# SCPI Programming Reference

# HDM3000 Digital multimeter

## Version: 1.02

# Contents

# SCPI Programming Reference

This section contains information to help you program HDM3000 series digital multimeters using the SCPI programming language through a remote interface.

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# 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. For example, the following string:

TRIG:SOUR EXT; COUNT 10

equivalents to the following two commands:

TRIG:SOUR EXT

TRIG:COUNT 10

Use a colon and a semicolon to link commands from different subsystems. In the following example, if you don't use colons and semicolons, errors will be generated:

TRIG:COUN MIN; :SAMP:COUN MIN

**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 trigger count to 10 measurements:

TRIG:COUN 10

Then, you can query the count value by sending:

TRIG:COUN?

You can also query the minimum or maximum counts allowed, as shown below:

TRIG:COUN?   MIN

TRIG:COUN?   MAX

# Calibration subsystem:

**TEST:ALL?**

**CALibration:FUNCtion**

**CALibration:VOLTage:{AC|DC}:RANGe**

**CALibration:CURRent:{AC|DC}:RANGe**

**CALibration:{RESistance|FRESistance}: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]" <br> "CURRent[:DC]", <br> "RESistance" <br> "FRESistance" <br> "CAPacitance" <br> "VOLTage:AC" <br> "CURRent:AC" <br> "FREQuency" <br><br> Default to Voltage [:DC]. | Enclose the abbreviated format of the selected function in quotes, with no optional keywords: <br><br> "CURR:AC", "CURR", and so on. |
|---|---|
| Select the AC voltage calibration function: <br> 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 } <br><br> 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 > : {100uA|1mA|10mA|100mA|1A|3A|10A } | + 1.00000000 E-04 |
| Default: 100uA | |

## CALibration:{RESistance|FRESistance}:RANGe {<range>|MIN|MAX|DEF}

**CALibration:{RESistance|FRESistance}:RANGe?   [{MAX MIN | | DEF}]**
**Select calibration ranges for the 2- wire and 4-wire resistance measurement.**

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

- 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 }. | + 1.00000000 E-09 |
| Default: 1 NF | |

- 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|FRESistance}**

**CONFigure:TEMPerature**

**CONFigure[:VOLTage]:{AC|DC}**

**CONFigure[:VOLTage][:DC]:RATio**

**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, $\Omega$ , 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 |
| Number of the triggers | A trigger |
| Trigger delay | Automatic delay |
| Trigger source | Immediately |
| Trigger slope | NEGative |
| 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 but does not place the instrument in the "wait to trigger" state.  READ?   puts the instrument in the "wait to trigger" state and measurement will be started when the rear panel Ext Trig input is

pulsed (low by default), and the measurement results will be stored in a reading memory, then transfers the measurement results to the output buffer of the instrument. Default range (automatic range adjustment) (10 PLC) is used for measurement.

CONF:VOLT:DC

TRIG:SOUR EXT

READ?

## CONFigure?

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: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 $4\frac{1}{2}$ 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 $\Omega$.

- For each measurement that is less than or equal to the continuity threshold ($\leqslant$10 $\Omega$), a buzzer is emitted (if the buzzer is enabled) and the actual resistance measurement is displayed on the display screen.

- From 10 $\Omega$ to 1.2 K $\Omega$, the instrument displays the actual resistance measurement without buzzing. Over 1.2K $\Omega$, 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 > : {100 μA\|1 mA\|10 mA\|100 mA\|1 A\|3 A\|10 A }.Default value: AUTO(automatic range adjustment). | none |
| <resolution> (AC): Optional and can be ignored; Fixed at $6\frac{1}{2}$ bits.<br><br>< resolution > (DC): The default value is equivalent to 10 PLC. < Resolution > is specified in units of measurement (V, A, HZ, $\Omega$ , etc.). | |

- Select 10 A range will automatically set the [SENSe:]CURRent:{AC|DC}:TERMinals parameter to 10 A, and the set range to 3 A or lower will set the [SENSe:]CURRent:{AC|DC}: parameter to 3 A.

- When the Front/Rear switch is set to Front, set the range to MAX to select the 10A range and 10A terminal. When the Front/Rear switch is set to Rear, set the range to MAX to select the 3A range and the 3A terminal.

- 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.

## 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 |
|------------|-----------------|
| < Range >:3 Hz to 300 kHz. Default value: 20 Hz. (FREQuency) <Range > : 3.33 μs to 333.33 ms. Default: 50 ms(PERiod). | none |

- 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|FRESistance} [{<range>|AUTO|MIN|MAX|DEF} [, {<resolution>|MIN|MAX|DEF}]]

All measurement parameters and trigger parameters are set to their default values for a 4-

wire or 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 [{FRTD|RTD|FTHermistor|THERmistorDEFault} [, {<type>|DEFault} [,1[, {<resolution>|MIN|MAX|DEF}]]]]

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

| parameter | A typical return |
|---|---|
| *<probe_type>*: {FRTD|RTD|FTHermistor|THERmistor} Default value: FRTD. | + 2.12320000 E+01 |
| <type >:85 (the only possible value for RTD/FRTD), 5000(the only possible value for Thermistor/Fthermistor) or E, J, K, N, R, T(TCouple). | |
| <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.

- For thermocouple measurements, select an internal reference. Please see SENSe:TEMPerature:TCouple:RJUNction:TYPE.

- 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 and trigger 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 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 }.Default value: AUTO(automatic range adjustment). | none |
| <resolution> (AC) : Optional and can be ignored; Fixed at $6\frac{1}{2}$ bits.<br><br>< resolution > (DC) : The default value is equivalent to 10 PLC. < Resolution > is specified in units of measurement (V, A, HZ, $\Omega$ , 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 and 4-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<br>CONTinuity<br>CURRent:AC<br>CURRent[:DC]<br>DIODe<br>FREQuency<br>FRESistance<br>PERiod<br>RESistance<br>TEMPerature<br>VOLTage:AC<br>VOLTage[:DC]<br>VOLTage[:DC]:RATio<br><br>Default to Voltage [:DC]. | Quote the abbreviated format of the selected function with no optional keywords:<br><br>"CONT", "CURR:AC", "CURR", "DIOD", etc. |
| Select AC voltage function:<br>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]:RATio:SECondary**

**[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. 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 }<br><br>AC default value: 10 V<br>DC default value: 1000 V | + 1.00000000 E+01 |

- 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 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 |
|---|---|
| { 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.

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| 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 MΩ 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 GΩ) to reduce the impact of measurement loading errors on these lower ranges. Keep the 100 V and 1000 V ranges at 10 MΩ 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]:RATio:SECondary {"OFF"|"SENSe:DATA"}
[SENSe:]VOLTage[:DC]:RATio:SECondary?

Select an auxiliary measurement function for DC proportional measurement.

| Parameters | Typical returns |
|---|---|
| {" OFF "\|" SENSe: DATA "}, default to "OFF" | "SENS:DATA" |
|  |  |

"SENSe:DATA" - DC signal voltage and DC reference voltage measurement.

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

(SYSTem:PRESet).

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

[SENSe:]VOLTage[:DC]:SECondary?

Select an auxiliary measurement function for DC voltage measurement.

| Parameters | Typical returns |
|---|---|
| {" OFF "\|" AC "VOLTage.}, default to " OFF" | " VOLT:AC " |

- " VOLTage:AC " - Measurement of the AC voltage of the input signal. Apply only when the
  instrument is used on the front panel. Measurements from the remote interface will
  ignore this setting. If you need to measure AC and DC voltage remotely and program for
  each function separately, please see the CONFigure [: VOLTage] : {AC | DC}.

  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.<br><Resolution > is specified in units of measurement (V, A, HZ, $\Omega$, 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|ONCE}

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

Disable or enable the auto zero mode for DC voltage and proportional 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 the CONFigure: VOLTage: DC, CONFigure: VOLTage: DC: thewire, MEASure: VOLTage: DC?   Or MEASure: VOLTage: DC: thewire? 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 digital multimeter with A 10A range, you cannot select a 10A range using this command. Please use [SENSe:]CURRent:{AC|DC}:TERMinals10 or CONF:CURRent:{AC|DC} 10.

| 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> : {100 μA|1 mA|10 mA|100 mA|1 A|3 A }.Default value: AUTO(automatic range adjustment). | + 1.00000000 E-01 |

- 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 10 A terminal will force the current measurement type using the 10 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|10}

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

Configure AC or DC current measurements to measure the power supply on terminals 3 A or 10 A.

| Parameters | Typical returns |
|---|---|
| {3|10}. Default value: 3. | +3 or +10 |
|  |  |

- Use [SENSe:]CURRent:{AC|DC}:TERMinals to choose the 10 A terminal will force the current measurement type using the 10 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 10 A terminal type will force the specified current measurement type to use the 10 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:AC:SECondary {"OFF"|"FREQuency"}
[SENSe:]CURRent:AC:SECondary?

Select an auxiliary measurement function for AC current cycle measurement.

| Parameters | Typical returns |
|---|---|
| {"OFF"|"FREQuency"}. Default: "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:]CURRent[:DC]:SECondary {"OFF"|"CURRent:AC"}
[SENSe:]CURRent[:DC]:SECondary?

Select an auxiliary measurement function for DC current measurement.

| Parameters | Typical returns |
|---|---|
| {"OFF"|"CURRent:AC"}. Default: "OFF" | " CURR:AC " |

- " CURRent:AC " - Input signal AC current measurement. Apply only when the instrument is used on the front panel. Measurements from the remote interface will ignore this setting. If you need to measure AC and DC current remotely, and program each function seperately, please see the CONFigure: CURRent: {AC | DC}.
- 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 | + 1.00000000 E+00 |

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, $\Omega$ , 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:] {hold | FRESistance} subsystem

This subsystem configures 2-wire and 4-wire resistance measurements.

Command profile

**[SENSe:]{RESistance|FRESistance}:NPLC**

**[SENSe:]{RESistance|FRESistance}:NULL[:STATe]**

**[SENSe:]{RESistance|FRESistance}:NULL:VALue**

**[SENSe:]{RESistance|FRESistance}:NULL:VALue:AUTO**
**[SENSe:]{RESistance|FRESistance}:RANGe**

**[SENSe:]{RESistance|FRESistance}:RANGe:AUTO**

**[SENSe:]{RESistance|FRESistance}:RESolution**

**[SENSe:]{FRESistance|RESistance}:SECondary**

**[SENSe:]RESistance:ZERO:AUTO**

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

**[SENSe:]{RESistance|FRESistance}: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 2 - and 4-wire resistance measurements. The FRESistance version using this command is the same as the RESistance version.

| 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|FRESistance}:NULL[:STATe] {ON|1|OFF|0}**

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

Enable or disable null functions for all resistance measurements.

NOTE This parameter is common for 2 - and 4-wire resistance measurements. The FRESistance version using this command is the same as the RESistance version.

| 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|FRESistance}:NULL:VALue:AUTO ON.

- To set a fixed null value, please use: [SENSe:]{RESistance|FRESistance}:NULL:VALue.

- Instrument disables null functions after factory reset (*RST), instrument preset

  (SYSTem:PRESet), or the CONFigure functions.

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

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

Stores a null value for all resistance measurements.

NOTE This parameter is common for 2 - and 4-wire resistance measurements. The FRESistance version using this command is the same as the RESistance version.

| 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|FRESistance}:NULL:VALue:AUTO OFF).

- To use a null value, you must open the null state

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

Enable or disable automatic null selection for all resistance measurements.

**NOTE** This parameter is common for 2 - and 4-wire resistance measurements. The FRESistance version using this command is the same as the RESistance version.

| 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|FRESistance}: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|FRESistance}:NULL:VALue.

- After enabling the null function, the instrument will enable automatic null value selection ([SENSe:]{RESistance|FRESistance}: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|FRESistance}:RANGe:AUTO {OFF|ON|ONCE}

### [SENSe:]{RESistance|FRESistance}: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 - and 4-wire resistance measurements. The FRESistance version using this command is the same as the RESistance version.

| 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|FRESistance}:RESolution {<resolution>|MIN|MAX|DEF}

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

**NOTE** This parameter is common for 2 - and 4-wire resistance measurements. The FRESistance version using this command is the same as the RESistance version.

| Parameters | Typical returns |
|---|---|
| <resolution>: The default value is equivalent to 10 PLC. < Resolution > is specified in units of measurement (V, A, HZ, $\Omega$ , 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|FRESistance}: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) |

- Does not affect the 4-wire resistance measurement, which is always performed with auto zero turned on.

- When you use CONFigure:{RESistance|FRESistance} or MEASure:{RESistance|FRESistance}? 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:SECondary**

**SENSe:]PERiod:SECondary**

**[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:<br><br>CONF:FREQ<br>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.<br>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 on the front and rear 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 on the front and rear 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 }. Default: 10V | + 1.04530000 E+03 |

- 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:]FREQuency:SECondary {"OFF"|"PERiod"}

### [SENSe:]FREQuency:SECondary?

Select an auxiliary measurement functions for frequency measurement.

| parameter | A typical return |
|---|---|
| {"OFF"|"PERiod"}. Default: "OFF" | " PERiod" |

- " PERiod " - The measurement of the period of the input signal.

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

## [SENSe:]PERiod:SECondary {"OFF"|"FREQuency"} [SENSe:]PERiod:SECondary?

Select an auxiliary measurement functions for periodic measurement.

| Parameters | Typical returns |
|---|---|
| {"OFF""FREQuency"}. Default: "OFF" | " FREQuency" |

" 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: 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 µF|10 µF|100 µF }. 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:SECondary**

**[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:SECondary {"OFF"|"SENSe:DATA"}

[SENSe:]TEMPerature:SECondary?

Select an auxiliary measurement function for temperature measurement.

| Parameters | Typical returns |
|---|---|
| {"OFF"\|"SENSe:DATA"}. Default: "OFF" | "SENS:DATA" |

- "Sense :DATA" is the original sensor value; Thermistor /RTD resistance, thermocouple voltage and reference temperature.

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

## [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 and 4-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 {FRTD|RTD|FTHermistor|THERmistor}

## [SENSe:]TEMPerature:TRANsducer:TYPE?

Choose a probe type sensor for temperature measurement. Probes supported are 2-wire and 4-wire RTD, 2-wire and 4-wire thermistors (type5 K 4400, see thermistor requirements below).

| Parameters | Typical returns |
|---|---|
| { FRTD\|RTD\|FTHermistor\|THERmistor }. Default value: FRTD. | FRTD, RTD, FTH, THER |

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

**[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:TYP 5000**

[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:TYP?

Select thermistor types for 2-wire and 4-wire temperature measurements. Choosing the Thermistor or Fthermistor 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) |

- Do not affect the 4-wire resistance measurement, which is always performed with auto zero turned 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).

## [SENSe:] DATA2 subsystem

The subsystem retrieves or clears the auxiliary measurement results.

### [SENSe:]DATA2?

Retrieve auxiliary measurement results.

| Parameters | Typical returns |
|---|---|
| none | See the example below |
| | |

- Return 1, 2, or 3 values, depending on the active secondary measure. For example, a proportional measurement will return two values (primary and sensing terminal measurements); PtPeak returns three values (minimum peak, maximum peak, peak-peak). If no valid secondary measure is currently specified, the query will return "9.91000000E+37".

- Use [SENSe:]CAPacitance:SECondary、[SENSe:]CURRent:AC:SECondary、[SENSe:]CURRent:DC:SECondary、[SENSe:]FREQuency:SECondary、[SENSe:]PERiod:SECondary、[SENSe:]TEMPerature:SECondary、[SENSe:]VOLTage:AC:SECondary、[SENSe:]VOLTage:DC:SECondary or [SENSe:]VOLTage[:DC]:RATio:SECondary to configure the auxiliary measurement。

- The instrument will clear all measurements from the reading memory when the measurement configuration changes, or when any of the following commands are executed: INITiate, MEASure:<*function*>?, READ?, *RST, SYSTem:PRESet.

### [SENSe:]DATA2:CLEar[:IMMediate]

Clean up the latest results of auxiliary measurements.

| Parameters | Typical returns |
|---|---|
| none | See the example below |

# 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 4-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)