

CONFigure:CAPacitance

CONFigure:CONTinuity

CONFigure:CURREnt:{AC|DC}

CONFigure:DIODE

CONFigure:{FREQuency|PERiod}

CONFigure:{RESistance}

CONFigure:TEMPerature

CONFigure[:VOLTage]:{AC|DC}

The default setting for the CONFigure command

The CONFigure command allows you to select functions and ranges with a single command.

< Resolution > is specified in units of measurement (V, A, HZ, Ω , etc.). All other parameters are set to their default values (the same below).

The measured parameters	The default Settings
AC input filter (bandwidth)	20 Hz(medium speed filter)
Range	Auto (including voltage range for frequency and period measurements)
Number of samples per trigger	A sample
Mathematical function	Disabled. Other parameters have not changed.
Empty state for each function	Disable

Use CONFigure and READ? in the following example to perform external trigger measurements. The CONFigure command configures the DC voltage measurement. Default range (automatic range adjustment) (10 PLC) is used for measurement.

CONF:VOLT:DC

READ?

CONFigure? Or CONFigure:CURRent?

Returns a quoted string indicating the current function and range. Always return the short-formatted function name (CURR:AC,FREQ).

Parameters	Typical returns
none	"VOLT, +1.00000000E+01, + 3.00000000E-06"
Returns the current function, range: CONF? CONFigure:CURRent?	

CONFigure:CAPacitance [{<range>|AUTO|MIN|MAX|DEF} [, {<resolution>|MIN|MAX|DEF}]]

Set all measurement parameters and trigger parameters to their default values for capacitance measurement. Range can also be specified.

Parameters	Typical returns
< Range > : {1 nF 10 nF 100 nF 1 µF 10 µF 100 µF }.Default value: AUTO.	none
<resolution> : Optional and can be ignored; Fixed at 4½ bits.	

- You can choose the automatic range adjustment to adjusting the range, or you can manually select a fixed range. Automatic range adjustment makes it easy to select ranges for each measurement based on input signals. For the fastest measurement, use manual range adjustment (automatic range adjustment may require more time for range selection).
- If you specify a <resolution>, the automatic range adjustment (AUTO or DEFAULT) will generate an error because the instrument cannot accurately resolve the integration time (especially if the input changes continuously). If your application requires automatic range adjustment, specify Default for < Resolution > or ignore < Resolution > altogether.
- Automatic range adjustment can adjust the range down to less than 10% of the original range, and up to more than 120% of the original range. When the automatic range adjustment is off, the instrument will not report "overload" if the reading exceeds 120% of the range (capacitance measurements only). Overload occurs only when the algorithm timeouts because the applied capacitance is too large to make measurements. In capacitance measurement mode, if you apply a DC voltage or short circuit to the input terminal, the instrument will report an "overload".
- If the input signal is greater than the value that can be measured at the specified manual range, the words "Overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface. Use the READ? to start measuring.

CONFigure:CONTinuity

Set all measurement parameters and trigger parameters to their default values for continuity measurement.

Parameters	Typical returns
none	none

- For continuity tests (2-wire resistance measurements), the range is fixed at 1 K Ω .
- For each measurement that is less than or equal to the continuity threshold ($\leq 10 \Omega$), a buzzer is emitted (if the buzzer is enabled) and the actual resistance measurement is displayed on the display screen.
- From 10 Ω to 1.2 K Ω , the instrument displays the actual resistance measurement without buzzing. Over 1.2K Ω , instrument displays "OPEN" without buzzing.
- READ? And the MEASure: CONTinuity? query the returned resistance, regardless of its value.

CONFigure:CURRent:{AC|DC} [{<range>|AUTO|MIN|MAX|DEF} [, {<resolution>|MIN|MAX|DEF}]]

Set all measurement parameters and trigger parameters to their default values for AC or DC measurements. In addition, the scope is specified.

Parameters	Typical returns
< Range > : PCS1000I : {30mA 300mA 3A 30A 300A} PCS2000I : {30mA 300mA 3A 30A 1000A} .Default value: AUTO(automatic range adjustment).	none
<resolution> (AC): Optional and can be ignored; Fixed at 6½ bits. < resolution > (DC): The default value is equivalent to 10 PLC. < Resolution > is specified in units of measurement (V, A, HZ, Ω , etc.).	

- Select 30 A range will automatically set the [SENSe:]CURRent:{AC|DC}:TERMinals parameter to 30 A, and the set range to 3 A or lower will set the [SENSe:]CURRent:{AC|DC}: parameter to 3 A.
- You can choose the automatic range adjustment to adjusting the range, or you can manually select a fixed range. Automatic range adjustment makes it easy to select ranges for each measurement based on input signals. For the fastest measurement, use manual range adjustment (automatic range adjustment may require more time for range selection).
- Automatic range adjustment can adjust the range down to less than 10% of the original range, and up to more than 120% of the original range.
- If the input signal is greater than the value that can be measured at the specified manual range, the words "Overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface.

- To control the measurement rate of the AC measurement, change the trigger delay or the bandwidth of the AC filter.

CONFigure:DIODE

Set all measurement parameters and trigger parameters to their default values to perform the diode test.

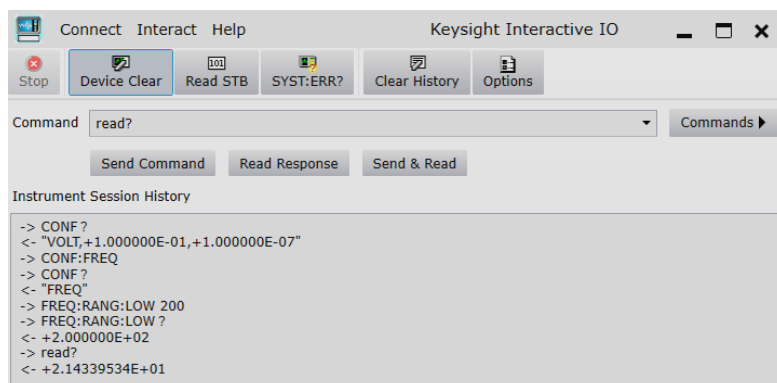
Parameters	Typical returns
none	none

- The range is fixed when performing the diode test: the range is 1 VDC (with 1 mA current source output).
- If the voltage is between 0 and 5.05 V, the voltage will be displayed on the front panel. When the signal is converted to a voltage range of 0.3 and 0.8 V, the instrument beeps (unless the buzzer is disabled). If the signal exceeds 5.05V, the front panel displays "OPEN" and returns a value of 9.9E37 from SCPI. READ? and the MEASure: DIODE? query the returned voltage regardless of its value.

CONFigure:{FREQuency | PERiod} [{<range> | MIN | MAX | DEF} [, {<resolution> | MIN | MAX | DEF}]]

Set all measurement and trigger parameters to their default values for frequency or period measurements. You can also specify a frequency or period range.

Parameters	Typical returns
none	none
CONF:FREQ FREQ:RANG:LOW 200 READ? return: +2.14339534E+01	



- Input signals for frequency or period measurements have AC voltage components. By default, use [SENSe:] {FREQuency | PERiod} : VOLTage RANGE: AUTO to enable or disable automatic voltage range adjustment or use the CONFigure: {FREQuency | PERiod} to select automatic automatic voltage range adjustment. Use [SENSe:]

{FREQuency | PERiod} :VOLTage:RANGE to select a fixed voltage range for frequency and period measurements.

- If the input voltage is too high for the selected voltage range (manually adjusting the measuring range), the words "Overload" will be displayed on the instrument panel and "9.9E37" will be returned from the remote interface. You can enable automatic range adjustment for input voltage.

CONFigure:RESistance [{<range>|AUTO|MIN|MAX|DEF} [, {<resolution>|MIN|MAX|DEF}]]

All measurement parameters and trigger parameters are set to their default values for 2-wire resistance measurement. In addition, the scope can be specified.

Parameters	Typical returns
< Range > : 100 Ω、1 kΩ、10 kΩ、100 kΩ、1 MΩ、10 MΩ、100 MΩ、AUTO or DEFault. Default value: AUTO.	+ 8.54530000 E+01
<resolution> : The default value is equivalent to 10PLC. < Resolution > is specified in units of measurement (V, A, HZ, Ω, etc.).	

- You can choose the automatic range adjustment to adjusting the range, or you can manually select a fixed range. Automatic range adjustment makes it easy to select ranges for each measurement based on input signals. For the fastest measurement, use manual range adjustment (automatic range adjustment may require more time for range selection).
- If you specify a <resolution>, the automatic range adjustment (AUTO or DEFAULT) will generate an error because the instrument cannot accurately resolve the integration time (especially if the input changes continuously). If your application requires automatic range adjustment, specify Default for < Resolution > or ignore < Resolution > altogether.
- Automatic range adjustment can adjust the range down to less than 10% of the original range, and up to more than 120% of the original range.
- If the input signal is greater than the value that can be measured at the specified manual range, the words "Overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface.

CONFigure:TEMPerature [{RTD|THERmistorDEFault} [, {<type>|DEFault} [,1[, {<resolution>|MIN|MAX|DEF}]]]]

Set all measurement parameters to their default values for temperature measurement.

parameter	A typical return
<probe_type>: {RTD THERmistor} Default value: RTD.	+ 2.12320000 E+01
<type >:85 (the only possible value for RTD), 5000(the only possible value for Thermistor).	
<resolution> : The default value is equivalent to 10 PLC.	

- For temperature measurements, a range will be selected inside the instrument. You cannot choose the scope to use.
- <resolution> parameter only determines the integration time. This parameter is optional. However, if you specify <resolution>, you must also specify "1" as the implied range parameter. For example: CONF:TEMP RTD,85,1,0.000001 Select 10 PLC integration time.
- To change the units of temperature, use UNIT:TEMPerature.
- For RTD and thermistor measurements, the instrument will automatically adjust to the correct range to measure the sensor resistance. For thermocouple measurements, choose a 100 mV range.
- If the input signal is greater than the value that can be measured at the specified manual range, the words "Overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface.

CONFigure[:VOLTage]:{AC|DC} [{<range>|AUTO|MIN|MAX|DEF} [, {<resolution>|MIN|MAX|DEF}]]

Set all measurement parameters to their default values for AC or DC voltage measurements. In addition, the scope can be specified.

WARNING The maximum range parameter (MAX) is 1000 V.

. However, the SAFETY LIMIT Hi /LO input terminals is 750 VAC (rms). The rms voltage depends on the waveform. Sine waves are limited to 750 VAC(rms), but 1000 Vpk square waves are safe. If connected to AC power supply, the sine waves are further limited to CAT II(300 V).

Parameters	Typical returns
< Range > : {100 mV 1 V 10 V 100 V 1000 V }	none
.Default value: AUTO(automatic range adjustment).	
<resolution> (AC) : Optional and can be ignored; Fixed at 6½ bits. < resolution > (DC) : The default value is equivalent to 10 PLC. < Resolution > is specified in units of measurement (V, A, HZ, Ω, etc.).	

- You can choose the automatic range adjustment to adjusting the range, or you can manually select a fixed range. Automatic range adjustment makes it easy to select ranges for each measurement based on input signals. For the fastest measurement, use manual range adjustment (automatic range adjustment may require more time for range selection).
- If you specify a <resolution>, the automatic range adjustment (AUTO or DEFAULT) will generate an error because the instrument cannot accurately resolve the integration time (especially if the input changes continuously). If your application requires automatic range adjustment, specify Default for < Resolution > or ignore < Resolution > altogether.

- Automatic range adjustment can adjust the range down to less than 10% of the original range, and up to more than 120% of the original range.
- If the input signal is greater than the value that can be measured at the specified manual range, the words "Overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface.
- To control the measurement rate of the AC measurement, change the trigger delay or the bandwidth of the AC filter.

Introduction to the Sense subsystem

Sense subsystem configuration measurement. The most basic SENSE command is [SENSe:]FUNCTION[:ON], which selects the measurement function. All other SENSE commands are associated with a specific measurement type:

Capacitance

Current

Data 2

Frequency and period

2-wire resistors

Temperature

Voltage

[SENSe:]FUNCTION[:ON] "<function>" [SENSe:]FUNCTION[:ON]?

Select the measure function (preserve all the measure properties associated with the function).

Parameters	Typical returns
------------	-----------------

CAPacitance CONTInuity CURRent:AC CURRent[:DC] DIODe FREQuency PERiod RESistance TEMPerature VOLTage:AC VOLTage[:DC] Default to Voltage [:DC].	Quote the abbreviated format of the selected function with no optional keywords: "CONT", "CURR:AC", "CURR", "DIOD", etc.
Select AC voltage function: FUNC"VOLT:AC"	

- If you change the measure function, remember all the measure properties of the previous function. If you return to the original function, those measured properties will be restored.

This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTEM:PRESet).

SENSe: VOLTage subsystem

This subsystem configures AC voltage measurement, DC voltage measurement and proportional measurement.

Command profile

[SENSe:]VOLTage:AC:BANDwidth

[SENSe:]VOLTage:{AC|DC}:NULL[:STATe]

[SENSe:]VOLTage:{AC|DC}:NULL:VALue

[SENSe:]VOLTage:{AC|DC}:NULL:VALue:AUTO

[SENSe:]VOLTage:{AC|DC}:RANGe

[SENSe:]VOLTage:{AC|DC}:RANGe:AUTO

[SENSe:]VOLTage:AC:SECondary

[SENSe:]VOLTage[:DC]:IMPedance:AUTO [SENSe:]VOLTage[:DC]:NPLC

[SENSe:]VOLTage[:DC]:RESolution

[SENSe:]VOLTage[:DC]:SECondary

[SENSe:]VOLTage[:DC]:ZERO:AUTO

[SENSe:]VOLTage:AC:BANDwidth {<filter>|MIN|MAX|DEF}

[SENSe:]VOLTage:AC:BANDwidth? [{MIN|MAX|DEF}]

Set the bandwidth for the AC voltage measurement.

The instrument uses three different AC filters, allowing you to optimize low-frequency accuracy or shorten AC stabilization time after changing the amplitude of the input signal. Based on the cut-off frequency specified by this command, the instrument selects a slow (3 Hz), medium (20 Hz), or fast (200 Hz) filter specifying the minimum frequency that you expect to encounter.

Parameters	Typical returns
{3 Hz 20 Hz 200 Hz }. Default value: 20Hz.	+ 2.00000000 E+01

- If you enter the lowest expected frequency you will encounter, the command will select the appropriate <filter>. For example, if you enter 15 Hz, a low speed filter (3 Hz) will be selected. If you enter 190 Hz, a medium-speed filter (20 Hz) will be selected to support the appropriate low cut-off frequency.
- Set the minimum frequency you expect to encounter. Lower bandwidth results in longer stabilization times.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]VOLTage:{AC|DC}:NULL[:STATe] {ON|1|OFF|0}

[SENSe:]VOLTage:{AC|DC}:NULL[:STATe]?

Enable or disable null functions for AC or DC voltage measurements.

NOTE This parameter setting is not shared between AC and DC measurements. This parameter is independent of AC and DC measurements.

Parameters	Typical returns
{ ON 1 OFF 0}. Default value: OFF.	0 (OFF) or 1 (ON)

- Enable calibration function will also enable automatic NULL value selection ([SENSe:] VOLTage: {AC | DC} : NULL: VALue: AUTO ON).
- To set a fixed NULL value, please use: [SENSe:] VOLTage: {AC | DC} : NULL: VALue.
- Null functions are not available for DC scale measurements.
- Instrument will disable null functions after factory reset (*RST), instrument preset (SYSTem:PRESet), or CONFigure functions.

[SENSe:]VOLTage:{AC|DC}:NULL:VALue {<value>|MIN|MAX|DEF}

[SENSe:]VOLTage:{AC|DC}:NULL:VALue? [{MIN|MAX|DEF}]

Store a null value for the voltage measurement.

NOTE This parameter setting is not shared between AC and DC measurements. This parameter is independent of AC and DC measurements.

Parameter	Typical returns
-1200 to +1200 V. Default value: 0.	+ 1.00000000E-02

- Specify a null value will disable automatic null value selection ([SENSe:] VOLTage: {AC | DC} : NULL: VALue: AUTO OFF).
- To use a NULL value, you must open the empty state (VOLTage: [SENSe:] {AC | DC} : NULL: STATE ON).
- Null functions are not available for DC scale measurements.
- This parameter is set to its default value after a factory reset (*RST), instrument preset (SYSTEM:PRESet), or the CONFIGure function.

SENSe:]VOLTage:{AC|DC}:NULL:VALue:AUTO {ON|1|OFF|0}

[SENSe:]VOLTage:{AC|DC}:NULL:VALue:AUTO?

Enable or disable automatic null selection for AC or DC voltage measurements.

NOTE This parameter setting is not shared between AC and DC measurements. This parameter is independent of AC and DC measurements.

Parameters	Typical returns
{ON 1 OFF 0}. Default value: OFF.	0 (OFF) or 1 (ON)

- When the automatic reference selection is turned on, the first measured value is used as the null value for all subsequent measurements. [SENSe:]VOLTage: {AC|DC}:NULL:VALue If it has been set for this value, automatic null selection is disabled.
- After disabling the automatic null value selection (OFF), use the following command to specify null values: [SENSe:] VOLTage: {AC | DC} : NULL: VALue.
- After enabling the null function, the instrument will enable automatic null value selection ([SENSe:] VOLTage: {AC | DC} : NULL: STATE ON).
- Null functions are not available for DC scale measurements.

- This parameter is set to its default value after a factory reset (*RST), instrument preset(SYSTEM:PRESet), or the CONFIGure function.

[SENSe:]VOLTage:{AC|DC}:RANGe {<range>|MIN|MAX|DEF}

[SENSe:]VOLTage:{AC|DC}:RANGe? [{MIN|MAX|DEF}]

Select fixed measuring ranges for AC and DC voltage measurements and DC proportional measurements.

NOTE

This parameter setting is not shared between AC and DC measurements. This parameter is independent of AC and DC measurements.

WARNING

The maximum range parameter (MAX) is 1000 V, HDM2000V rear is 2000 V, PCSV rear is 3000 V. However, the SAFETY LIMIT on the front and rear Hi /LO input terminals is 750 VAC (**rms**). The **rms** voltage depends on the waveform. Sine waves are limited to 750 VAC(rms), but 1000 Vpk square waves are safe. If connected to AC power supply, the sine waves are further limited to CAT II (300 V).

Parameters	Typical returns
<Range> : {100 mV 1 V 10 V 100 V 1000 V }	+ 1.00000000 E+01
AC default value: 10 V DC default value: 1000 V	

- Select the fixed range ([SENSe:]<function>:RANGe) to disable automatic range adjustment.
- If the input signal is greater than the value that can be measured at the specified manual range, the words "Overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface.
- After restoring factory settings (* RST) or instrument preset(SYSTEM: PRESet), the instrument will be set to the default range, and enable the automatic range adjustment ([SENSe:]VOLTage:{AC|DC}:RANGe:AUTO ON).

[SENSe:]VOLTage:{AC|DC}:RANGe:AUTO {OFF|ON|ONCE}

[SENSe:]VOLTage:{AC|DC}:RANGe:AUTO?

Disable or enable automatic range adjustment for AC and DC voltage measurements and DC proportional measurements. The automatic range adjustment is convenient because it automatically selects a range for each measurement based on the input signal.

Specifying ONCE will perform the automatic range adjustment immediately, then will turn it off.

NOTE

This parameter setting is not shared between AC and DC measurements. This parameter is independent of AC and DC measurements.

WARNING

The maximum range parameter (MAX) is 1000 V. However, the SAFETY LIMIT Hi /LO input terminals is 750 VAC (**rms**). The rms voltage depends on the waveform. **Sine waves are limited to 750 VAC(rms), but 1000 Vpk square**

waves are safe. If connected to AC power supply, the sine waves are further limited to CAT II(300 V).

Parameters	Typical returns
{ ON 1 OFF 0}. Default value: ON.	0 (OFF) or 1 (ON)

- Automatic range adjustment can adjust the range down to less than 10% of the original range, and up to more than 120% of the original range.
- With automatic range adjustment enabled, the instrument selects ranges based on input signals.
- Select the fixed range([SENSe:]<function>:RANGe) to disable the automatic rangeadjustment.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]VOLTage:AC:SECondary {"OFF"|"FREQuency"}

[SENSe:]VOLTage:AC:SECondary?

Select an auxiliary measurement function for AC voltage measurement.

Parameters	Typical returns
{"OFF" "FREQuency"}, default to "OFF"	"FREQ"

- "Frequency" - Frequency measurement of the input signal.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]VOLTage[:DC]:IMPedance:AUTO {ON|1|OFF|0}

[SENSe:]VOLTage[:DC]:IMPedance:AUTO?

Disable or enable automatic input impedance mode for DC voltage and proportional measurements.

parameter	A typical return
{ON 1 OFF 0}. Default value: OFF.	0 (OFF) or 1 (ON)

- OFF: For all ranges, the input impedance of the DC voltage measurement is fixed at 10 M Ω to minimize noise pickup.
- ON: The input impedance of the DC voltage measurement varies with the range. For 100 mV, 1 V, and 10 V ranges, set it to "HI-Z" (>10 G Ω) to reduce the impact of measurement loading errors on these lower ranges. Keep the 100 V and 1000 V ranges at 10 M Ω input impedance. CONFigure and MEASure? commands automatically select "AUTO OFF".
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]VOLTage[:DC]:NPLC {<PLC>|MIN|MAX|DEF}

[SENSe:]VOLTage[:DC]:NPLC? [{MIN|MAX|DEF}]

Set the integration time in terms of the number of power line cycles (PLC) for DC voltage and proportional measurements. Integration time is the period during which the instrument's analog-to-digital (A/D) converter collects an input signal sample for measurement. Longer integration time gives higher measurement resolution, but slower measurement speed.

Parameters	Typical returns
0.02, 0.2, 1, 10, 100. Default value: 10	+ 1.00000000 E+01

- Only 1, 10 or 100 PLC integration times provide normal mode (line frequency noise) suppression.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]VOLTage[:DC]:RESolution {<resolution>|MIN|MAX|DEF}

[SENSe:]VOLTage[:DC]:RESolution? [{MIN|MAX|DEF}]

Parameters	Typical returns
<resolution> : The default value is equivalent to 10 PLC. < Resolution > is specified in units of measurement (V, A, HZ, Ω , etc.).	+ 3.00000000 E-05

- You can specify MIN or MAX instead of <resolution>.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]VOLTage[:DC]:ZERO:AUTO {OFF|ON}

[SENSe:]VOLTage[:DC]:ZERO:AUTO?

Disable or enable the auto zero mode for DC voltage measurements.

- **ON(default)** After each measurement, the DMM internally measures the offset. The measurement is then subtracted from the previous reading. This prevents the offset voltage on the DMM input circuit from affecting the measurement accuracy.
- **OFF:** The instrument subtracts the last measured zero reading from each measured value. Every time you change the function, range, or integration time, it reads a new zero reading.

Parameters	Typical returns
{OFF ON}	0 (OFF) or 1 (ON)

- When you use the CONFIGure: VOLTage: DC, MEASure: VOLTage: DC? If the integration time you select with these commands is less than 1 PLC, the auto zero function will be turned off automatically.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTEM:PRESet).

SENSe: CURRent subsystem

This subsystem configures AC and DC current measurements.

Command profile

[SENSe:]CURRent:AC:BANDwidth

[SENSe:]CURRent:{AC|DC}:NULL[:STATe]

[SENSe:]CURRent:{AC|DC}:NULL:VALue

[SENSe:]CURRent:{AC|DC}:NULL:VALue:AUTO

[SENSe:]CURRent:{AC|DC}:RANGe

[SENSe:]CURRent:{AC|DC}:RANGe:AUTO

[SENSe:]CURRent:{AC|DC}:TERMinals

[SENSe:]CURRent:AC:SECondary

[SENSe:]CURRent[:DC]:NPLC

[SENSe:]CURRent[:DC]:RESolution [SENSe:]CURRent[:DC]:SECondary

[SENSe:]CURRent[:DC]:ZERO:AUTO

[SENSe:]CURRent:{AC|DC}:RANGe {<range>|MIN|MAX|DEF}

[SENSe:]CURRent:{AC|DC}:RANGe? [{MIN|MAX|DEF}]

Select a fixed measuring range for AC or DC current measurements on the 3A terminal. For A Isolated Output High Precision Current Shunt Meter with A 30A range, you cannot select a 30A range using this command. Please use [SENSe:]CURRent:{AC|DC}:TERMinals 30 or CONF:CURRent:{AC|DC} 30.

NOTE

This parameter setting is not shared between AC and DC measurements. This parameter is independent of AC and DC measurements.

Use [SENSe:]CURRent:{AC|DC}:TERMinals command to specify the current terminals for measurement.

Parameters	Typical returns
< Range> : PCS1000I : {30mA 300mA 3A 30A 300A}	+ 30.00000000 E-03
PCS2000I : {30mA 300mA 3A 30A 1000A}.Default value: AUTO(automatic range	

adjustment).	
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- Select the fixed range ([SENSe:]<function>:RANGe) to disable automatic range adjustment.
- If the input signal is greater than the value that can be measured at the specified manual range, the words "Overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface.
- Use [SENSe:]CURRent:{AC|DC}:TERMiNals to choose the 30 A terminal will force the current measurement type using the 30 A range, but will not affect the value of [SENSe:]CURRent:{AC|DC}:RANGe or [SENSe:]CURRent:{AC|DC}:RANGe:AUTO.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]CURRent:{AC|DC}:TERMiNals {3|30|1000}

[SENSe:]CURRent:{AC|DC}:TERMiNals?

Configure AC or DC current measurements to measure the power supply on terminals 3 A or 30 A or 1000 A.

Parameters	Typical returns
{3 30 1000}. Default value: 3.	+3 or +30 or +1000

- Use [SENSe:]CURRent:{AC|DC}:TERMiNals to choose the 30 A terminal will force the current measurement type using the 30 A range, but will not affect the value of [SENSe:]CURRent:{AC|DC}:RANGe or [SENSe:]CURRent:{AC|DC}:RANGe:AUTO.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]CURRent:AC:BANDwidth {<filter>|MIN|MAX|DEF}

[SENSe:]CURRent:AC:BANDwidth? [{MIN|MAX|DEF}]

Set the bandwidth for the AC current measurement.

The instrument uses three different AC filters, allowing you to optimize low-frequency accuracy or shorten AC stabilization time after changing the amplitude of the input signal.

NOTE

Use [SENSe:]CURRent:{AC|DC}:TERMiNals command to specify the current terminals used for measurement.

Parameters	Typical returns
{3 Hz 20 Hz 200 Hz}. Default value: 20Hz.	+ 2.00000000 E+01

- If you enter the lowest expected frequency you intend to encounter, the command will select the appropriate <filter>. For example, if you enter 15 Hz, a low speed filter (3 Hz) will be selected. If you enter 190 Hz, a medium-speed filter (20 Hz) will be selected to support the appropriate low cut-off frequency.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]CURRent:{AC|DC}:NULL:VALue {<value>|MIN|MAX|DEF}

[SENSe:]CURRent:{AC|DC}:NULL:VALue? [{MIN|MAX|DEF}]

Set null values for AC or DC current measurements.

NOTE This parameter setting is not shared between AC and DC measurements. This parameter is independent of AC and DC measurements

NOTE Use [SENSe:]CURRent:{AC|DC}:TERMinals command to specify the current terminals used for measurement.

Parameters	Typical returns
-12 to 12 A. Default value: 0	+ 1.04530000 E+00

- Specify a null value will disable automatic zero value selection ([SENSe:]CURRent:{AC|DC}:NULL:VALue:AUTO OFF).
To use null values, it is necessary to open the null state (/ SENSe: the CURRent: {AC | DC} : NULL: STATe ON).
- This parameter is set to its default value after a factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure function.

[SENSe:]CURRent:{AC|DC}:NULL:VALue:AUTO {ON|1|OFF|0}

[SENSe:]CURRent:{AC|DC}:NULL:VALue:AUTO?

Enable or disable automatic null value selection for AC or DC current measurements.

NOTE This parameter setting is not shared between AC and DC measurements. This parameter is independent of

NOTE Use [SENSe:]CURRent:{AC|DC}:TERMinals command to specify the current terminals used for measurement.

Parameters	Typical returns
{ON 1 OFF 0}. Default value: ON.	0 (OFF) or 1 (ON)

- When the automatic reference selection is turned on, the first measurement made will be used as the null value for all subsequent measurements. [SENSe:]CURRent: {AC|DC}:NULL:VALue has been set for this value. Automatic null value selection will be disabled.
- After disabling the automatic null value selection (OFF), use the following command to specify null value:
[SENSe:]CURRent:{AC|DC}:NULL:VALue.

After enabling the null function, the instrument will enable automatic null value selection

([SENSe:]CURREnt:{AC|DC}:NULL:STATe ON).

- This parameter is set to its default value after a factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure function.

[SENSe:]CURREnt:{AC|DC}:RANGe:AUTO {OFF|ON|ONCE}

[SENSe:]CURREnt:{AC|DC}:RANGe:AUTO?

Disable or enable automatic range adjustment for AC or DC measurements. Automatic range adjustment is convenient because it automatically selects a range for each measurement based on the input signal.

Specifying ONCE will perform automatic range adjustment immediately, then will turn it off.

NOTE

This parameter setting is not shared between AC and DC measurements. This parameter is independent of the AC and DC measurements. Use [SENSe:]CURREnt:{AC|DC}:TERMinals command to specified the current terminals used for measurement.

Parameters	Typical returns
{ ON 1 OFF 0}. Default value: ON.	0 (OFF) or 1 (ON)

- Automatic range adjustment can adjust the range down to less than 10% of the original range, and up to more than 120% of the original range.
- With automatic range adjustment enabled, the instrument selects ranges based on input signals.
- Select a fixed range ([SENSe:]<function>:RANGe) to disable automatic RANGe adjustment.
- Use [SENSe:]CURREnt:{AC|DC}:TERMinals to choose 30 A terminal type will force the specified current measurement type to use the 30 A range but will not affect the value of [SENSe:]CURREnt:{AC|DC}:RANGe 或 [SENSe:]CURREnt:{AC|DC}:RANGe:AUTO.
- This parameter is set to its default value after factory reset (*RST) or instrument preset(SYSTem:PRESet).

[SENSe:]CURREnt[:DC]:NPLC {<PLC>|MIN|MAX|DEF}

[SENSe:]CURREnt[:DC]:NPLC? [{MIN|MAX|DEF}]

Set the integration time in terms of the power line cycle number (PLC) for the DC current measurement. Integration time is the period during which the instrument's analog-to-digital (A/D) converter collects an input signal sample for measurement. Longer integration time gives higher measurement resolution, but slower measurement speed.

NOTE

Use [SENSe:]CURREnt:{AC|DC}:TERMinals command to specify the current terminals used for measurement.

Parameters	Typical returns

0.02, 0.2, 1, 10, 100. Default value: 10	+ 10.00000000 E+00
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Normal mode (line frequency noise) suppression is provided for 1, 10 or 100 PLC integration time only.

This parameter is set to its default value after factory reset (*RST) or instrument PRESET (SYSTem:PRESet). Also see [SENSe:]CURRent[:DC]:RESolution.

[SENSe:]CURRent[:DC]:RESolution {<resolution>|MIN|MAX|DEF}

[SENSe:]CURRent[:DC]:RESolution? [{MIN|MAX|DEF}]

NOTE

Use [SENSe:]CURRent:{AC|DC}:TERMinals command to specify the current terminals used for measurement.

Parameters	Typical returns
< Resolution > is specified in units of measurement (V, A, HZ, Ω , etc.).	+ 3.00000000 E-05

- You can specify MIN or MAX to replace <resolution>.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet). Also see [SENSe:]CURRent[:DC]:NPLC.

[SENSe:]CURRent[:DC]:ZERO:AUTO {OFF|ON|ONCE}

[SENSe:]CURRent[:DC]:ZERO:AUTO?

Disable or enable auto zero mode for DC current measurements.

NOTE

Use [SENSe:]CURRent:{AC|DC}:TERMinals command to specify the current terminals used for measurement.

Parameters	Typical returns
{ OFF ON ONCE }. Default value: ON.	0 (OFF) or 1 (ON)

- ON(default): After each measurement, the DMM internally measures the offset. The measurement is then subtracted from the previous reading. This prevents the offset voltage on the DMM input circuit from affecting the measurement accuracy.
- OFF: The instrument subtracts the last measured zero reading from each measured value. Every time you change the function, range, or integration time, it reads a new zero reading.
- ONCE: The instrument obtains a zero reading and sets the auto zero to OFF. The obtained zero reading is used for all subsequent measurements until the function, range, or integration time is changed again. If the specified integration

time is less than 1 PLC, 1 PLC will be used for auto zero measurement to optimize noise suppression. measurements should use the specified fast integration time (< 1 PLC).

- When you use `CONFigure:CURRent:DC` or `MEASure:CURRent:DC?` If the integration time you select with these commands is less than 1 PLC, the auto zero function will be turned off automatically.
- This parameter is set to its default value after factory reset (*RST) or instrument preset(SYSTEM:PRESet).

[SENSe:]{RESistance} subsystem

This subsystem configures 2-wire resistance measurements.

Command profile

- [SENSe:]{RESistance}:NPLC
- [SENSe:]{RESistance}:NULL[:STATe]
- [SENSe:]{RESistance}:NULL:VALue
- [SENSe:]{RESistance}:NULL:VALue:AUTO
- [SENSe:]{RESistance}:RANGe
- [SENSe:]{RESistance}:RANGe:AUTO
- [SENSe:]{RESistance}:RESolution
- [SENSe:]RESistance:ZERO:AUTO

[SENSe:]{RESistance}:NPLC {<PLC> | MIN | MAX | DEF}

[SENSe:]{RESistance}:NPLC? [{MIN | MAX | DEF}]

Set the integration time in terms of the power line cycle number (PLC) for all resistance measurements. Integration time is the period during which the instrument's analog-to-digital (A/D) converter collects an input signal sample for measurement. Longer integration time gives higher measurement resolution, but slower measurement speed.

NOTE This parameter is common for 2resistance measurements.

Parameters	Typical returns
0.02, 0.2, 1, 10, 100. Default value: 10	+ 1.00000000 E+01

- Only 1, 10 or 100 PLC integration times provide normal mode (line frequency noise) suppression.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTEM:PRESet).

[SENSe:]{RESistance}:NULL[:STATe] {ON|1|OFF|0}

[SENSe:]{RESistance}:NULL[:STATe]?

Enable or disable null functions for all resistance measurements.

NOTE

This parameter is common for 2 resistance measurements. .

Parameters	Typical returns
{ ON 1 OFF 0}. Default value: OFF.	0 (OFF) or 1 (ON)

- Enable calibration function will also enable automatic null value selection (SENSe:RESistance:NULL:VALue:AUTO ON).
- To set a fixed null value, please use: [SENSe:]{RESistance}:NULL:VALue.
- Instrument disables null functions after factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure functions.

[SENSe:]{RESistance}:NULL:VALue {<value>|MIN|MAX|DEF}

[SENSe:]{RESistance}:NULL:VALue? [{MIN|MAX|DEF}]

Stores a null value for all resistance measurements.

NOTE

This parameter is common for 2 wire resistance measurements. .

Parameters	Typical returns
-120 MΩ to +120 MΩ. Default value: 0.	+ 1.04530000 E+02

- Specify a null value will disable automatic null value selection ([SENSe:]{RESistance}:NULL:VALue:AUTO OFF).
- To use a null value, you must open the null state ([SENSe:]{RESistance}:NULL:STATe ON).
- This parameter is set to its default value after a factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure function.

[SENSe:]{RESistance}:NULL:VALue:AUTO {ON|1|OFF|0}

[SENSe:]{RESistance}:NULL:VALue:AUTO?

Enable or disable automatic null selection for all resistance measurements.

NOTE

This parameter is common for 2 wire resistance measurements. .

Parameters	Typical returns
{ ON 1 OFF 0}. Default value: OFF.	0 (OFF) or 1 (ON)

- When the automatic reference selection is turned on, the first measurement made is used as the null value for all subsequent measurements. [SENSe:]
{RESistance}:NULL:VALue has been set for this value. Automatic null selection is disabled.
After disabling automatic null value selection (OFF), specify null value using the following command: [SENSe:]
{RESistance}:NULL:VALue.
- After enabling the null function, the instrument will enable automatic null value selection ([SENSe:]{RESistance}:NULL:STATe ON).
- This parameter is set to its default value after a factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFIgure function.

[SENSe:]{RESistance}:RANGe:AUTO {OFF|ON|ONCE}

[SENSe:]{RESistance}:RANGe:AUTO?

Disable or enable automatic range adjustment for all resistance measurements. Automatic range adjustment is convenient because it automatically selects a range for each measurement based on the input signal. Specifying ONCE will perform the automatic range adjustment immediately, then will turn it off.

NOTE

This parameter is common for 2 wire resistance measurements. .

Parameters	Typical returns
{ON 1 OFF 0}. Default value: ON.	0 (OFF) or 1 (ON)

- Automatic range adjustment can adjust the range down to less than 10% of the original range, and up to more than 120% of the original range.
- With automatic range adjustment enabled, the instrument selects ranges based on input signals.
- Select a fixed range ([SENSe:]<function>:RANGe) to disable automatic range adjustment.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]{RESistance}:RESolution {<resolution>|MIN|MAX|DEF}

[SENSe:]{RESistance}:RESolution? [{MIN|MAX|DEF}]

NOTE

This parameter is common for 2 wire resistance measurements. .

Parameters	Typical returns
<resolution>: The default value is equivalent to 10 PLC. < Resolution > is specified in units of measurement (V, A, HZ, Ω , etc.).	+ 3.00000000 E+00

- You can specify MIN or MAX to replace <resolution>.

This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet). Also see [SENSe:]{RESistance}:NPLC.

[SENSe:]RESistance:ZERO:AUTO {OFF|ON|ONCE}

[SENSe:]RESistance:ZERO:AUTO?

Disable or enable auto zero mode for 2-wire resistance measurements.

- ON (default): After each measurement, the DMM internally measures the offset. The measurement is then subtracted from the previous reading. This prevents the offset voltage on the DMM input circuit from affecting the measurement accuracy.
- OFF: The instrument subtracts the last measured zero reading from each measured value. Every time you change the function, range, or integration time, it reads a new zero reading.
- ONCE: The instrument obtains a zero reading and sets the auto zero to OFF. The obtained zero reading is used for all subsequent measurements until the function, range, or integration time is changed again. If the specified integration time is less than 1 PLC, 1 PLC will be used for auto zero measurement to optimize noise suppression. measurements should use the specified fast integration time (< 1 PLC).

Parameters	Typical returns
{OFF ON ONCE}	0 (OFF) or 1 (ON)

- When you use CONFigure:{RESistance} or MEASure:{RESistance}? If the integration time you select with these commands is less than 1 PLC, the auto zero function will be turned off automatically.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:] {FREQuency | PERiod} subsystem

The subsystem configures frequency and period measurements.

Command profile

[SENSe:]{FREQuency|PERiod}:APERture

[SENSe:]{FREQuency|PERiod}:NULL[:STATe]

[SENSe:]{FREQuency|PERiod}:NULL:VALue

[SENSe:]{FREQuency|PERiod}:NULL:VALue:AUTO

[SENSe:]{FREQuency|PERiod}:RANGe:LOWer

[SENSe:]{FREQuency|PERiod}:TIMEout:AUTO

[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe

[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe:AUTO

[SENSe:]{FREQuency|PERiod}:APERture {<seconds>|MIN|MAX|DEF}

[SENSe:]{FREQuency|PERiod}:APERture? [{MIN|MAX|DEF}]

Set aperture time (gate time) for frequency and period measurement. **NOTE** This parameter is shared between frequency and period measurements. The FREQuency version setting or query parameter for this command is the same as the PERiod version setting or query.

Parameters	Typical returns
{10 ms 100 ms 1 s}. Default value: 100 ms.	+ 1.00000000 E-01
The frequency measurement is configured with 1 s aperture, and the measurement is carried out and the results are returned: CONF:FREQ FREQ:APER1 READ?	

- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]{FREQuency|PERiod}:NULL[:STATe] {ON|1|OFF|0}

[SENSe:]{FREQuency|PERiod}:NULL[:STATe]?

Enable or disable null functions for frequency and period measurements.

NOTE Unlike the range and aperture commands of SENSe:FREQuency and SENSe:PERiod, this parameter is shared between frequency and period measurements. Null parameters are independent of frequency and period measurements.

Parameters	Typical returns
{ON 1 OFF 0}. Default value: OFF.	0 (OFF) or 1 (ON)

- Enable calibration function will also enable automatic null value selection ([SENSe:]{FREQuency|PERiod}:NULL:VALue:AUTO ON).
- To set a fixed NULL values, please use: [SENSe:]{FREQuency|PERiod}:NULL:VALue.
- Instrument disables null functions after factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure functions.

[SENSe:]{FREQuency|PERiod}:NULL:VALue {<value>|MIN|MAX|DEF}

[SENSe:]{FREQuency|PERiod}:NULL:VALue? [{MIN|MAX|DEF}]

Stores a null value for the frequency and period measurements.

NOTE

Unlike the range and aperture commands of SENSE:FREQuency and SENSE:PERiod, this parameter is shared between frequency and period measurements. Null parameters are independent of frequency and period measurements.

Parameters	Typical returns
Frequency: -1.2E6 to +1.2E6. Default value: 0. Period: -1.2 to +1.2 seconds. Default value: 0.	+ 1.00000000 E-02

- Specify a null value will disable automatic null value ([SENSe:]{FREQuency|PERiod}:NULL:VALue:AUTO OFF).
To use a NULL value, you must open the null state ([SENSe:]{FREQuency|PERiod}:NULL:STATe ON).
- This parameter is set to its default value after a factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure function.

[SENSe:]{FREQuency|PERiod}:NULL:VALue:AUTO {ON|1|OFF|0}

[SENSe:]{FREQuency|PERiod}:NULL:VALue:AUTO?

Enable or disable automatic null selection for frequency and period measurements.

NOTE

Unlike the range and aperture commands of SENSE:FREQuency and SENSE:PERiod, this parameter is shared between frequency and period measurements. Null parameters are independent of frequency and period measurements.

Parameters	Typical returns
{ ON 1 OFF 0}. Default value: OFF.	0 (OFF) or 1 (ON)

- When the automatic reference selection is turned on, the first measurement made is used as the null value for all subsequent measurements. [SENSe:] {FREQuency|PERiod}:NULL:VALue has been set for this VALue. Automatic null selection is disabled.
After disabling automatic null value selection(OFF), use the following command to specify null value:
[SENSe:]{FREQuency|PERiod}:NULL:VALue.

After enabling null function, the instrument will enable automatic null value selection

([SENSe:]{FREQuency|PERiod}:NULL:STATe ON).

This parameter is set to its default value after a factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure function.

[SENSe:]{FREQuency|PERiod}:RANGe:LOWer {<freq>|MIN|MAX|DEF}

[SENSe:]{FREQuency|PERiod}:RANGe:LOWer? [{MIN|MAX|DEF}]

Sets the AC bandwidth used to detect signals during frequency and period measurements.

NOTE

This parameter is shared between frequency and period measurements. The Freacquired version using this command or query is the same as the acquired version using the RESistance version.

The instrument uses three different AC filters, allowing you to optimize low-frequency accuracy or shorten AC stabilization time after changing the amplitude of the input signal. Based on the cut-off frequency specified by this command, the instrument selects a slow (3 Hz), medium (20 Hz), or fast (200 Hz) filter. Specify the minimum frequency that you expect to encounter.

Parameters	Typical returns
{3 Hz 20 Hz 200 Hz}. Default value: 20Hz.	+ 2.000000 E+01

- If you enter the lowest expected frequency you intend to encounter, the command will select the appropriate <filter>. For example, if you enter 15 Hz, a low speed filter (3 Hz) will be selected. If you enter 190 Hz, a medium-speed filter (20 Hz) will be selected to support the appropriate low cut-off frequency.
- This parameter is set to its default value after factory reset (*RST) or instrument preset(SYSTem:PRESet).

[SENSe:]{FREQuency|PERiod}:TIMeout:AUTO {ON|1|OFF|0}

[SENSe:]{FREQuency|PERiod}:TIMeout:AUTO?

Controls how long the instrument waits before timeout if there is no signal during a frequency or period measurement.

Parameters	Typical returns
{ ON 1 OFF 0}. Default value: OFF.	0 (OFF) or 1 (ON)

- If set to OFF, the instrument waits 1 second before timeout. If set to ON, the wait time will vary depending on the AC filter bandwidth; For faster bandwidth, the instrument has to wait less time before timeout and returning 0.0. This facilitates the manufacture of test systems, where DUT failure may result in no signal. In this case, the fault can be found more quickly and the overall test speed can be improved.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe:AUTO {OFF|ON|ONCE}

[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe:AUTO?

Disable or enable automatic voltage range adjustment for frequency and period measurements. Automatic range adjustment is convenient because it automatically selects a range for each measurement based on the input signal.

Specifying ONCE will perform auto range adjustment immediately, and then will turn it off.

NOTE This parameter is shared between frequency and period measurements. The FREQuency version setting or query parameter for this command is the same as the PERiod version setting or query.

WARNING The maximum range parameter (MAX) is 1000 V. However, the SAFETY LIMIT Hi /LO input terminals is 750 VAC (rms). The rms voltage depends on the waveform. The sine wave is limited to 750 VAC (rms), but 1000 Vpk square waves are safe. If connected to AC power supply, the sine waves are further limited to CAT II(300 V). See Safety and Regulatory Information for detailed information about the safety functions and safe operation of this instrument.

Parameters	Typical returns
{OFF ON ONCE}. Default value: ON.	0 (OFF) or 1 (ON)

- Input signals for frequency or period measurements have AC voltage components. By default, using this can enable or disable automatic voltage range adjustment. Or you can use CONFIGure: {FREQuency | PERiod} to select automatic voltage range adjustment. Use [SENSe:]{FREQuency|PERiod}:VOLTage:RANGe to select a fixed voltage range for frequency and period measurement.
- Automatic range adjustment can adjust the range down to less than 10% of the original range, and up to more than 120% of the original range.
- Select a fixed range ([SENSe:]<function>:RANGe) to disable automatic range adjustment.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe {<range>|MIN|MAX|DEF}

[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe? [{MIN|MAX|DEF}]

Select a fixed voltage range for frequency and period measurements.

NOTE This parameter is shared between frequency and period measurements. The FREQuency version setting or query parameter for this command is the same as the PERiod version setting or query.

WARNING The maximum range parameter (MAX) is 1000 V. However, the SAFETY LIMIT Hi /LO input terminals is 750 VAC (rms). The rms voltage depends on the waveform. The sine wave is limited to 750 VAC (rms), but 1000 Vpk square waves are safe. If connected to AC power supply, the sine waves are further limited to CAT II(300 V).

Parameters	Typical returns
< Range > : {100 mV 1 V 10 V 100 V 1000 V }	+ 1.04530000 E+03

. Default: 10V	
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- Input signals for frequency or period measurements have AC voltage components. Use this command to select a fixed voltage range for frequency and period measurements. By default, use [SENSe:]{FREQuency|PERiod}:VOLTage:RANGe:AUTO to enable or disable automatic voltage range adjustment or use CONFigure: {FREQuency | PERiod} to select automatic voltage range adjustment.
Select a fixed range ([SENSe:]<function>:RANGe) to disable automatic range adjustment.
- If the input voltage is too high for the selected voltage range (the manually adjusted measuring range), the words "Overload" will be displayed on the instrument panel and "9.9E37" will be returned from the remote interface. You can enable automatic range adjustment for input voltage.
This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

SENSe: CAPacitance subsystem

Capacitance measurements can be configured with this subsystem.

Command profile

[SENSe:]CAPacitance:NULL[:STATe]

[SENSe:]CAPacitance:NULL:VALue

[SENSe:]CAPacitance:NULL:VALue:AUTO

[SENSe:]CAPacitance:RANGe:AUTO

[SENSe:]CAPacitance:RANGe

[SENSe:]CAPacitance:NULL[:STATe] {ON|1|OFF|0}

[SENSe:]CAPacitance:NULL[:STATe]?

Null functions can be turned on or off for capacitance measurements.

Parameters	Typical returns
{ON 1 OFF 0}. Default value: ON.	0 (OFF) or 1 (ON)

- Enable the zoom function will also enable automatic null value selection ([SENSe:]CAPacitance:NULL:VALue:AUTO).
- To set a fixed null value, use: [SENSe:]CAPacitance:NULL:VALue.

- Instrument disables null functions after factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure function.

[SENSe:]CAPacitance:NULL:VALue {<value>|MIN|MAX|DEF}

[SENSe:]CAPacitance:NULL:VALue? [{MIN|MAX|DEF}]

Stores a null value for the capacitance measurement. If the null state is turned on, the null value will vbe deducted from each sample.

Parameter	Typical returns
< value> -120μF to +120 μF. Default value: 0.	1.20000000 E-04

- Specify a null value will disable automatic null value selection ([SENSe:]CAPacitance:NULL:VALue:AUTO OFF).
- To use the null value, use [Sense:]CAPacitance:NULL[:STATe] command to open the empty state.
- This parameter is set to its default value after a factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure function.

[SENSe:]CAPacitance:NULL:VALue:AUTO {ON|1|OFF|0}

[SENSe:]CAPacitance:NULL:VALue:AUTO?

Enable or disable automatic null selection for capacitance measurements.

Parameters	Typical returns
{ON 1 OFF 0}. Default value: ON.	0 (OFF) or 1 (ON)

- When the automatic reference selection is turned on, the first measurement made is used as the null value for all subsequent measurements.
[SENSe:]CAPacitance:NULL:VALue has set to this value. Automatic null selection will be disabled.
- After disabling automatic null value selection (OFF), use the following command to specify a null value:
[SENSe:]CAPacitance:NULL:VALue.
- After enabling the null function, the automatic null value selection will be enabled automatically([SENSe:]CAPacitance:NULL:STATe ON).
- This parameter is set to its default value after a factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure function.

[SENSe:]CAPacitance:RANGe:AUTO {OFF|ON|ONCE}

[SENSe:]CAPacitance:RANGe:AUTO?

Disable or enable automatic range adjustment for capacitance measurements.

Parameters	Typical returns
{OFF ON ONCE}. Default value: ON.	0 (OFF) or 1 (ON)

- Automatic range adjustment can adjust the range down to less than 10% of the original range, and up to more than 120% of the original range. When the automatic range adjustment range is off, the instrument will not report "overload" if the reading exceeds 120% of the range (capacitance measurements only). Overload occurs only when the algorithm timeouts because the applied capacitance is too large to make measurements. In capacitance measurement mode, if you apply a DC voltage or short circuit to the input terminal, the instrument will report an "overload".
- After performing the immediate automatic range adjustment, set the automatic range adjustment to OFF. (This way, the query will return "0".)
- Selecting discrete range (see [Sense:]CAPacitance:RANGe command) will disable the automatic range adjustment.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]CAPacitance:RANGe {<range> | MIN | MAX | DEF}

[SENSe:]CAPacitance:RANGe? [{MIN | MAX | DEF}]

Select a fixed range for capacitance measurement.

Parameter	Typical returns
<Range>: {1 nF 10 nF 100 nF 1 μ F 10 μ F 100 μ F }. Default: 1nF.	+ 1.00000000 E-09

- Select a fixed range ([SENSe:]<function>:RANGe) to disable automatic range adjustment.
- If the input signal is greater than the value that can be measured at the specified fixed range, the word "overload" will be displayed on the front panel of the instrument and "9.9E37" will be returned from the remote interface.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:] TEMPerature subsystem

This subsystem configures temperature measurement.

Command profile

[SENSe:]TEMPerature:NPLC

[SENSe:]TEMPerature:NULL[:STATe]

[SENSe:]TEMPerature:NULL:VALue

[SENSe:]TEMPerature:NULL:VALue:AUTO

[SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:RESistance[:REFerence]

[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:TYPE

[SENSe:]TEMPerature:TRANsducer:TYPE

[SENSe:]TEMPerature:ZERO:AUTO

[SENSe:]TEMPerature:NPLC {<PLC>|MIN|MAX|DEF}

[SENSe:]TEMPerature:NPLC? [{MIN|MAX|DEF}]

Set the integration time in the power line cycle number (PLC) to measure the temperature. Integration time is the period during which the instrument's analog-to-digital (A/D) converter collects an input signal sample for measurement. Longer integration time gives higher measurement resolution, but slower measurement speed.

Parameters	Typical returns
0.02, 0.2, 1, 10, 100. Default value: 10	+ 1.00000000 E+01

- Select the integration time from the number of power line cycles to cover the apertureset set by [SENSe:]TEMPerature:APERture command.
- Only 1, 10 or 100 PLC integration times provide normal mode (line frequency noise) suppression.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]TEMPerature:NULL[:STATE] {ON|1|OFF|0}

[SENSe:]TEMPerature:NULL[:STATE]?

Enable or disable null functions for temperature measurement.

Parameters	Typical returns
{ ON 1 OFF 0}. Default value: OFF.	0 (OFF) or 1 (ON)

- Enabling calibration function will also enable automatic null value selection ([SENSe:]TEMPerature:NULL:VALue:AUTO ON).
- To set a fixed null value, use: [SENSe:]TEMPerature:NULL:VALue.
- Instrument disables null functions after factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure function.

[SENSe:]TEMPerature:NULL:VALue {<value>|MIN|MAX|DEF}

[SENSe:]TEMPerature:NULL:VALue? [{MIN|MAX|DEF}]

Stores a null value for the temperature measurement.

Parameters	Typical returns
-1.0E15 to +1.0E15. Default value: 0.	+ 2.50000000 E+01

- Specifies a null value will disable automatic null value selection ([SENSe:]TEMPerature:NULL:VALue:AUTO OFF).
- To use null values, the null state must be turned on ([SENSe:]TEMPerature:NULL:STATe ON).
- This parameter is set to its default value after a factory reset (*RST), instrument preset (SYSTem:PRESet), or the CONFigure function.

[SENSe:]TEMPerature:NULL:VALue:AUTO {ON|1|OFF|0}

[SENSe:]TEMPerature:NULL:VALue:AUTO?

Enable or disable automatic null selection for temperature measurement.

Parameters	Typical returns
{ON 1 OFF 0}. Default value: OFF.	0 (OFF) or 1 (ON)

- When the automatic reference selection is turned on, the first measurement made is used as the null value for all subsequent measurements.
[SENSe:]TEMPerature:NULL:VALue is set to this value. Automatic null selection will be disabled.
- After disabling automatic null selection (OFF), specify null values using the following command:
[SENSe:]TEMPerature:NULL:VALue/
- After enabling the automatic null value selection, the instrument will enable the automatic null value selection ([SENSe:]TEMPerature:NULL:STATe ON).
- This parameter is set to its default value after a factory reset (*RST), instrument preset(SYSTem:PRESet), or the CONFigure function.

[SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:RESistance[:REFerence] {<reference>|MIN|MAX|DEF}

[SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:RESistance[:REFerence]? [{MIN|MAX|DEF}]

Select the nominal resistance (R0) for 2-wire RTD measurements. R0 is an RTD nominal resistor at 0 °C.

Parameters	Typical returns
80 Ω to 120 Ω. Default value: 100 Ω .	+ 1.00100000 E+02

- This parameter is set to its default value after factory reset (*RST) or instrument PRESET (SYSTem:PRESet).

[SENSe:]TEMPerature:TRANsducer:TYPE {RTD|THERmistor}

[SENSe:]TEMPerature:TRANsducer:TYPE?

Choose a probe type sensor for temperature measurement. Probes supported are 2-wire RTD, 2-wire thermistors (type5 K 4400, see thermistor requirements below).

Parameters	Typical returns
{ RTD THERmistor }. Default value: RTD.	RTD, THER

- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

[SENSe:]TEMPerature:TRANsducer:{THERmistor}:TYPE 5000

[SENSe:]TEMPerature:TRANsducer:{THERmistor}:TYPE?

Select thermistor types for 2-wire temperature measurements. Choosing the Thermistor command format makes no difference because both commands affect the same parameters.

Parameters	Typical returns
5000(the only option)	+ 5000

[SENSe:]TEMPerature:ZERO:AUTO {OFF|ON|ONCE}

[SENSe:]TEMPerature:ZERO:AUTO?

Disable or enable auto zero mode for 2-wire temperature measurement.

- ON(default) After each measurement, the DMM internally measures the offset. The measurement is then subtracted from the previous reading. This prevents the offset voltage on the DMM input circuit from affecting the measurement accuracy.
- OFF: The instrument subtracts the last measured zero reading from each measured value. Every time you change the function, range, or integration time, it reads a new zero reading.
- ONCE: The instrument obtains a zero reading and sets the auto zero to OFF. The obtained zero reading is used for all subsequent measurements until the function, range, or integration time is changed again. If the specified integration time is less than 1 PLC, 1 PLC will be used for auto zero measurement to optimize noise suppression. measurements should use the specified fast integration time (< 1 PLC).

Parameters	Typical returns
{OFF ON ONCE}. Default value: ON.	0 (OFF) or 1 (ON)

- When you use CONFigure:TEMPerature or MEASure:TEMPerature?. If the integration time selected by you using these commands is less than 1 PLC, the auto zero function will be automatically turned off.
- This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTem:PRESet).

General protocol:

TEST:ALL?

Run instrument self-check and return a pass/fail indication. The same with * TST?

CAUTION

Before running a full self-check, all input connections to the instrument must be disconnected.

Parameters	Typical returns
none	none
Run self-check: TEST:ALL? Typical response: +0(pass) or +1(one or more tests fail)	

- If one or more tests fail, the query will return +1 and store an error in the error queue. It's necessary to know the complete list of error messages related to self-checking failures.
- After completion of the test, the instrument returns to the state it was in before the self-test.

UNIT:TEMPerature {C|F|K} UNIT:TEMPerature?

Select the unit to be used for all temperature measurements (° C, ° F, or Kelvin), System: Temperature? Queries excepted.

Parameters	Typical returns
{ C F K }. The default value: C.	C, F or K
Perform a 2-wire RTD measurement and return the results in ° F: UNIT:TEMP F MEAS:TEMP? FRTD typical response: +6.82320000E+01	

This parameter is set to its default value after factory reset (*RST) or instrument preset (SYSTEM:PRESet)

ABORT

Aborts a measurement in progress, returning the instrument to the trigger idle state.

Parameter	Typical Return
(none)	(none)

Abort a measurement in progress: ABORt

Use this to abort a measurement when the instrument is waiting for a trigger, or for aborting a long measurement or series of measurements.

FETCh?

Waits for measurements to complete and copies all available measurements to the instrument's output buffer. The readings remain in reading memory.

Parameter	Typical Return
(none)	(none)
Use FETCh? with CONFigure and INITiate. The FETCh? query transfers the measurement from reading memory to the instrument's output buffer. CONF:VOLT:DC 10 TRIG:SOUR EXT SAMP:COUN 2 INIT FETC? Typical Response: -1.28748741E-01,-1.35163427E-01 Special instructions regarding current are as follows: FETCh:CURRent?	

- The FETCh? query does not erase measurements from the reading memory. You can send the query multiple times to retrieve the same data.
You can store up to 1,000 measurements in the reading memory. If reading memory overflows, new measurements overwrite the oldest measurements stored; the most recent measurements are always preserved. No error is generated.
- The instrument clears all measurements from reading memory when the measurement configuration changes, or when any of these commands are executed: INITiate, MEASure:<function>?, READ?, *RST, SYSTem:PRESet.

INITiate[:IMMediate]

Changes the state of the triggering system from "idle" to "wait-for-trigger", and clears the previous set of measurements from reading memory. Measurements begin when the specified trigger conditions are satisfied following the receipt of INITiate.

Parameter	Typical Return
(none)	(none)
Return five DC voltage measurements, using a software trigger to start the measurements: CONF:VOLT:DC 10 TRIG:SOUR BUS SAMP:COUN 2 INIT *TRG FETC?	

- Storing measurements in reading memory with INITiate is faster than sending measurements to the instrument's output buffer using READ? (provided you do not send FETCh? until done). The INITiate command is also an "overlapped" command. This means that after executing INITiate, you can send other commands that do not affect the measurements.
- You can store up to 1,000 measurements in the reading memory. If reading memory overflows, new measurements overwrite the oldest measurements stored; the most recent measurements are always preserved. No error is generated.
- To retrieve the measurements from the reading memory, use FETCh?. Use DATA:REMove? or R? to read and erase all or part of the available measurements.
- Use ABORt to return to idle.

R? [<max_readings>]

Reads and erases all measurements from reading memory up to the specified <max_readings>. The measurements are read and erased from the reading memory starting with the oldest measurement first.

Parameter	Typical Return
1 to 10000 (readings) Default is all readings in memory.	(none)
Read and remove the three oldest readings: R? 3 Typical Response: #247-1.18748897E-01,-1.25166787E-01,-1.41855678E-01 The "#2" means that the next 2 digits indicate how many characters are in the returned memory string. These two digits are the "47" after the "#2". Therefore, the remainder of the string is 47 digits long: -1.18748897E-01,-1.25166787E-01,-1.41855678E-01 Special instructions regarding current are as follows: R:CURRent?	

- The R? queries can be used during a long series of readings to periodically remove readings from memory that would normally cause the reading memory to overflow. R? does not wait for all readings to complete. It sends the readings that are complete at the time the instrument receives the command. Use Read? or Fetch? if you want the instrument to wait until all readings are complete before sending readings.
- If you do not specify a value for <max_readings>, all measurements are read and erased.
- No error is generated if the reading memory contains less readings than requested. In this case, all available readings in memory are read and deleted.
- The number of readings returned may be less than that requested depending on the amount of reading memory in your instrument. You can store up to 1,000 measurements in the reading memory. If reading memory overflows, new measurements overwrite the oldest measurements stored; the most recent measurements are always preserved. No error is generated.
- The instrument clears all measurements from reading memory when the measurement configuration changes, or when any of these commands are executed: INITiate, MEASure:<function>?, READ?, *RST, SYSTem:PRESet.

READ?

Starts a new set of measurements, waits for all measurements to complete, and transfers all available measurements. Sending READ? is similar to sending INITiate followed immediately by FETCh?.

Parameter	Typical Return
(none)	(none)
Transfer measurements from reading memory: READ? Typical Response: -1.33748741E-01,-1.35163427E-01,-1.33118686E-01,-1.48109378E-01 Special instructions regarding current are as follows: READ:CURRent?	

- The FETCh? query does not erase measurements from the reading memory. You can send the query multiple times to retrieve the same data.
- You can store up to 1,000 measurements in the reading memory. If reading memory overflows, new measurements overwrite the oldest measurements stored; the most recent measurements are always preserved. No error is generated.
- The instrument clears all measurements from reading memory when the measurement configuration changes, or when any of these commands are executed: INITiate, MEASure:<function>?, READ?, *RST, SYSTem:PRESet.

