

Programming  
Guide

# Keysight DAQ970A Data Acquisition System



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### Software Revision

The latest firmware is available at [www.keysight.com/DAQ970Afirmware](http://www.keysight.com/DAQ970Afirmware).

The latest product documentation is available at [www.keysight.com/DAQ970Amanuals](http://www.keysight.com/DAQ970Amanuals).

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This product uses Microsoft Windows CE. Keysight highly recommends that all Windows-based computers connected to Windows CE instruments use current anti-virus software. For more information, see [www.keysight.com/find/DAQ970A](http://www.keysight.com/find/DAQ970A).

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### **WARNING**

The **WARNING** sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a **WARNING** sign until the indicated conditions are fully understood and met.

---

### **CAUTION**

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---

### **NOTE**

The **NOTE** sign denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

---

# 1 DAQ970A Remote Operation

**Introduction to the SCPI Language**

**Factory Reset State**

**Instrument Preset State**

This chapter describes the remote operation for the DAQ970A using SCPI programming language.

## Introduction to the SCPI Language

SCPI (Standard Commands for Programmable Instruments) is an ASCII-based programming language for test and measurement instruments. SCPI commands use a hierarchical structure known as a tree system. Associated commands are grouped under a common node or root, thus forming subsystems. A portion of the SENSE subsystem illustrates this, as below.

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

**SENSe** is the root keyword of the command, **VOLTage** is a second-level keyword, and **DC** is a third-level keyword. A colon (:) separates consecutive keywords.

### Syntax conventions

#### SCPI command separators

#### Querying parameter settings

#### Using the MIN, MAX, and DEF parameters

#### SCPI command terminators

#### IEEE-488.2 common commands

#### Channel list parameter

#### SCPI parameter types

#### Using Device Clear

#### LAN port usages

## Syntax conventions

The format used to show commands is illustrated as below:

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

The command syntax shows most commands (and some parameters) as a mixture of upper- and lower-case letters. The upper-case letters indicate the abbreviated spelling for the command. For shorter program lines, you can send the abbreviation form. For better program readability, you can send the full form.

For example, in the above syntax statement, VOLT and VOLTage are both acceptable forms. You can use upper- or lower-case letters. Therefore, VolTaGe, volt and Volt are all acceptable forms. Other forms, such as VOL and VOLTAG, are not valid and will generate an error.

- Braces ( { } ) enclose the parameter choices. The braces are not sent with the command string.
- A vertical bar ( | ) separates multiple parameter choices. For example, {<range>|MIN|MAX|DEF} in the above command indicates that you can specify a numeric range parameter, or "MIN", "MAX", or "DEF". The bar is not sent with the command string.

## 1 DAQ970A Remote Operation

- Angle brackets ( < > ) indicate that you must specify a value for the enclosed parameter. For example, the above syntax statement shows the <range> parameter in angle brackets. Do not send the brackets with the command string. You must specify a value for the 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 ( []). The brackets are not sent with the command string. If you do not specify a value for an optional parameter, the instrument uses a default value.

### SCPI command separators

A colon ( : ) separates consecutive keywords. You must insert a blank space to separate a parameter from a command keyword. If a command requires more than one parameter, separate adjacent parameters using a comma:

```
CONF:VOLT:DC 10,0.003
```

A semicolon ( ; ) separates commands within the same subsystem and can also minimize typing. For example, the following string:

```
TRIG:SOUR EXT; COUNT 10
```

... is equivalent to the following two commands:

```
TRIG:SOUR EXT  
TRIG:COUNT 10
```

Use a semicolon and colon ( ; : ) to link commands from different subsystems. For example, in the following command string, an error is generated if you do not use both the semicolon and colon:

```
DISP:TEXT:CLE;;SOUR:CURR MIN
```

### Querying parameter settings

You can query the current value of most parameters by adding a question mark ( ? ) to the command. The following example sets the trigger count to 10 measurements:

```
TRIG:COUN 10
```

You can then query the count value by executing:

```
TRIG:COUN?
```

You can also query the minimum or maximum count allowed as follows:

```
TRIG:COUN? MIN  
TRIG:COUN? MAX
```

### Using the MIN, MAX, and DEF parameters

For many commands, you can substitute "MIN" or "MAX" in place of a parameter. In some cases you may also substitute "DEF". For example,

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

Instead of selecting a specific value for the *<range>* parameter, you can substitute MIN to set the range to its minimum value, MAX to set the range to its maximum value, or DEF to set the range to its default value.

## SCPI command terminators

A command string sent to the instrument must terminate with a *<new line>* (*<NL>*) character. The IEEE-488 EOI (End-Or-Identify) message is interpreted as a *<NL>* character and can be used to terminate a command string in place of a *<NL>* character. A *<carriage return>* followed by a *<NL>* is also accepted. Command string termination will always reset the current command path to the root level.

### NOTE

For every message that includes a query and is sent to the instrument, the instrument terminates the returned response with a *<NL>* or line-feed character (EOI). For example, if *\*IDN?* is sent, the response is terminated with a *<NL>* after the block of data that is returned. If a message includes multiple queries separated by semicolons (for example *\*\*ESR?;\*IDN?*), the returned response is again terminated by a *<NL>* after the response to the last query. In either case, the program must read this *<NL>* in the response before another command is sent to the instrument, or an error will occur.

## IEEE-488.2 common commands

The IEEE-488.2 standard defines a set of common standards that perform functions such as reset, self-test, and status operations. Common commands always begin with an asterisk (\*), three characters in length, and may include one or more parameters. The common keyword is separated from the first parameter by a blank space. Use a semicolon (;) to separate multiple commands as shown below:

```
*RST; *CLS; *ESE 32; *OPC?
```

## Channel list parameter

A channel list always starts with "@" and is enclosed in parentheses, shown as "@*<ch\_list>*" throughout this document.

You can use the channel list parameter to address one or more channels, example:

(@301) - channel 01 on the module in slot 3.

(@301:302) - channels 01 and 02 on the module in slot 3.

Or list a range of channels, example:

(@101,201:202,302) - channel 01 on the module in slot 1, channels 01 and 02 on the module in slot 2, and channel 02 on the module in slot 3.

A maximum of three channels may be specified through a combination of single channel and ranges. Query results are channel list order-sensitive. Results are returned in the order they are specified in the list.

### NOTE

If you omit the optional @*<ch\_list>* parameter, the command applies to the currently defined scan list.

When adding a channel list parameter to a query, you must include a space character between the query indicator ( ? ) and the channel list parameter, example: CALC:MATH? (@401). Otherwise error "-103 Invalid separator" will occur as listed in **Command Errors** list.

---

### SCPI parameter types

The SCPI language defines several data formats to be used in program messages and response messages.

#### Numeric parameters

Commands that require numeric parameters accept all commonly used decimal representations of numbers including optional signs, decimal points, and scientific notation. Special values for numeric parameters such as MIN, MAX, and DEF are also accepted. You can also send engineering unit suffixes with numeric parameters (e.g., M, k, m, or  $\mu$ ). If a command accepts only certain specific values, the instrument rounds the input numeric parameters to the accepted values. The following command requires a numeric parameter for the range value:

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

#### NOTE

As the SCPI parser is case-insensitive, there is some confusion over the letter "M" (or "m"). For your convenience, the instrument interprets "mV" (or "MV") as millivolts, but "MHZ" (or "mhz") as megahertz. Likewise "M $\Omega$ " (or "m $\Omega$ ") is interpreted as megaohm. You can use the prefix "MA" for mega. For example, "MAV" is interpreted as megavolts.

---

#### Discrete parameters

Discrete parameters are used to program settings that have a limited number of values (like IMMEDIATE, EXTERNAL, or BUS). They have a short form and a long form just like command keywords. You can mix upper- and lower-case letters. Query responses always return the short form in all upper-case letters. The following example requires a discrete parameters for the temperature units:

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

#### Boolean parameters

Boolean parameters represent a single binary condition that is either true or false. For a false condition, the instrument accepts "OFF" or "0". For a true condition, the instrument accepts "ON" or "1". When you query a Boolean setting, the instrument returns "0" or "1". The following example requires a Boolean parameter:

```
DISPlay:STATe {OFF|ON}
```

#### ASCII string parameters

String parameters can contain virtually any set of ASCII characters. A string must begin and end with matching quotes; either with a single quote or a double quote. You can include the quote delimiter as part of the string by typing it twice without any characters in between. The following command uses a string parameter:

```
DISP:TEXT "<string>"
```

The following example displays the message "WAITING..." on the instrument's front panel (the quotes are not displayed).

```
DISP:TEXT "WAITING..."
```

You can also display the same message with single quotes.

```
DISP:TEXT 'WAITING...'
```

## Using Device Clear

Device Clear is an IEEE-488.2 low-level bus message that you can use to return the instrument to a responsive state. Different programming languages and IEEE-488.2 interface cards provide access to this capability through their own unique commands. The status registers, error queue, and all configuration states are left unchanged when a Device Clear message is received.

Device Clear performs the following actions:

- If a measurement is in progress, it is aborted.
- The instrument returns to the trigger "idle" state.
- The instrument's input and output buffers are cleared.
- The instrument is prepared to accept a new command string.
- An overlapped command, if any, is terminated with no "Operation Complete" indication (applies to initiate, INIT command).

### NOTE

The **ABORt** command is the recommended method to terminate a measurement.

---

## LAN port usages

Keysight DAQ970A uses the following LAN ports:

- Port 5024 is used for SCPI Telnet sessions.
- Port 5025 is used for Socket sessions.

## Factory Reset State

Tables below show the states of the instrument from the front panel (press [Save Recall] > Set to Defaults > Factory Reset), or from the remote interface (\*RST command).

Measurement configuration	Factory reset state
Function	DC Volts
Range	Autorange (for all functions)
Integration Time	1 PLC NPLC On, 1 power line cycles (PLC)
Auto zero	On
Input Resistance	10 M $\Omega$ (fixed for all DCV ranges)
Channel Delay	Automatic Delay
Totalizer Reset Mode	Count Not Reset When Read
Totalizer Edge Detect	Rising Edge

Scanning operations	Factory reset state
Scan List	Empty
Reading Memory	All Readings are Cleared
Min, Max, and Average	Not Changed
Scan Trigger Source	Immediate
Scan Interval	10 Seconds
Scan Count	1
Scan Reading Format	Reading Only (No Units, Channel, Time)
Monitor in Progress	Stopped

Measurement scaling	Factory reset state
Gain Factor ("M")	1
Offset Factor ("B")	0
Scale Label	VDC

Alarm limits	Factory reset state
Alarm Queue	Not Cleared
Alarm State	Off
HI and LO Alarm Limits	0
Alarm Output	Alarm 1
Alarm Output Configuration	Latched Mode
Alarm Output State	Output Lines are Cleared
Alarm Output Slope	Neg



Module hardware	Factory reset state
DAQM900A, DAQM901A, DAQM902A, DAQM908A	All Channels Open
DAQM903A, DAQM904A	All Channels Open
DAQM905A	Channels 11 and 21 Selected
DAQM907A	Both DIO Ports = Input, Totalizer Count = 0, Both DACs = 0 VDC/0 A [1]

System-related operations	Factory reset state
Display State	On (Number)
Error Queue	Errors Not Cleared
Stored States	No Change

Note:

[1] 0 VDC when output mode is locked to voltage (**SOURce:MODE:LOCK OFF** command); 0 A when output lock is locked to current (**SOURce:MODE:LOCK ON** command).

## Instrument Preset State

Table below shows the states of the instrument from the front panel (press **[Save Recall]** > **Set to Defaults** > **Preset State**), or from the remote interface (**SYSTem:PRESet** command).

Measurement configuration	Instrument preset state
Function	No Change
Range	No Change
Advanced Settings	No Change
Totalizer Reset Mode	Count Not Reset When Read
Totalizer Edge Detect	Rising Edge

Scanning operations	Instrument preset state
Scan List	No Change
Reading Memory	All Readings are Cleared
Min, Max, and Average	No Change
Scan Interval Source	No Change
Scan Interval	No Change
Scan Count	No Change
Scan Reading Format	No Change
Monitor in Progress	Stopped

mX+b scaling	Instrument preset state
Gain Factor ("M")	No Change
Offset Factor ("B")	No Change
Scale Label	No Change

Alarm limits	Instrument preset state
Alarm Queue	No Change
Alarm State	No Change
HI and LO Alarm Limits	No Change
Alarm Output Configuration	No Change
Alarm Output State	Output Lines are Cleared
Alarm Output Slope	No Change

Module hardware	Instrument preset state
DAQM900A, DAQM901A, DAQM902A, DAQM908A	All Channels Open

Module hardware	Instrument preset state
DAQM903A, DAQM904A	All Channels Open
DAQM905A	Channels 11 and 21 Selected
DAQM907A	Both DIO Ports = Input, Totalizer Count = 0, Both DACs = 0 VDC/0 A [1]

System-related operations	Instrument preset state
Display State	No Change
Error Queue	Errors Not Cleared
Stored States	No Change

Note:

[1] 0 VDC when output mode is locked to voltage (**SOURCE:MODE:LOCK OFF** command); 0 A when output lock is locked to current (**SOURCE:MODE:LOCK ON** command).

# 2 SCPI Programming

ABORt  
FETCh?  
INITiate  
INSTrument:DMM  
R?  
READ?  
TEST:ALL?  
UNIT:TEMPerature  
CALCulate Subsystem  
CALibration Subsystem  
CONFigure Subsystem  
DATA Subsystem  
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FORMat Subsystem  
HCOPy Subsystem  
IEEE-488.2 Common Commands  
LXI Subsystem  
MEASure Subsystem  
MMEMory Subsystem  
OUTPut Subsystem  
ROUte Subsystem  
SENSe Subsystem  
SOURce Subsystem  
STATus Subsystem  
SYSTem Subsystem  
TRIGger Subsystem

This chapter describes all the SCPI commands available in the DAQ970A.

## ABORt

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

Parameter	Typical return
(none)	(none)

Aborts the measurement in progress: `ABOR`

- If a scan is in progress when the command is received, the scan will not be completed and you cannot resume the scan from where it left off. Note that if you initiate a new scan, all readings are cleared from reading memory.
- The Factory Reset (`*RST` command) will abort a measurement, clear the scan list, and set all measurement parameters to the factory configuration. The Instrument Preset (`SYSTem:PRESet` command) also aborts a measurement but will not clear the scan list.

## 2 SCPI Programming

### FETCh?

Waits for measurements to complete and transfers all available readings stored in reading memory to the instrument's output buffer. The readings remain in reading memory will not be erased when read with this command.

Parameter	Typical return
(none)	(none)

Use the FETCh? command with CONFigure and INITiate. The INITiate command places the instrument in the "wait-for-trigger" state, scans the specified channels when the rear-panel Ext Trig Input line is pulsed (low by default), and then sends the readings to reading memory. The FETCh? command transfers the readings from reading memory to the instrument's output buffer.

```
CONF:VOLT:DC 10,0.003,(@103,108)
TRIG:SOUR EXT
INIT
FETC?
```

Typical response: +4.27150000E-03,+1.32130000E-03

- You can save up to 100,000 readings in reading memory and all readings are automatically time stamped. If reading memory overflows, the new readings will overwrite the first (oldest) readings saved; the most recent readings are always preserved. No error is generated, but the Reading Memory Overflow bit (bit 12) is set in the Questionable Data Register's condition register (see **STATus Subsystem**).
- Readings can be acquired during a scan using the multiplexer or multifunction modules.
- Each time you start a new scan, the instrument clears all readings (including alarm data) saved in reading memory from the previous measurement. Therefore, the contents of reading memory are always from the most recent scan.
- The instrument clears all readings from reading memory when a new scan is initiated, or after a Factory Reset (**\*RST** command).

## INITiate

Immediately changes the state of the triggering system from "idle" to "wait-for-trigger", and clears the previously set of readings from reading memory. Scanning will begin when the specified trigger conditions are satisfied following the receipt of INITiate command. If the trigger system is not initiated, all triggers are ignored.

Parameter	Typical return
(none)	(none)

Use the INITiate command with CONFigure and FETCh?. The INITiate command places the instrument in the "wait-for-trigger" state, scans the specified channels when the rear-panel Ext Trig Input line is pulsed (low by default), and then sends the readings to reading memory. The FETCh? command transfers the readings from reading memory to the instrument's output buffer.

```
CONF:VOLT:DC 10,0.003,(@103,108)
TRIG:SOUR EXT
INIT
FETC?
```

Typical response: +4.27150000E-03,+1.32130000E-03

- The INITiate command is an "overlapped" command. This means that after executing INITiate, you can send other commands that do not affect the measurements.
- You can save up to 100,000 readings in reading memory and all readings are automatically time stamped. If reading memory overflows, the new readings will overwrite the first (oldest) readings saved; the most recent readings are always preserved. No error is generated, but the Reading Memory Overflow bit (bit 12) is set in the Questionable Data Register's condition register (see **STATus Subsystem**).
- If a scan list containing multiplexer channels is currently defined (see **ROUTE:SCAN** command), the INITiate command performs a scan of the selected channels. When the scan is initiated, the instrument will open all channels in modules that contain one or more channels in the scan list.
- The instrument scans the list of channels in ascending order from slot 1 through slot 3 (channels are re-ordered as needed). When you specify a range of channels in the `<ch_list>`, the channels are always sorted in ascending order. Therefore, `(@109:101)` will always be interpreted as 101, 102, 103, ..., 109.
- Once you initiate a scan, an error will be generated if you attempt to change any measurement parameters (**CONFigure** and **SENSe** commands) or the triggering configuration (**TRIGger** commands).

## INSTrument:DMM

### INSTrument:DMM {OFF|ON} INSTrument:DMM?

Enables (On) or disables (Off) the internal DMM.

Parameter	Typical return
{OFF ON} Default: ON	0 (OFF) or 1 (ON)
Enables the internal DMM: <code>INST:DMM ON</code>	

- When you change the state of the internal DMM, the instrument issues a Factory Reset (**\*RST** command).



## R?

## R? [&lt;max\_rdgs&gt;]

Reads and erases readings from reading memory up to the specified <max\_rdgs>, starting with the oldest readings. This command allows you to periodically remove readings that would normally cause reading memory to overflow (for example, during a scan with an infinite scan count).

Parameter	Typical return
<max_rdgs> = 1 to 100,000 readings Default: Erases all saved readings, up to 100,000 readings.	A series of readings in Definite-Length Block format

Reads the three oldest readings and erases from reading memory:

R? 3

Typical response: #247+8.11900000E-03,+5.15280000E-03,+3.11220000E-03

The "#2" means that the next 2 digits indicate how many characters are in the returned memory string. In the above example, the 2 digits are the "47" after the "#2". Therefore, the remaining of the string is 47 digits long.

- This command is a special version of the **DATA:REMove?** command with faster execution time. You can read memory at any time using the R? command, even during a scan.
- If no readings are available in reading memory, #10 is returned.
- If you do not specify a value or the reading memory has fewer readings than <max\_rdgs>, all readings are read and erased.
- Readings can be acquired during a scan using the multiplexer or multifunction modules.
- You can save up to 100,000 readings in reading memory and all readings are automatically time stamped. If reading memory overflows, the new readings will overwrite the first (oldest) readings saved; the most recent readings are always preserved. No error is generated, but the Reading Memory Overflow bit (bit 12) is set in the Questionable Data Register's condition register (see **STATus Subsystem**).
- The instrument clears all readings from reading memory when a new scan is initiated, or after a Factory Reset (**\*RST** command).

## 2 SCPI Programming

### READ?

Changes the state of the triggering system from "idle" to "wait-for-trigger". Scanning will begin when the specified trigger conditions are satisfied following the receipt of the READ? command. Readings are then sent to reading memory and the instrument's output buffer.

Parameter	Typical return
(none)	(none)

Use the READ? command with CONFigure. The READ? command places the instrument in the "wait-for-trigger" state, scans the specified channels when the rear-panel Ext Trig Input line is pulsed (low by default), and then sends the readings to reading memory and the instrument's output buffer.

```
CONF:VOLT:DC 10,0.003,(@103,108)
TRIG:SOUR EXT
READ?
```

Typical response: +4.27150000E-03,+1.32130000E-03

- Sending the READ? command is equivalent to sending the **INITiate** command followed immediately by the **FEtCh?** command.
- You can save up to 100,000 readings in reading memory and all readings are automatically time stamped. If reading memory overflows, the new readings will overwrite the first (oldest) readings saved; the most recent readings are always preserved. No error is generated, but the Reading Memory Overflow bit (bit 12) is set in the Questionable Data Register's condition register (see **STATus Subsystem**).
- The READ? query is not valid with the **\*TRG** command (used with **TRIGger:SOURce BUS** command for software triggering).
- The instrument clears all readings from reading memory when a new scan is initiated, or after a Factory Reset (**\*RST** command).

## TEST:ALL?

Runs an instrument complete self-test and returns a pass or fail indication. It will take few seconds to complete. If all tests pass, you can have high confidence that the instrument is operational. If fail, errors will save in error queue.

### CAUTION

You must remove the sources from the instrument's input terminals before running the full self-test.

Parameter	Typical return
(none)	+0 (pass) or +1 (one or more tests failed)
Runs a self-test: TEST:ALL?	

- This command is more comprehensive than **\*TST?** self test.
- For a complete listing of the error messages related to self-test failures, see [Self-test Errors](#).
- Following the test, the instrument returns to the instrument state that existed before the self-test.

## UNIT:TEMPerature

**UNIT:TEMPerature {C|F|K} [, (@<ch\_list>)]****UNIT:TEMPerature? [(@<ch\_list>)]**

Specifies the units °C (Celsius), °F (Fahrenheit), or K (Kelvin) to be used for all temperature measurements except the **SYSTem:TEMPerature?** query.

**NOTE**

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Table below shows transducer types that are supported on each multiplexer module.

Multiplexer module	Transducer types				
	Thermocouple	2-wire RTD	4-wire RTD	2-wire thermistor	4-wire thermistor
DAQM900A	√				
DAQM901A	√	√	√	√	√
DAQM902A	√	√	√	√	√
DAQM908A		√		√	

Parameter	Typical return
{C F K}	C, F, or K
Default: C	

On the selected multiplexer channels, sets the temperature units to °F, for thermocouple type B:

CONF:TEMP TC,B, (@312,313)

UNIT:TEMP F, (@312,313)

- You can mix temperature units on different channels within the instrument and on the same module.
- If the corresponding channels are not configured for temperature measurements prior to sending of this command, instrument will dispatch an error message.
- Setting the mX+b (**CALCulate:SCALE:UNIT** command) measurement units to °C, °F, or K has no effect on the temperature measurement units that is currently selected.
- The **CONFigure** and **MEASure?** commands automatically select °C.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

## CALCulate Subsystem

This subsystem receives the real-time data from the measurement hardware and sends them to reading memory.

### Command Summary

Measurement Statistics

Digital Input Pattern Comparison

Alarm Limits

Computed Channel

Measurement Scaling

### CALCulate:AVERage Subsystem

**NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

---

This subsystem calculates measurement statistics. Each channel must be configured to be part of the scan list. If it is not part of the scan list, no error will be generated, but the value returned will be a meaningless value of 0.

#### Command Summary

CALCulate:AVERage:ALL?

CALCulate:AVERage:AVERage?

CALCulate:AVERage:MAXimum?

CALCulate:AVERage:MINimum?

CALCulate:AVERage:PTPeak?

CALCulate:AVERage:SDEViation?

CALCulate:AVERage:CLEar

CALCulate:AVERage:COUNT?

CALCulate:AVERage:MAXimum:TIME?

CALCulate:AVERage:MINimum:TIME?

**CALCulate:AVERage:ALL? [(@<ch\_list>)]**

Returns the minimum, maximum, arithmetic mean (average), and standard deviation values of all measurements taken since the statistic were last cleared. Count and peak-to-peak statistics are not returned by this command.

Parameter	Typical return
(none)	(none)

Returns the statistics of all readings on channels 105 through 108:

`CALC:AVER:ALL? (@105:108)`

Typical response: +1.00520000E+03,+1.00512000E+03,+1.00527000E+03,+4.13500000E-01

**CALCulate:AVERage:{AVERage | MAXimum | MINimum | PTPeak | SDEViation}? [(@<ch\_list>)]**

Returns the arithmetic mean (average), maximum, minimum, peak-to-peak, and standard deviation values of all measurements taken since the statistic were last cleared.

Parameter	Typical return
(none)	(none)

Returns the minimum values of all readings taken on channels 105 through 108:

`CALC:AVER:MIN? (@105:108)`

Typical response: +3.13830293E+01,+1.98732123E+01,9.38293055E+00,1.20393822E+01

In this example, you can replace the MIN node with MAX, AVER, PTP, or SDEV.

**CALCulate:AVERage:CLEar [(@<ch\_list>)]**

Clears all readings from the statistics registers for the selected channels. The minimum, maximum, average, count, peak-to-peak, and standard deviation values are cleared. The values for all scanned channels are also cleared at the beginning of a new scan. No readings are cleared from reading memory.

Parameter	Typical return
(none)	(none)

Clears the saved statistic readings on channels 105 through 108:

`CALC:AVER:CLE (@105:108)`

## 2 SCPI Programming

### **CALCulate:AVERage:COUNT? [(@<ch\_list>)]**

Returns the number of readings taken on each of the selected channels during the scan.

Parameter	Typical return
(none)	(none)

Returns the number of readings taken on channels 105 through 108:

CALC:AVER:COUN? (@105:108)

Typical response: +2.00000000E+01,1.90000000E+01,2.10000000E+01,2.00000000E+01

- If you omit the scan list parameter, it returns the count for all channels in the currently defined scan list.

### **CALCulate:AVERage:{MINimum | MAXimum}:TIME? [(@<ch\_list>)]**

Returns the time that the minimum or maximum reading was taken on the selected channels during the scan (in full time and date format).

Parameter	Typical return
(none)	(none)

Returns the time of the minimum readings taken on channels 103 and 104:

CALC:AVER:MIN:TIME? (@103:104)

Typical response: 2018,01,01,08,39,27.283,2018,01,01,08,39,28.011

In this example, you can replace the MIN node with MAX.

- For each channel, the query returns the time in the form "yyyymmdd,hh:mm:ss.sss", where 2018,01,01,08,39,27.283 would mean January 01, 2018 at 08:39:27.283 AM.
- This command is not affected by the **FORMat:READing:TIME:TYPE** command, which selects the time format for saving scanned data in reading memory (absolute time versus relative time).



## CALCulate:COMPare Subsystem

**NOTE**

Only supported on DAQM907A multifunction module (digital I/O channels - channel 01 and 02).

---

### Command Summary

CALCulate:COMPare:DATA

CALCulate:COMPare:MASK

CALCulate:COMPare:STATe

CALCulate:COMPare:TYPE

## 2 SCPI Programming

**CALCulate:COMPare:DATA <data> [, (@<ch\_list>)]**

**CALCulate:COMPare:DATA? [, (@<ch\_list>)]**

Sets the digital data on the selected channels. You can use the patterns comparison feature to generate an alarm when a selected digital patterns is detected.

Parameter	Typical return
<data> = An 8-bit digital patterns for comparison, specified as an integer from 0 to 255.	Any integer from 0 to 255
Sets the digital patterns in slot 1 and then enables the patterns comparison mode. When the data read from the module which is equal to the comparison patterns, an alarm will be generated on Alarm 2.	
CALC:COMP:DATA #HF6,(@101) CALC:COMP:TYPE EQUAL,(@101) OUTP:ALARM2:SOUR (@101) CALC:COMP:STAT ON,(@101)	

- After specifying the desired digital patterns, use the **CALCulate:COMPare:STATe** command to enable patterns comparisons on the selected channels. If you want to monitor the state of specific bits, use this command in conjunction with the **CALCulate:COMPare:MASK** command to specify a mask patterns.
- Uses the **CALCulate:COMPare:TYPE** command to specify whether an alarm or hardware interrupt condition is generated when a specific bit patterns or bit patterns change is detected.
- A Factory Reset (**\*RST** command) clears the digital patterns and turns off the patterns comparison mode.

**CALCulate:COMPare:MASK <mask> [, (@<ch\_list>)]**

**CALCulate:COMPare:MASK? [, (@<ch\_list>)]**

This command is used in conjunction with the **CALCulate:COMPare:DATA** command to set the digital mask data for an 8-bit digital patterns comparisons on the selected channels.

Parameter	Typical return
<mask> = An 8-bit digital patterns for comparison, specified as an integer from 0 to 255.	Any integer from 0 to 255

To illustrate how the calculations are performed, see the example below which assumes that a decimal 146 was read from the digital input channel. Since the calculations produce a non-zero result (decimal 16), an interrupt is not generated. Active bits are specified as 1's, and "don't care" bits are specified as 0's.

MSB LSB

1001 0010 Data read from port (decimal 146)

1000 1100 CALC:COMP:DATA command (decimal 140)

0001 1110 X-OR result

1111 0000 CALC:COMP:MASK command (decimal 240)

0001 0000 AND result (decimal 16, no interrupt generated)

Note:

MSB = Most significant bit

LSB = Least significant bit

The query returns the mask as a decimal value (binary and hexadecimal values are converted to their decimal equivalents). The following query returns the comparison patterns selected for the module in slot 3:

CALC:COMP:MASK? (@301)

Typical response: 240

- After specifying the desired digital patterns, use the **CALCulate:COMPare:STATe** command to enable patterns comparisons on the selected channels.
- A Factory Reset (**\*RST** command) clears the digital patterns and turns off the patterns comparison mode.

**CALCulate:COMPare:STATe {OFF | ON} [, (@<ch\_list>)]**

**CALCulate:COMPare:STATe? [, (@<ch\_list>)]**

Enables (On) or disables (Off) the patterns comparison mode on the selected channels. You can use the patterns comparison feature to generate an alarm when a selected digital pattern is detected.

Parameter	Typical return
{OFF   ON} Default: OFF	0 (OFF) or 1 (ON)
Sets the comparison mode ON for the three selected channels: CALC:COMP:STAT 1,(@201,202,301)	

- A Factory Reset (**\*RST** command) clears the digital patterns and turns off the patterns comparison mode.

**CALCulate:COMPare:TYPE {EQUal | NEQual} [, (@<ch\_list>)]**

**CALCulate:COMPare:TYPE? [, (@<ch\_list>)]**

Configures the selected channels to generate an alarm when a specific bit patterns or bit patterns change is detected. This command is used in conjunction with the **CALCulate:COMPare:DATA** command which sets the data bit patterns and the **CALCulate:COMPare:MASK** command which sets the mask bit patterns.

Parameter	Typical return
{EQUal   NEQual} Default: NEQual	EQU or NEQ
Sets the comparison mode for the specified channels to EQUal: CALC:COMP:TYPE EQU, (@301:302)	

- Selects EQUal to generate an alarm or interrupt when the data read from the selected channel is equal to **CALCulate:COMPare:DATA**, after masking by **CALCulate:COMPare:MASK**.
- Selects NEQual (not equal) to generate an alarm or interrupt when the data read from the bank is not equal to **CALCulate:COMPare:DATA**, after masking by **CALCulate:COMPare:MASK**.
- Bits masked off as 0 ("don't care") by **CALCulate:COMPare:MASK** are ignored.
- A Factory Reset (**\*RST** command) clears the digital pattern and turns off the pattern comparison mode.

## CALCulate:LIMit Subsystem

This subsystem specifies measurements and indicates when a reading limit has been exceeded.

**NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

---

### Command Summary

CALCulate:LIMit:LOWer

CALCulate:LIMit:UPPer

CALCulate:LIMit:LOWer:STATe

CALCulate:LIMit:UPPer:STATe

## 2 SCPI Programming

**CALCulate:LIMit:{LOWer|UPPer} {<limit> | MIN | MAX | DEF} [, (@<ch\_list>)]**

**CALCulate:LIMit:{LOWer|UPPer}? [(@<ch\_list>) | MIN | MAX | DEF]**

The instrument has four alarms which you can configure to alert you when a reading exceeds specified limits during a scan. These commands set the lower and upper limits for alarms on the selected channels.

Parameter	Typical return
<limit> = <lo_limit> or <hi_limit>	(none)
MIN: -1.0E+15 to -1.0E-15	
DEF: 0	
MAX: +1.0E-15 to 1.0E+15	

For totalizer channel, <hi\_limit> refers to a maximum count.

Sets the lower limit to -0.25 on channels 03 and 13 in slot 1:

```
CALC:LIM:LOW -0.25,@103,113
```

Typical response: -2.50000000E-01,-2.50000000E-01

In this example, you can replace the LOW node with UPP.

- You can assign a lower limit, an upper limit, or both to any configured channel in the scan list. The lower limit value must always be less than or equal to the upper limit; whereas the upper limit value must always be greater than or equal to the lower limit.
- You cannot configure the alarm when the internal DMM is disabled (see **INSTrument:DMM** command).
- The alarms on the active monitor channel are evaluated by the internal DMM from the time the **CALCulate:LIMit:LOWer:STATe ON** and **CALCulate:LIMit:UPPer:STATe ON** commands are executed. Alarms on other channels are only evaluated during a scan.
- If you change the measurement configuration, alarms are turned off and the limit values are cleared.
- You can assign multiple channels to any of the four available alarms (numbered 1 through 4, see **OUTPut:ALARm{1|2|3|4}:SOURce** command). For example, you can configure the instrument to generate an alarm on the Alarm 1 output when a limit is exceeded on any of channels 103, 205, or 310. You cannot, however, assign alarms on a specific channel to more than one alarm number.
- To generate an alarm when a specific count is reached (high limit) is reached on a totalizer channel, use the **CALCulate:LIMit:UPPer** command. If you use alarms on the totalizer channel with the measurement scaling, the alarm limits will only be evaluated according to the initial scanned reading, scaled reading will not affect the alarms evaluations on totalizer channel.
- To generate an alarm when a specific bit pattern or bit pattern change is detected on a digital input channel, see the **CALCulate:COMParE** commands.
- If you plan to use alarms on a channel that will also use measurement scaling, be sure to configure the scaling values first. If you attempt to assign the alarm limits first, the instrument will turn off alarms and clear the limit values when you enable scaling on that channel. If you specify a custom measurement label with scaling, it is automatically used when alarms are logged on that channel.

- If you redefine the scan list, alarms are no longer evaluated on those channels (during a scan) but the limit values are not cleared. If you decide to add a channel back to the scan list (without changing the function), the original limit values are restored and alarms are turned back on. This makes it easy to temporarily remove a channel from the scan list without entering the alarm values.
- The instrument clears all alarm limits and turns off all alarms after a Factory Reset (**\*RST** command).

**CALCulate:LIMit:{LOWer|UPPer}:STATe {OFF | ON} [, (@<ch\_list>)]**

**CALCulate:LIMit:{LOWer|UPPer}:STATe? [(@<ch\_list>)]**

Enables or disables the lower and upper alarm limits on the specified channels during a scan.

Parameter	Typical return
{OFF   ON}	0 (OFF) or 1 (ON)
Default: OFF	

Sets an upper limit on channels 03 and 13 in slot 1 and then enables alarms on these channels:

```
CALC:LIM:UPP 10.25,@103,113
```

```
CALC:LIM:UPP:STAT ON,@103,113
```

In this example, you can replace the UPP node with LOW.

- Alarm data can be saved in one of two locations depending on whether a scan list is running when the alarm occurs.
  - a. If an alarm event occurs on a channel as it is being scanned, then that channel's alarm status is saved in reading memory as the readings are taken. Each reading that is outside the specified alarm limit is logged in reading memory. You can save at least 100,000 readings in reading memory during a scan.
  - b. As alarm events are generated, they are also logged in an alarm queue, which is separate from reading memory. This is the only place that non-scanned alarms get logged (alarms during a channel monitor, alarms generated by the digital modules, etc.). Up to 20 alarms can be logged in the alarm queue. If more than 20 alarm events are generated, they will be lost (only the first 20 alarms are saved). Even if the alarm queue is full, the alarm status is saved in reading memory during a scan.
- You cannot configure the alarm when the internal DMM is disabled (see **INSTrument:DMM** command).
- To generate an alarm when a specific count is reached (high limit) is reached on a totalizer channel, use the **CALCulate:LIMit:UPPer** command. If you use alarms on the totalizer channel with the measurement scaling, the alarm limits will only be evaluated according to the initial scanned reading, scaled reading will not affect the alarms evaluations on totalizer channel.
- To generate an alarm when a specific bit pattern or bit pattern change is detected on a digital input channel, see the **CALCulate:COMParE** commands.
- When an alarm occurs, the instrument stores relevant information about the alarm in the queue. This includes the reading that triggered the alarm, the time of day and date of the alarm, and the channel number on which the alarm occurred. The information stored in the alarm queue is always in absolute time and is not affected by the **FORMat:READing:TIME:TYPE** command setting.
- Alarms are logged in the alarm queue only when a reading crosses a limit, not while it remains outside the limit and not when it returns to within limits.
- In addition to being stored in reading memory, alarms are also recorded in their own SCPI Status System. You can configure the instrument to use the status register to generate a Service Request (SRQ) when alarms are generated. For more information on the Status System, see **Status System Introduction**.
- You can set an upper limit for the totalizer channels (no lower limit is allowed).
- The instrument clears all alarm limits and turns off all alarms after a Factory Reset (**\*RST** command).





**CALCulate:MATH****CALCulate:MATH** <expression>, (@<computed\_ch\_list>)**CALCulate:MATH?** (@<computed\_ch\_list>)**NOTE**

Only supported on computed channels (channels 401 through 420).

A computed channel performs mathematical operation on the readings from measurement channels, or other computed channels list. Selects type of <expression> to specify the mathematical operation, and the operand channels that are used for computing.

Computation type	Mathematical operation	Parameter (<expression>)	Typical return
Basic math	Add	(@chan1+@chan2)	(none)
	Subtract	(@chan1-@chan2)	
	Multiply	(@chan1*@chan2)	
	Divide	(@chan1/@chan2)	
	Power	(power(@chan1, 2))	
	Square root	(sqrt(@chan1))	
	Reciprocal	(1/@chan1)	
Polynomial	Fifth order	(poly(@chan1, <n5>, <n4>, <n3>, <n2>, <n1>, <n0>)) where n = value of variable in each order	
Statistics	Min	(min(@<ch_list>))	
	Max	(max(@<ch_list>))	
	Average	(avg(@<ch_list>))	
	Standard deviation	(sdev(@<ch_list>))	

**Basic math examples:**

Selects math operation (add), and operand channels (channel 101 and 102) that are used for computing in channel 401:

```
CALC:MATH (@101+@102),(@401)
```

Typical response: "(@101+@102)"

In this example, you can replace the (@101+@102) with (@101-@102), (@101\*@102), and (@101/@102) for subtract, multiply, and divide operations.

Selects math operation (power), and operand channels (channel 101) that are used for computing in channel 401:

```
CALC:MATH (power(@101, 2)),(@401)
```

Typical response: "(power(@101, 2))"

In this example, you can replace the (power(@101, 2)) with (sqrt(@101)) for square root operation.

Selects math operation (reciprocal), and operand channels (channel 101) that are used for computing in

channel 401:

```
CALC:MATH (1/@101),(@401)
```

Typical response: "(1/@101)"

**Polynomial (fifth order) example:**

Selects polynomial operation (fifth order), and operand channels (channel 101) that are used for computing in channel 401:

```
CALC:MATH (poly(@101,5,4,3,2,1,0)),(@401)
```

Typical response: "(poly

(@101,+5.00000000E+00,+4.00000000E+00,+3.00000000E+00,+2.00000000E+00,+1.00000000E+00-  
,+0.00000000E+00))"

**Statistics example:**

Selects statistic operation (min), and range of operand channels (channel 101 to 110) that are used for computing in channel 401:

```
CALC:MATH (min(@101:110)),(@401)
```

Typical response: "(min(@101,102,103,104,105,106,107,108,109,110))"

In this example, you can replace the (min(@101:110)) with max(@101:110), (avg(@101:110)), and (sdev (@101:110)) for maximum, average, and standard deviation operations.

## 2 SCPI Programming

### **CALCulate:SCALE Subsystem**

This subsystem controls math scaling.

#### **NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

---

#### Command Summary

CALCulate:SCALE:DB:REFerence

CALCulate:SCALE:DBM:REFerence

CALCulate:SCALE:FUNCTion

CALCulate:SCALE:GAIN

CALCulate:SCALE:OFFSet

CALCulate:SCALE:OFFSet:NULL

CALCulate:SCALE:REFerence

CALCulate:SCALE:REFerence:AUTO

CALCulate:SCALE:REFerence:IMMEdiate

CALCulate:SCALE[:STATe]

CALCulate:SCALE:UNIT

CALCulate:SCALE:UNIT:STATe

**CALCulate:SCALE:DB:REfERENCE {<reference> | MIN | MAX | DEF} [, (@<ch\_list>)]**

**CALCulate:SCALE:DB:REfERENCE? [{"(@<ch\_list>)} | MIN | MAX | DEF]}**

Stores a relative value in the dB Relative Register, which is used for the dB function in **CALCu- late:SCALE:FUNcTION**. When the dB function is enabled, this value is subtracted from each voltage measurement after the measurement is converted to dBm.

Parameter	Typical return
<reference> = -200.0 dBm to +200.0 dBm Default: 0	+3.00000000E+02

Sets dB scaling with a -10 dB reference and a 300  $\Omega$  dBm reference resistance:

```
CALC:SCAL:DBM:REF 300
CALC:SCAL:DB:REF -10.0
CALC:SCAL:FUNC DB
CALC:SCAL:STAT ON
```

- Specifying a reference value disables automatic reference selection (**CALCulate: SCALE:REfERENCE:AUTO OFF**).
- The dB relative value parameter is relative to the dBm reference resistance set with **CALCulate: SCALE:DBM:REfERENCE**.
- The instrument sets the reference value to 0.0 with automatic reference selection enabled after a Factory Reset (**\*RST**), an Instrument Preset (**SYSTem:PRESet**), or a change in measurement function.

**CALCulate:SCALE:DBM:REfERENCE {<reference> | MIN | MAX | DEF} [, (@<ch\_list>)]**

**CALCulate:SCALE:DBM:REfERENCE? [{"(@<ch\_list>)} | MIN | MAX | DEF]}**

Selects the reference resistance for converting voltage measurements to dBm. This reference value affects the dBm and dB scaling functions.

Parameter	Typical return
<reference> = 50, 75, 93, 110, 124, 125, 135, 150, 250, 300, 500, 600, 800, 900, 1000, 1200 or 8000 $\Omega$ . Default: 600	+3.00000000E+02

Sets dBm scaling with a reference resistance of 300  $\Omega$ :

```
CALC:SCAL:DBM:REF 300
CALC:SCAL:FUNC DBM
CALC:SCAL:STAT ON
```

- The instrument sets the reference value to 0.0 with automatic reference selection enabled after a Factory Reset (**\*RST**), an Instrument Preset (**SYSTem:PRESet**), or a change in measurement function.

## 2 SCPI Programming

**CALCulate:SCALE:FUNCTION {DB | DBM | PCT | SCALE} [, (@<ch\_list>)]**

**CALCulate:SCALE:FUNCTION? [(@<ch\_list>)]**

Selects the operation performed by the scaling function.

Parameter	Typical return
{DB   DBM   PCT   SCALE} Default: SCALE	DB, DBM, PCT, or SCAL

Sets the DB scaling function referenced to the next measurement taken:

CALC:SCAL:FUNC DB

CALC:SCAL:STAT ON

- **DB** performs a relative dB computation. The result is the difference between the input signal and the stored DB relative value reference (**CALCulate:SCALE:DB:REference**), with both values converted to dBm (dB = measurement in dBm – relative value in dBm). For the dB function, the reference value can be automatically selected using the first measurement converted to dBm as the reference value (see **CALCulate:SCALE:REference:AUTO**), or it can be specified by **CALCulate:SCALE:DB:REference**. dB scaling applies to ACV and DCV measurements only.
- **DBM** performs a dBm computation. The result is logarithmic and is based on a calculation of power delivered to a reference resistance (**CALCulate:SCALE:DBM:REference**), relative to 1 milliwatt. (dBm =  $10 \times \log_{10}(\text{measurement}^2 / \text{reference resistance} / 1 \text{ mW})$ ). dBm scaling applies to ACV and DCV measurements only.
- **PCT** performs a percent change operation. The result is the percent change of the measurement from the reference value:

$$\text{Result} = ((\text{Measurement} - \text{Reference}) / \text{Reference}) * 100$$

For the PCT function, the reference value can be automatically selected using the first measurement as the reference value (see **CALCulate:SCALE:REference:AUTO**), or it can be specified by **CALCulate:SCALE:REference**. Percentage of scaling applies to all measurement functions except Diode.

- **SCALE** performs an mX+B operation. The result is the measurement multiplied by the gain value m (**CALCulate:SCALE:GAIN**) plus the offset value B (**CALCulate:SCALE:OFFSet**). mX+B scaling applies to all measurement functions.
- Scaling function results must be in the range of -1.0E+24 to -1.0E-24, or +1.0E-24 to 1.0E+24. Results outside these limits will be replaced with -9.9E37 (negative infinity), 0, or 9.9E37 (positive infinity).
- You must execute **CALCulate:SCALE:FUNCTION** before executing **CALCulate:SCALE[:STATe]**, otherwise an incompatibility error will be generated.
- This parameter is set to its default value after a Factory Reset (**\*RST**) or Instrument Preset (**SYSTem:PRESet**).
- Scaling is set to OFF when you change measurement functions (for example, changing from DCV to ACV). You must re-enable scaling after changing measurement functions.

**CALCulate:SCALE:GAIN** {<gain> | MIN | MAX | DEF} [, (@<ch\_list>)]

**CALCulate:SCALE:GAIN?** [(@<ch\_list>) | MIN | MAX | DEF]

**CALCulate:SCALE:OFFSet** {<offset> | MIN | MAX | DEF} [, (@<ch\_list>)]

**CALCulate:SCALE:OFFSet?** [(@<ch\_list>) | MIN | MAX | DEF]

Stores a gain value (M) and offset value (B) for the scaling function in **CALCulate:SCALE:FUNCTION**

Parameter	Typical return
<gain>	+1.25000000E+00,+1.25000000E+00
MIN: -1.0E+15 to -1.0E-15	
DEF: 1.0	
MAX: +1.0E-15 to 1.0E+15	
<offset>	
MIN: -1.0E+15 to -1.0E-15	
DEF: 0.0	
MAX: +1.0E-15 to 1.0E+15	

Sets the gain to +1.25 on channels 03 and 13 in slot 1: **CALC:SCAL:GAIN 1.25,@103,113**

In this example, you can replace the GAIN node with OFFS.

- Scaling is applied using the following equation: Scaled Reading = (Gain x Measurement) + Offset
- After setting the gain and offset values, use the **CALCulate:SCALE:STATe** command to enable the scaling function.
- Readings can be acquired during a scan using the multiplexer. For scanning measurements using the multiplexer modules, an error is generated if the internal DMM is disabled (see **INSTRument:DMM** command).
- You must configure the channel (function, transducer type, etc.) before applying any scaling values. If you change the measurement configuration, scaling is turned off on that channel and the gain and offset values are reset (gain = 1, offset = 0). Scaling is also turned off when you change the temperature probe type, temperature units, or disable the internal DMM.
- If you change the measurement configuration (function, transducer type, etc.) on a channel or the internal DMM, scaling is turned off on those channels and the gain and offset values are cleared.
- If you plan to use scaling on a channel which will also use alarms, be sure to configure the scaling values first. If you attempt to assign the alarm limits first, the instrument will turn off alarms and clear the limit values when you enable scaling on that channel. If you specify a custom measurement label with scaling, it is automatically used when alarms are logged on that channel.
- If you redefine the scan list, no change will be made to the scaling state or the gain and offset values. If you decide to add a channel back to the scan list, the original gain and offset values are restored.
- The **CONFigure** and **MEASure?** commands automatically set the gain value (M) to 1 and offset value (B) to 0.
- A Factory Reset (**\*RST** command) turns off scaling and clears the scaling values on all channels (gain = 1, offset = 0).

## 2 SCPI Programming

### **CALCulate:SCALE:OFFSet:NULL [(@<ch\_list>)]**

Makes an immediate null measurement on the specified channels and stores it as the offset (B) for subsequent measurements. This allows you to adjust for voltage or resistive offsets through your wiring to the point of the measurement.

Parameter	Typical return
(none)	(none)

Sets an immediate null measurement on channels 105 through 108:

```
CALC:SCAL:OFFS:NULL (@105:108)
```

### **CALCulate:SCALE:REFerence {<reference> | MIN | MAX | DEF} [, (@<ch\_list>)]** **CALCulate:SCALE:REFerence? [(@<ch\_list>) | MIN | MAX | DEF]**

Stores a reference value for the PCT function in **CALCulate:SCALE:FUNCTion**.

Parameter	Typical return
<reference>	+3.00000000E+02
MIN: -1.0E+15 to -1.0E-15	
DEF: 0.0	
MAX: +1.0E-15 to 1.0E+15	

Sets PCT scaling with a 100 V reference:

```
CALC:SCAL:REF 100  
CALC:SCAL:FUNC PCT  
CALC:SCAL:STAT ON
```

- Specifying a reference value disables automatic reference selection (**CALCulate:SCALE:REFERENCE:AUTO OFF**).
- The instrument sets the reference value to 0.0 with automatic reference selection enabled after a Factory Reset (**\*RST**), an Instrument Preset (**SYSTem:PRESet**), or a change in measurement function.



**CALCulate:SCALE:REFERENCE:AUTO {OFF | ON} [, (@<ch\_list>)]**

**CALCulate:SCALE:REFERENCE:AUTO? [, (@<ch\_list>)]**

Enables or disables automatic reference selection for the scaling functions.

Parameter	Typical return
{OFF   ON} Default: ON	0 (OFF) or 1 (ON)

Enables the DB function with automatic reference selection and use the first measurement as the reference value:

```
CALC:SCAL:DBM:REF 50
CALC:SCAL:FUNC DB
CALC:SCAL:REF:AUTO ON
CALC:SCAL:STAT ON
READ?
```

- **ON**: the first measurement made is used as the reference for all subsequent measurements, and automatic reference selection is disabled:
  - a. For the dB scaling function, the first measurement is converted to dBm, and **CALCulate:SCALE:DB:REFERENCE** is set to the result.
  - b. For the PCT scaling function, **CALCulate:SCALE:REFERENCE** is set to the first measurement.
- **OFF**: **CALCulate:SCALE:DB:REFERENCE** specifies the reference for DB scaling, **CALCulate:SCALE:REFERENCE** specifies the reference for PCT scaling.
- The instrument enables automatic reference selection when the scaling function is enabled (**CALCulate:SCALE:STATe ON**).
- This parameter is set to its default value after a Factory Reset (**\*RST**), an Instrument Preset (**SYSTem:PRESet**), or a change in measurement function.
- You must execute **CALCulate:SCALE:FUNCTION** before executing **CALCulate:SCALE[:STATe]**, otherwise an incompatibility error will be generated.
- Scaling is set to OFF when you change measurement functions (for example, changing from DCV to ACV). You must re-enable scaling after changing measurement functions.

## 2 SCPI Programming

### **CALCulate:SCALE:REFerence:IMMediate [(@<ch\_list>)]**

Makes an immediate reference measurement on PCT (%) and dB scaling functions and save the reference value for subsequent measurements. This allows you to adjust for voltage or resistive offsets through your wiring to the point of the measurement.

Parameter	Typical return
(none)	(none)

---

Sets an immediate reference measurement: CALC:SCAL:REF:IMM

- dB scaling function is only available when the measurement function on the specified channels sets to DCV or ACV.
- This command performs the reference measurement on both PCT and dB scaling functions simultaneously.

### **CALCulate:SCALE[:STATe] {OFF | ON} [, (@<ch\_list>)]**

### **CALCulate:SCALE[:STATe]? [, (@<ch\_list>)]**

Enables or disables the scaling function.

Parameter	Typical return
{OFF   ON} Default: OFF	0 (OFF) or 1 (ON)

---

Enables the DB function with automatic reference selection and use the first measurement as the reference value:

```
CALC:SCAL:DBM:REF 50  
CALC:SCAL:FUNC DB  
CALC:SCAL:REF:AUTO ON  
CALC:SCAL:STAT ON  
READ?
```

- Enabling the scaling function also enables automatic null value selection (**CALCulate:SCALE:REFerence:AUTO**).
- This parameter is set to its default value after a Factory Reset (**\*RST**), an Instrument Preset (**SYSTEM:PRESet**), or a change in measurement function.
- Scaling is set to OFF when you change measurement functions (for example, changing from DCV to ACV). You must re-enable scaling after changing measurement functions.

**CALCulate:SCALE:UNIT "<string>" [, (@<ch\_list>)]**

**CALCulate:SCALE:UNIT? [, (@<ch\_list>)]**

To specify the custom unit up to three characters (for example: RPM, PSI, or °C) for scaled measurements.

Parameter	Typical return
<string> Quoted string of up to three characters.	"RPM"
Sets scaling with a gain of 100 and an offset of 5, and display "PSI" with measurements on the front panel.	
CALC:SCAL:FUNC SCAL CALC:SCAL:GAIN 100 CALC:SCAL:OFFS 5 CALC:SCAL:UNIT "PSI" CALC:SCAL:UNIT:STAT ON CALC:SCAL:STAT ON	
Typical response: "PSI"	

- You can use letters (A-Z), numbers (0-9), an underscore ( \_ ), or the "#" character which displays a degree symbol ( ° ) on the front panel (displayed as a blank space in an output string from the remote interface).
- The first character must be a letter or the "#" character (the "#" character is allowed only as the leftmost character in the label). The remaining two characters can be letters, numbers, or an underscore.
- Single quotes ( ' ') and double quotes ( " ") are both acceptable in the <string> format.
- Readings can be acquired during a scan using the multiplexer. For scanning measurements using the multiplexer modules, an error is generated if the internal DMM is disabled (see **INSTrument:DMM** command).
- If you set the measurement label to °C, °F, or K, note that this has no effect on the temperature units set using the **UNIT:TEMPerature** command.
- The **CONFigure** and **MEASure?** commands automatically reverts the unit to the natural units for the function.
- The instrument resets the units to the null string after a Factory Reset (**\*RST**), an Instrument Preset (**SYSTem:PRESet**).

## 2 SCPI Programming

**CALCulate:SCALE:UNIT:STATe {OFF | ON} [, (@<ch\_list>)]**

**CALCulate:SCALE:UNIT:STATe? [, (@<ch\_list>)]**

Enables or disables displaying the unit string with measurements on the front panel when the scaling function is enabled.

Parameter	Typical return
{OFF   ON} Default: OFF	0 (OFF) or 1 (ON)
Enables scaling with a gain of 100 and an offset of 5, and display "PSI" with measurements on the front panel.	
CALC:SCAL:FUNC SCAL	
CALC:SCAL:GAIN 100	
CALC:SCAL:OFFS 5	
CALC:SCAL:UNIT "PSI"	
CALC:SCAL:UNIT:STAT ON	
CALC:SCAL:STAT ON	

- Enabling the scaling function also enables automatic null value selection (**CALCulate:SCALE:REference:AUTO**).
- This parameter is set to its default value after a Factory Reset (**\*RST**), an Instrument Preset (**SYSTEM:PRESet**), or a change in measurement function.
- Scaling is set to OFF when you change measurement functions (for example, changing from DCV to ACV). You must re-enable scaling after changing measurement functions.

## CALibration Subsystem

This subsystem is used to calibrate the Keysight DAQ970A Data Acquisition System.

**NOTE**

For further details on calibration procedures, see the *DAQ970A Service Guide*. Please refer to that guide before attempting to calibrate the instrument as improper use of the CALibration commands can adversely affect the accuracy and reliability of the instrument.

---

To perform calibration, you must unsecure the instrument, or change the instrument's calibration code or security code.

---

### Command Summary

CALibration:ADC?

CALibration[:ALL]?

CALibration:COUNT?

CALibration:DATE?

CALibration:SECure:CODE

CALibration:SECure:STAtE

CALibration:STORe

CALibration:STRing

CALibration:TEMPerature?

CALibration:TIME?

CALibration:VALue

## 2 SCPI Programming

### CALibration:ADC?

Performs a low-level calibration of the ADC (analog-to-digital converter) circuitry.

Parameter	Typical return
(none)	+0 (pass) or +1 (fail)

---

Performs a ADC calibration: CAL:ADC?

- This is the first step in a re-calibration sequence, and must be done before doing the offset calibration.
- If a calibration fails, the instrument returns 1 and generates an error message. See **Calibration Errors** for a complete listing of the calibration error messages.

### CALibration:[ALL]?

Performs a calibration using the value specified in **CALibration:VALue** command. A short must be applied for the resistance and voltage measurement functions, and the inputs must be open for the current measurement functions.

Parameter	Typical return
(none)	+0 (pass) or +1 (fail)

---

Performs a calibration and returns a pass/fail indication:

CAL?

- This query increments the instrument's calibration count (**CALibration:COUNT?**) and modifies the volatile version of the calibration constants. Use **CALibration:STORe** to save these constants in reading memory at the end of calibration.

### CALibration:COUNT?

Queries the instrument to return the number of times it has been calibrated.

#### NOTE

The instrument was calibrated before shipping from the factory. When you receive your instrument, be sure to read the various counts to determine its initial value.

Parameter	Typical return
(none)	+273

---

Returns the calibration count: CAL:COUN?

- The calibration count increments up to a maximum of 65,535, after which it rolls over to 0. As the value increments by one for each calibration point, a complete calibration may increase the value by various counts.
- The mainframe calibration count is incremented by the **CALibration:STORe** command (the mainframe must be unsecured; see **CALibration:SECure:STATe OFF** command). You can read the calibration count regardless of whether the instrument is secured.

- The calibration count is stored in reading memory, and does not change when power has been off, after a factory reset (**\*RST** command), or after an instrument preset (**SYSTem:PRESet** command).

### CALibration:DATE?

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

Parameter	Typical return
(none)	+2018,+1,+1

Returns the date of the last calibration: CAL:DATE?

- You can perform this query regardless of whether the instrument is secured.
- The date is based on the instrument's real-time clock. Set the date for the instrument's real-time clock with **SYSTem:DATE** and **SYSTem:TIME**.
- This setting is non-volatile; it will not be changed by power cycling, after a factory reset (**\*RST** command), or after an instrument preset (**SYSTem:PRESet** command).

### CALibration:SECure:CODE <new\_code>

Sets a new security code (calibration password) to prevent accidental or unauthorized calibrations. The specified code is used to unsecure the mainframe and all plugged-in modules. To change the security code, you must first unsecure the instrument using the old security code, and then enter a new code.

Parameter	Typical return
<new_code> = Unquoted string of up to 12 characters. First character must be a letter (A-Z), remaining may contains letters, numbers (0-9), or underscore "_". Blank spaces are not allowed.	(none)

Sets a new calibration security code to "DAQ970A":

```
CAL:SEC:STAT OFF,OLD_CAL_CODE
CAL:SEC:CODE DAQ970A
CAL:SEC:STAT ON
```

- When you first receive your instrument, it is secured, and the default security code is set to "DAQ970A".
- This setting is non-volatile; it will not be changed by power cycling, after a factory reset (**\*RST** command), or after an instrument preset (**SYSTem:PRESet** command).
- If you forget your security code, you can override the security feature. For more information, see *DAQ970A Service Guide*.

## 2 SCPI Programming

### **CALibration:SECure:STATe {OFF|ON} [, <code>]**

#### **CALibration:SECure:STATe?**

Secures (On) or unsecures (Off) the instrument for calibration. This feature requires you to provide a security code (calibration password) to prevent accidental or unauthorized calibrations of the instrument. Before you can calibrate the instrument, you must unsecure it by entering the correct security code.

Parameter	Typical return
{OFF ON} Default: ON	0 (OFF) or 1 (ON)
<code> = Unquoted string of up to 12 characters. First character must be a letter (A-Z), remaining may contains letters, numbers (0-9), or underscore "_". Blank spaces are not allowed.	(none)
Unsecure the instrument: <code>CAL:SEC:STAT OFF,DAQ970A</code>	

- When you first receive your instrument, it is secured, and the default security code is set to "DAQ970A".
- The <code> is optional when re-enabling security, but must be matched with the existing security code if provided.
- Front panel and remote interface calibration share the same code.
- Unsecuring the instrument using this command enables the internal DMM and DAQM907A multifunction module to be calibrated.
- This setting is non-volatile. It will not be changed by power cycling, after a Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet** command).

### **CALibration:STORe**

Takes calibration constants in volatile memory (**CALibration:ALL?** command), and places them in non-volatile memory.

Parameter	Typical return
(none)	(none)
Store calibration constants into non-volatile memory: <code>CAL:STOR</code>	

- This setting is non-volatile. It will not be changed by power cycling, after a Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet** command).
- Do this at the end of calibration to avoid losing changes.



**CALibration:STRing "<string>"****CALibration:STRing?**

Stores one message in calibration memory in the mainframe. For example, you can store such information as the date when the last calibration was performed, the date when the next calibration is due, the instrument's serial number, or even the name and phone number of the person to contact for a new calibration.

Parameter	Typical return
<string> = Quoted string of up to 40 characters. May contains letter (A-Z), numbers (0-9), or special characters (@, *, %, and so on).	"CAL: Jan 1 2018"
Stores a message in calibration memory in the mainframe: CAL:STR "CAL: Jan 1 2018"	

- If no calibration message has been specified, an empty quoted string ("") is returned.
- You can record a calibration message only when the instrument is unsecured (**CALibration:SECure:STATe OFF** command). You can read the message from either the front-panel or over the remote interface. You can read the calibration message whether the instrument is secured or unsecured.
- Storing a calibration message will overwrite any message previously stored in calibration memory.
- This setting is non-volatile. It will not be changed by power cycling, after a Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet** command).

**CALibration:TEMPerature?**

Returns the temperature of the last calibration in Celsius, °C.

Parameter	Typical return
(none)	+2.42850208E+001
Returns the calibration temperature: CAL:TEMP?	

- You can perform this query regardless of whether the instrument is secured.
- This setting is non-volatile. It will not be changed by power cycling, after a Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet** command).

## 2 SCPI Programming

### CALibration:TIME?

Returns the amount of time since the last calibration in the format hh,mm,ss.sss.

Parameter	Typical return
(none)	20,15,30.000

Returns the calibration time: CAL:TIME?

- You can perform this query regardless of whether the instrument is secured.
- This setting is non-volatile. It will not be changed by power cycling, after a Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet** command).

### CALibration:VALue <value>

#### CALibration:VALue?

Specifies the value of the applied calibration signal.

Parameter	Typical return
<value> = Numeric value. Default: 0.0	+1.00101000E+01

Sets calibration value to +10.001010 volts: CAL:VAL 10.001010

- This setting is non-volatile. It will not be changed by power cycling, after a Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet** command).

## CONFigure Subsystem

CONFigure commands provide the most flexible way to program the instrument for measurements. When you execute these commands, the instrument uses default values for the requested measurement configuration (like the **MEASure?** command). However, the measurement *is not* automatically started and you can change some measurement attributes before actually initiating the measurement. This allows you to incrementally change the instrument's configuration from the default conditions.

### NOTE

Supported on all Keysight DAQ970A plug-in modules that can be configured to be part of a scan. Internal DMM must also be enabled.

---

Use the **INITiate** or **READ?** command to initiate the measurement. A **MEASure?** command is equivalent to a CONFigure command followed by a **READ?**.

---

### Command Summary

CONFigure?

CONFigure:CAPacitance

CONFigure:CURREnt:{AC|DC}

CONFigure:DAC:OUTPut

CONFigure:DAC:SENSe

CONFigure:DIgital[:BYTE]

CONFigure:DIODE

CONFigure:{FREQuency|PERiod}

CONFigure:{RESistance|FRESistance}

CONFigure:STRain Subsystem

CONFigure:TEMPerature

CONFigure:TOTALize

CONFigure[:VOLTage]:{AC|DC}

### Default Settings for CONFigure commands

The CONFigure commands select the function, range and resolution in one command. Specify *<resolution>* in the measurement's units (V, A, Hz,  $\Omega$ , and so on). All other parameters are set to their default values as defined in **Factory Reset State**.

### Using the CONFigure commands

*Example 1 - Uses CONFigure command, with READ?*

Uses CONFigure and READ? to make an externally-triggered measurement. CONFigure specifies DC voltage measurements but does not place the instrument in the "wait-for-trigger" state. READ? places the instrument in the "wait-for-trigger" state, initiates a measurement when the rear-panel Ext Trig input is

## 2 SCPI Programming

pulsed (low by default), stores the measurement in reading memory, and transfers the measurement to the instrument's output buffer. The *default range (autorange)* and *default resolution (10 PLC)* are used for the measurement.

```
CONF:VOLT:DC
TRIG:SOUR EXT
READ?
```

Typical response: +4.27150000E+00

*Example 2 - Uses CONFigure command, with INITiate and FETCh?*

This example is like previous example 1, but it uses INITiate and **FETCh?** instead of READ?. The INITiate command places the instrument in the "wait-for-trigger" state, triggers a measurement when the rear panel Ext Trig input is pulsed (low by default), and sends the measurement to reading memory. The FETCh? query transfers the measurement from reading memory to the instrument's output buffer.

```
CONF:VOLT:DC
TRIG:SOUR EXT
INIT
FETC?
```

Typical response: +5.34250000E+00

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. This allows you to check for data availability before initiating a read attempt that might otherwise time out. The FETCh? query waits until all measurements are complete to terminate. You can store up to 100,000 measurements in the reading memory of the DAQ970A.

The following example configures the instrument for 2-wire resistance measurements, triggers the instrument to make one measurement using INITiate, and stores the measurement in reading memory. The 10 k $\Omega$  range is selected with 100  $\Omega$  resolution.

```
CONF:RES 10000, 100
INIT
FETC?
```

**CONFigure? [(@<ch\_list>)]**

Returns the present configurations (function, range, and resolution) on the specified channels with a series of quoted strings. The short form of the function name is always returned (e.g., "CURR:AC", "FREQ", etc.).

Parameter	Typical return
(none)	"RES +1.000000E+03,+1.000000E-01","TEMP THER,5000,+1.000000E+00,+1.000000E-04"

Return the present function, range, and resolution: CONF?

Configures multiplexer channels 03 and 08 in slot 100:

CONF:RES 1000,1,(@103)

CONF:TEMP THER,5000,1,0.1,(@108)

CONF? (@103,108)

- The query returns a series of comma-separated fields indicating the present function, range, and resolution for the specified channels. Multiple responses are separated by commas. The short form of the function name is always returned (e.g., "CURR:AC", "FREQ", etc.).

Example: Multiplexer channel

```
"VOLT +1.000000E+01,+3.000000E-03"
```

Function: DC Volts	Range: 10V	Resolution: 3 mV

Example: Digital I/O channel

```
"DIG OUTP WORD"
```

Function: DIO	State: Output	Width: Word

Example: Totalizer channel

```
"TOT RRES"
```

Function: Totalize	Mode: Read/Reset

**CONFigure:CAPacitance** [{<range> | AUTO | MIN | MAX | DEF}, [{<resolution> | MIN | MAX | DEF},]] (@<scan\_list>)

**NOTE**

Only supported on DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

## 2 SCPI Programming

Configures the channels for capacitance measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
<code>&lt;range&gt; = {1 nF 10 nF 100 nF 1 μF 10 μF 100 μF}.</code> Default: AUTO.	-3.85588562E-12
<code>&lt;resolution&gt; =</code> Optional and ignored; fixed at 4½ digits	
Configure capacitance measurements on channel 101:	
CONF:CAP (@101)	
READ?	

- You can let autoranging select the measurement range, or you can manually select a fixed range. Autoranging conveniently selects the range for each measurement based on the input signal. For fastest measurements, use manual ranging (autoranging may require additional time for range selection).
- Autoranging (AUTO or DEFault), will generate an error if you specify a `<resolution>` because the instrument cannot accurately resolve the integration time (especially if the input continuously changes). If your application requires autoranging, specify DEFault for the `<resolution>` or omit the `<resolution>` altogether.
- Autoranging goes down a range at less than 10% of range and up a range at greater than 120% of range. For capacitance measurements only, when autorange is off, the instrument does not report an overload for readings greater than 120% of range. Overload only occurs when the algorithm times out because the applied capacitance is too large for the algorithm to measure. If you apply a DC voltage or a short to the input terminals in capacitance measurement mode, the instrument reports an overload.
- If the input signal is greater than can be measured on the specified manual range, the instrument displays the word Overload on front panel and returns "9.9E37" from the remote interface.

**CONFigure:CURRENT:{AC|DC} [{<range>|AUTO|MIN|MAX|DEF},  
[<resolution>|MIN|MAX|DEF],] (@<scan\_list>)**

### NOTE

Only supported on DAQM901A multiplexer module (channel 21 and 22).

Configures the channels for AC and DC current measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
<p>&lt;range&gt;</p> <p>AC current: {AUTO  100 <math>\mu</math>A   1 mA   10 mA   100 mA   1 A}</p> <p>DC current: {AUTO  1 <math>\mu</math>A   10 <math>\mu</math>A   100 <math>\mu</math>A   1 mA   10 mA   100 mA   1 A}</p> <p>Default: AUTO</p>	(none)
<p>&lt;resolution&gt;</p> <p>AC current: Optional and ignored; fixed at 6½ digits</p> <p>DC current: 1 PLC</p>	
<hr/> <p>Configure AC current measurement using the 1 A range, read the measurement:</p> <pre>CONF:CURR:AC 1 (@121) READ?</pre> <p>Typical Response: -5.07423414E-12</p>	
<p>Configure DC current measurements using the 1 A range with 1 mA resolution. Then make a measurement using an external trigger with positive slope (rising edge) and read the measurement:</p> <pre>CONF:CURR:DC 1,0.001 (@121) TRIG:SOUR EXT;SLOP POS INIT FETC?</pre> <p>Typical Response: +4.27150000E-01</p> <hr/>	

- When you specify a range of channels with this command, any channels that are invalid will be ignored (no error will be generated) but the selected function must be valid for at least one channel in the range, or an error will be generated.
- You can allow the instrument to automatically select the measurement range using *autoranging* or you can select a fixed range using manual ranging. Autoranging is convenient because the instrument decides which range to use for each measurement based on the input signal. For fastest scanning operation, use manual ranging on each measurement (some additional time is required for autoranging since the instrument has to make a range selection).
- If you select autoranging (by specifying "AUTO" or "DEF") and specify a discrete value for the <resolution> parameter, the integration time selected based on the default range for the function (1 A for AC or DC current measurements).
- Autorange thresholds:
  - Down range at: <10% of range
  - Up range at: >120% of range
- Because this command resets all measurement parameters on the specified channels to their **default values**, be sure to send the CONFIGure command *before* setting any other measurement parameters.

## 2 SCPI Programming

- If the input signal is greater than can be measured on the selected AC voltage range (manual ranging, see FREQUency:VOLTage:RANGe command), the instrument gives an overload indication: "±OVLD" from the front panel or "±9.9E+37" from the remote interface.
- For AC measurements, the resolution is fixed at 6½ digits. The only way to control the reading rate for AC measurements is by changing the **channel delay** or by setting the **AC filter** to the highest frequency limit.
- The **\*RST** command will clear the scan list and set all measurement parameters to their factory settings. The Instrument Preset (**SYSTem:PRESet** command) will not clear the scan list; however, this command will clear reading memory and all stored statistical data.

### CONFigure:DAC:OUTPut (@<scan\_list>)

#### NOTE

Only supported on DAC output channels (channel 04 and 05) in DAQM907A multifunction module.

Configures the DAC output channels (channel 04 and 05) in the DAQM907A multifunction module. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
(none)	(none)

Configure and read a default DAC output measurement on channel 104:

```
CONF:DAC:OUTP (@104)  
READ?
```

Typical Response: -5.74962483E-12

- For the DAC output channels, no actual output measurement is made; the scanned value will be the programmed output value (voltage or current). For example, if channel 04 is set to voltage mode, then the corresponding channel 06 will measure current. If the output channel is set to current mode, the sense channel will measure voltage.
- This command is useful when using DAC to control the measurements, varying the output from time-to-time, and record the sweep data of DAC settings in fact for that sweep.

### CONFigure:DAC:SENSe (@<scan\_list>)

#### NOTE

Only supported on DAC output sense channels (channel 06 and 07) in DAQM907A multifunction module.



Configures the DAC output sense channels (channel 06 and 07) in the DAQM907A multifunction module. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
(none)	(none)

Configure and read a default DAC sense measurement on channel 106:

```
CONF:DAC:SENS (@106)
READ?
```

Typical Response: +1.32130000E-01

- The DAC output sense channels will make a complementary (voltage or current) measurement based on the output mode of the corresponding DAC output channel.
  - a. Channel 06 will make the measurement based on the output mode set in channel 04.
  - b. Channel 07 will make the measurement based on the output mode set in channel 05.
- This command does makes an actual measurement. The range and resolution are fixed at 1 PLC on the 10 VDC range.

### CONFigure:DIGital[:BYTE] (@<scan\_list>)

#### NOTE

Only supported on digital I/O channels (channel 01 and 02) in DAQM907A multifunction module.

Configures the instrument to scan the specified digital I/O channels on the multifunction module as byte data, but does not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
(none)	(none)

Configures the instrument to scan on specific digital channels as byte data:

```
CONF:DIG:BYTE (@101:102)
```

- Note that if you include both digital input channels in the scan list, the instrument will read data from both ports simultaneously with the same time stamp. This allows you to externally combine the two 8-bit value into one 16-bit value.

### CONFigure:DIODe (@<scan\_list>)

## 2 SCPI Programming

### NOTE

Only supported on DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Configures the channels for diode measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
(none)	(none)

Configure and read a default diode measurement on channel 101:

```
CONF:DIOD (@101)  
READ?
```

Typical Response: +1.32130000E-01

- The range and resolution are fixed for diode tests: the range is 1 VDC (with a 1 mA current source output).
- The voltage is displayed on the front panel if it is between 0 and 5.05 V. If the signal exceeds 5.05 V, the front panel shows "OPEN" when **Monitor** is selected (or "Overload" when **View** is selected), and the value returned from SCPI is 9.9E37.
- The **FETCh?**, **READ?**, and **MEASure:DIODE?** queries return the measured voltage, regardless of its value.

**CONFigure:{FREQuency|PERiod} [{<range>|AUTO|MIN|MAX|DEF},  
{<resolution>|MIN|MAX|DEF},,] (@<scan\_list>)**

### NOTE

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Configures the channels for frequency and period measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
<range> Frequency: 3 Hz to 300 kHz. Default: 20 Hz Period: 3.33 $\mu$ s to 333.33 ms. Default: 50 ms Default: AUTO	(none)
<resolution> = 1 PLC (0.000003 x Range)	

Parameter	Typical return
Configure frequency measurements using the default aperture and the 200 Hz (fast) AC filter. Then read the measurement.  CONF:FREQ (@101) FREQ:RANG:LOW 200 READ?  Typical Response: +1.32130000E+03	

- Setting measurement timeout and aperture: The instrument selects the slow (3 Hz), medium (20 Hz), or fast (200 Hz) measurement timeout based on the input frequency that you specify with the **[SENSe:]FREQUency:RANGe:LOWer** command for the selected channels. The instrument selects the aperture time (also called *gate time*) for frequency and period measurements based on the aperture that you specify with the **[SENSe:]FREQUency:APERture** command on the specified channels.
- When you specify a range of channels with this command, any channels that are invalid will be ignored (no error will be generated) but the selected function must be valid for at least one channel in the range, or an error will be generated.
- If the input signal is greater than can be measured on the selected AC voltage range (manual ranging, see **FREQUency:VOLTage:RANGe** command), the instrument gives an overload indication: "±OVLD" from the front panel or "±9.9E+37" from the remote interface.
- The **\*RST** command will clear the scan list and set all measurement parameters to their factory settings. The Instrument Preset (**SYSTem:PRESet** command) will not clear the scan list; however, this command will clear reading memory and all stored statistical data.

**CONFigure:{FRESistance|RESistance} [{<range>|AUTO|MIN|MAX|DEF},  
[<resolution>|MIN|MAX|DEF],] (@<scan\_list>)**

**NOTE**

RESistance measurements only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

FRESistance measurements only supported on DAQM900A, DAQM901A, and DAQM902A multiplexer modules.

Configures the channels for 2-wire and 4-wire resistance measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

## 2 SCPI Programming

Parameter	Typical return
<i>&lt;range&gt;</i>	(none)
RESistance: { 100 $\Omega$   1 k $\Omega$   10 k $\Omega$   100 k $\Omega$   1 M $\Omega$   10 M $\Omega$   100 M $\Omega$   1 G $\Omega$ }. Default: 1 k $\Omega$	
FRESistance: { 100 $\Omega$   1 k $\Omega$   10 k $\Omega$   100 k $\Omega$   1 M $\Omega$   10 M $\Omega$   100 M $\Omega$   1 G $\Omega$ }. Default: 1 k $\Omega$	
<i>&lt;resolution&gt;</i> = 1 PLC (0.000003 x Range)	
Configure 2-wire measurements on channel 101. Then read the measurement.	
CONF:RES (@101) READ?	
Typical Response: +1.99409115E+02	

- For the FRESistance version of this command, channel *n* is paired with channel *n+10* (DAQM900A or DAQM901A) or *n+8* (DAQM902A) to provide source and sense connections.
- When you specify a range of channels with this command, any channels that are invalid will be ignored (no error will be generated) but the selected function must be valid for at least one channel in the range, or an error will be generated.
- You can allow the instrument to automatically select the measurement range using *autoranging* or you can select a fixed range using manual ranging. Autoranging is convenient because the instrument decides which range to use for each measurement based on the input signal. For fastest scanning operation, use manual ranging on each measurement (some additional time is required for autoranging since the instrument has to make a range selection).
- If you select autoranging (by specifying "AUTO" or "DEF"), an error will be generated if you specify a discrete value for the *<resolution>* parameter. When autoranging is combined with a discrete resolution, the instrument cannot accurately resolve the integration time (especially if the input signal is continuously changing). If your application requires autoranging, be sure to specify "AUTO" for the *<resolution>* parameter, or omit the parameter from the command and use the **[SENSe:]VOLTage [:DC]NPLC** command to specify the desired integration time.
- Autorange thresholds:
  - Down range at: <10% of range
  - Up range at: >120% of range
- Since CONF:*<function>* commands reset all measurement parameters on the specified channels to their default values, be sure to send the **CONFigure** command before setting any other measurement parameters.

- If the input signal is greater than can be measured on the selected AC voltage range (manual ranging, see `FREQuency:VOLTage:RANGe` command), the instrument gives an overload indication: " $\pm$ OVLD" from the front panel or " $\pm$ 9.9E+37" from the remote interface.
- The `*RST` command will clear the scan list and set all measurement parameters to their factory settings. The Instrument Preset (`SYSTem:PRESet` command) will not clear the scan list; however, this command will clear reading memory and all stored statistical data.

**CONFigure:STRain Subsystem****CONFigure:STRain:{DIRect|FDIRect}****CONFigure:STRain:{FULL|HALF}:BENDing****CONFigure:STRain:{FULL|HALF}:POISson****CONFigure:STRain:FULL:BENDing:POISson****CONFigure:STRain:QUARter**

**CONFigure:STRain:{DIRect | FDIRect} [{<gage\_ohms> | MIN | MAX | DEF}, [{<gage\_factor> | MIN | MAX | DEF}, [{<range> | MIN | MAX | DEF}, [{<resolution> | MIN | MAX | DEF},]]]] (@<scan\_list>)**

**NOTE**

DIRect measurements only supported on DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

FDIRect measurements only supported on DAQM901A and DAQM902A multiplexer modules.

Configures the channels for direct 2-wire and 4-wire strain gage measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
<gage_ohms> = Any numeric value between 80 and 1,100 ohms Default = 120 ohms	(none)
<gage_factor> = Any numeric value between 0.5 and 5 Default = 2	
<range> = {100 Ω   1kΩ   10 kΩ   100 kΩ   1 MΩ   10 MΩ   100 MΩ   1 GΩ} Default = 1 kΩ	
<resolution> = 1 PLC (0.000003 x Range)	

Configure 2-wire strain gage measurement on channel 101:

```
CONF:STR:DIR (@101)
```

**CONFigure:STRain:{FULL|HALF}:BENDing [{<gage\_factor> | MIN | MAX | DEF}, [{<range> | MIN | MAX | DEF}, [{<resolution> | MIN | MAX | DEF},]]]] (@<scan\_list>)**

**NOTE**

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Configures the channels for full and half bending bridge strain gage measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
<i>&lt;gage_factor&gt;</i> = Any numeric value between 0.5 and 5 Default = 2	None
<i>&lt;range&gt;</i> = {Auto   100 mV   1V   10 V   100V   300V} Default = AUTO	
<i>&lt;resolution&gt;</i> = 1 PLC (0.000003 x Range)	
Configures a full bending bridge strain gage measurement on channel 101:	
CONF:STR:FULL:BEND (@101)	

**CONFigure:STRain:{FULL|HALF}:POISSon** [{*<gage\_factor>* | MIN | MAX | DEF], [{*<poisson\_ratio>* | MIN | MAX | DEF], [{*<range>* | MIN | MAX | DEF], [{*<resolution>* | MIN | MAX | DEF},]]]] (@*<scan\_list>*)

**NOTE**

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Configures the channels for full and half poisson bridge strain gage measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
<i>&lt;gage_factor&gt;</i> = Any numeric value between 0.5 and 5 Default = 2	(none)
<i>&lt;poisson_ratio&gt;</i> = Any numeric value between -0.9999 and +0.5 Default = 0.3	
<i>&lt;range&gt;</i> = {Auto   100 mV   1V   10 V   100V   300V} Default = AUTO	
<i>&lt;resolution&gt;</i> = 1 PLC (0.000003 x Range)	
Configures a full poisson bridge strain gage measurement on channel 101:	
CONF:STR:FULL:POIS (@101)	

**CONFigure:STRain:FULL:BENDing:POISson** [{<gage\_factor> | MIN | MAX | DEF}, [{<poisson\_ratio> | MIN | MAX | DEF}, [{<range> | MIN | MAX | DEF}, [{<resolution> | MIN | MAX | DEF},]]]]] (@<scan\_list>)

**NOTE**

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Configures the channels for full bending poisson bridge strain gage measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
<gage_factor> = Any numeric value between 0.5 and 5 Default = 2	(none)
<poisson_ratio> = Any numeric value between -0.9999 and +0.5 Default = 0.3	
<range> = {Auto   100 mV   1V   10 V   100V   300V} Default = AUTO	
<resolution> = 1 PLC (0.000003 x Range)	

Configures a full bending poisson bridge strain gage measurement on channel 101:

```
CONF:STR:FULL:BEND:POIS (@101)
```

**CONFigure:STRain:QUARter** {<gage\_factor> | MIN | MAX | DEF}, [{<range> | MIN | MAX | DEF}, [{<resolution> | MIN | MAX | DEF},]]]] (@<scan\_list>)

**NOTE**

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Configures the channels for quarter bridge strain gage measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
<gage_factor> = Any numeric value between 0.5 and 5 Default = 2	(none)
<range> = {Auto   100 mV   1V   10 V   100V   300V} Default = AUTO	
<resolution> = 1 PLC (0.000003 x Range)	



Parameter	Typical return
Configures a quarter bridge strain gage measurement on channel 101:	
CONF:STR:QUAR (@101)	

---

## 2 SCPI Programming

### CONF:TEMP:Temperature:<probe\_type> [{<type> | DEF}, [{<resolution>|MIN|MAX|DEF},]] (@scan\_list)

#### NOTE

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Configures the channels for temperature measurements, but they do not initiate the scan. This command redefines the scan list.

The CONF:TEMP command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONF:TEMP to place the instrument in the "wait-for-trigger" state.

Table below shows transducer types that are supported on each multiplexer module.

Multiplexer module	Transducer types				
	Thermocouple	2-wire RTD	4-wire RTD	2-wire thermistor	4-wire thermistor
DAQM900A	√				
DAQM901A	√	√	√	√	√
DAQM902A	√	√	√	√	√
DAQM908A		√		√	

Parameter	Typical return
<probe_type>: {FRTD   RTD   FTHERmistor   THERmistor   TCouple   DEF} Default: TCouple	(none)
<type>: For FRTD and RTD: 85 For FTHERmistor and THERmistor: {2252   5000   10000} Default: 5000 For TCouple: {B   E   J   K   N   R   S   T} Default: J	
<resolution> Default: 1 PLC (0.000003 x Range)	

Configure a 4-wire RTD measurement. Then make a measurement using an external trigger with positive slope (rising edge) and read the measurement:

```
CONF:TEMP FRTD,85
TRIG:SOUR EXT;SLOP POS
READ?
```

- For temperature measurements, the instrument internally selects the range; you cannot select which range is used.
- For RTD and FRTD measurements, use "85" to specify  $\alpha = 0.00385$ .
- When you specify a range of channels with this command, any channels that are invalid will be ignored (no error will be generated) but the selected function must be valid for at least one channel in the range, or an error will be generated.

- For thermocouple measurements, the instrument internally selects the 100 mV range. For thermistor and RTD measurements, the instrument autoranges to the correct range for the transducer resistance measurement. Specify the paired channel in the lower bank (source) as the `<scan_list>` channel.
- Thermocouple measurements require a reference junction temperature (see `[SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction:TYPE` command). For the reference junction temperature, you can use an internal measurement on the module's terminal block (DAQM900A, DAQM901A, and DAQM902A), an external thermistor or RTD measurement, or a known fixed junction temperature. If you select an external reference, the instrument makes thermocouple measurements relative to a previously-stored RTD or thermistor measurement stored in the reference register.
- By default, a fixed reference junction temperature of 0.0 °C is used (see `[SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction` command).
- If you select autoranging (by specifying "AUTO" or "DEF"), an error will be generated if you specify a discrete value for the `<resolution>` parameter. When autoranging is combined with a discrete resolution, the instrument cannot accurately resolve the integration time (especially if the input signal is continuously changing). If your application requires autoranging, be sure to specify "DEF" for the `<resolution>` parameter, or omit the parameter from the command and use the `[SENSe:]TEMPerature:NPLC` command to specify the desired integration time.
- Since this command resets all measurement parameters on the specified channels to their default values, be sure to send the `CONFigure` command before setting any other measurement parameters.
- For 4-wire resistance measurements, the instrument automatically pairs channel  $n$  in Bank 1 with channel  $n+10$  in Bank 2 (DAQM900A or DAQM901A) or  $n+8$  (DAQM902A) to provide the source and sense connections. For example, make the source connections to the HI and LO terminals on channel 02 in Bank 1 and the sense connections to the HI and LO terminals on channel 12 (DAQM900A or DAQM901A) or 10 (DAQM902A) in Bank 2. Specify the paired channel in Bank 1 (source) as the `<ch_list>` channel (paired channels in Bank 2 are not allowed in the `<ch_list>`).
- Because channels are automatically paired for 4-wire resistance measurements, attempts to re-configure the paired channel in Bank 2 will result in an error. For example:

```
CONF:VOLT:DC (@105) !Configure Bank 2 channel for DC voltage measurements
ROUT:SCAN (@101:110) !Add channels to scan list
CONF:FRES (@101) !Generates error and clears scan list
```

- For 4-wire RTD measurements, the instrument automatically enables the autozero function.
- The `*RST` command will clear the scan list and set all measurement parameters to their factory settings. The Instrument Preset (`SYSTem:PRESet` command) will not clear the scan list; however, this command will clear reading memory and all stored statistical data.

**CONFigure:TOTalize {READ | RRESet}, (@<scan\_list>)****NOTE**

Only supported on totalizer channel (channel 03) in DAQM907A multifunction module.

Configures the instrument to read the specified totalizer channels on the multifunction module but does not initiate the scan. To read the totalizer during a scan without resetting the count, set to READ. To read the totalizer during a scan and reset the count to 0 after it is read, set to RRESet (this means "read and reset"). This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
{READ   RRESet} Default: READ	READ or RRES

Configures totalizer channel to be read without resetting its count on channel 203:

CONF:TOT READ,(@203)

- The maximum count is 67,108,863 ( $2^{26} - 1$ ). The count rolls over to 0 after reaching the maximum allowed value.
- If the count rolls over to 0, the "Totalizer Overflow" bit (bit 11) is set in the Questionable Data register. For more information on the Status System for the instrument, see [Status System Introduction](#).
- Selecting the RRESet mode performs a synchronized read and reset operation on the specified totalizer channels. If you were to use discrete commands, such as **READ?** and **[SENSe:]TOTAlize:CLEar:IMMEDIATE**, you would likely lose counts occurring between the two commands.
- The **\*RST** command will clear the scan list and set all measurement parameters to their factory settings. The Instrument Preset (**SYSTem:PRESet** command) will not clear the scan list; however, this command will clear reading memory and all stored statistical data.

**CONFigure[:VOLTage]:{AC|DC} [{<range>|AUTO|MIN|MAX|DEF},  
[<resolution>|MIN|MAX|DEF],] (@<scan\_list>)**

**NOTE**

AC voltage measurements only supported on DAQM901A multiplexer module.

DC voltage measurements only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Configures the channels for AC and DC voltage measurements, but they do not initiate the scan. This command redefines the scan list.

The CONFigure command does not place the instrument in the "wait-for-trigger" state. Use the **INITiate** or **READ?** command in conjunction with CONFigure to place the instrument in the "wait-for-trigger" state.

Parameter	Typical return
<range>: {100 mV 1 V 10 V 100 V 300 V}. Default: AUTO	(none)
<resolution> AC voltage: Optional and ignored; fixed at 6½ digits DC voltage: 1 PLC	

Configure AC voltage measurements using the 100 V range on channel 101, and read the measurement:

```
CONF:VOLT:AC 100, (@101)
READ?
```

Typical Response: +8.54530000E+01

- When you specify a range of channels with this command, any channels that are invalid will be ignored (no error will be generated) but the selected function must be valid for at least one channel in the range, or an error will be generated.
- You can allow the instrument to automatically select the measurement range using *autoranging* or you can select a fixed range using manual ranging. Autoranging is convenient because the instrument decides which range to use for each measurement based on the input signal. For fastest scanning operation, use manual ranging on each measurement (some additional time is required for autoranging since the instrument has to make a range selection).
- If you select autoranging (by specifying "AUTO" or "DEF") and specify a discrete value for the <resolution> parameter, the integration time selected based on the default range for the function (1 A for AC or DC current measurements).
- Autorange thresholds:  
 Down range at: < 10% of range  
 Up range at: > 120% of range
- Because this command resets all measurement parameters on the specified channels to their **default values**, be sure to send the CONFigure command *before* setting any other measurement parameters.

## 2 SCPI Programming

- If the input signal is greater than can be measured on the selected AC voltage range (manual ranging, see FREQuency:VOLTage:RANGe command), the instrument gives an overload indication: "±OVLD" from the front panel or "±9.9E+37" from the remote interface.
- For AC measurements, the resolution is fixed at 6½ digits. The only way to control the reading rate for AC measurements is by changing the **channel delay** or by setting the **AC filter** to the highest frequency limit. The *<resolution>* parameter only affects the number of digits shown on the front panel.
- The **\*RST** command will clear the scan list and set all measurement parameters to their factory settings. The Instrument Preset (**SYSTem:PRESet** command) will not clear the scan list; however, this command will clear reading memory and all stored statistical data.

## DATA Subsystem

This subsystem allows you to configure and remove data from reading memory when the measurement configuration changes, or when any of these commands are executed: **INITiate**, **MEASure?**, **READ?**, **\*RST**, or **SYSTem:PRESet**.

### Command Summary

**DATA:LAST?**

**DATA:POINts?**

**DATA:POINts:EVENT:THReshold**

**DATA:REMOve?**

## 2 SCPI Programming

### DATA:LAST? [<num\_rdgs>,@<channel>]

Returns the most recent reading or readings taken on the selected channel during the scan.

Parameter	Typical return
<num_rdgs> = Any integer from 1 to 1,000 readings <channel> = A single channel	(none)

Returns the last reading on channel 101:

DATA:LAST? (@101)

Typical response: -1.93147367E-04

- Each reading is returned with some combination of measurement units, time stamp, channel number, and alarm status information. Reading returned is depending on the settings set by the **FORMat Sub-system** commands.
- Readings returned in order, starting with the earliest reading in the group of recent measurements. If you specify more readings than are currently saved in reading memory, the instrument generates an error message.
- Readings can be acquired during a scan using the multiplexer or multifunction modules.
- If no data is available for the specified channel, an error will be generated.

### DATA:POINTs? (@<ch\_list>)

Returns the total number of readings currently saved in reading memory from a scan.

Parameter	Typical return
(none)	(none)

Returns the number of readings in reading memory:

DATA:POIN?

Typical response: +320

- All readings are automatically time stamped. If reading memory overflows, a bit in the **STATus:QUESTIONable:CONDition?** register is set and new readings will overwrite the first (oldest) readings stored. The most recent readings are always preserved. Reading memory is not cleared when you read it.
- The questionable status bit will be cleared when reading memory is cleared. The questionable status bit will not be cleared if reading memory is emptied with **DATA:REMove?** or **R?**.
- The instrument clears all readings from reading memory when a new scan is initiated, or after a Factory Reset (**\*RST** command).



**DATA:POINts:EVENT:THReshold <num\_rdgs>****DATA:POINts:EVENT:THReshold?**

Sets the number of readings to store in reading memory before setting bit 9 (reading memory threshold bit) in the **Standard Operation Register** group event register to 1. An event register is a read-only register that latches events from the condition register. While an event bit is set, subsequent events corresponding to that bit are ignored. For more information, see **STATus Subsystem**.

Parameter	Typical return
<num_rdgs> = Any integer from 1 to 100,000 readings	(none)

Sets the reading memory threshold to 125 readings:

DATA:POIN:EVEN:THR 125

Typical response: +125

- To report any subsequent events, the reading count must first drop below the programmed reading memory threshold before reaching the threshold again. Use **R?** or **DATA:REMove?** to remove readings from reading memory.
- Use **STATus:OPERation:ENABLE** to enable the bit 9 to be reported to the Status Byte Register.
- Once the bit 9 is set, it remains set until cleared by **STATus:OPERation[:EVENT]?** or **\*CLS** (clear status) command.
- This parameter is set to its default value after a Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet**).

**DATA:REMove? <num\_rdgs> [, WAIT]**

Reads and erases <num\_rdgs> readings from the reading memory. If fewer than <num\_rdgs> readings are available, the query returns an error unless the WAIT parameter is specified, in which case the query waits until <num\_rdgs> readings are available.

Parameter	Typical return
<num_rdgs> = Any integer from 1 to 100,000 readings	(none)

Read and erase the three oldest readings from reading memory:

DATA:REM? 3

Typical response: +4.27150000E+02,+1.32130000E+03,+3.65300000E+03

- You can remove readings from reading memory at any time, even during a scan.
- You can save up to 100,000 readings in reading memory and all readings are automatically time stamped. If reading memory overflows, the new readings will overwrite the first (oldest) readings saved; the most recent readings are always preserved. No error is generated, but the Reading Memory Overflow bit (bit 12) is set in the Questionable Data Register's condition register (see **STATus Subsystem**).
- You can use the **DATA:POINts?** query to determine the total number of readings currently in reading memory.

## 2 SCPI Programming

- The instrument clears all readings from reading memory when a new scan is initiated, or after a Factory Reset (**\*RST** command).

## DISPlay Subsystem

This subsystem controls front panel display of the instrument.

### Command Summary

DISPlay

DISPlay:TEXT

DISPlay:TEXT:CLEAr

## 2 SCPI Programming

### DISPlay {OFF|ON}

#### DISPlay?

Enables (On) or disables (Off) front-panel display. For security reasons or for a slight increase in measurement rates, you may want to turn off the front panel display. When disabled, the entire front panel display turns black and error annunciator (ERR) is displayed.

Parameter	Typical return
{OFF ON} Default: ON	0 (OFF) or 1 (ON)
Disable the front panel display: DISP OFF	

- All keys except "Local" are disabled when the display is OFF.
- When you disabled the display with this command (DISP OFF), you can only enabled it again from the remote interface by sending the command (DISP ON).
- Sending a text message to the display (**DISPlay:TEXT** command) overrides the display state; this means that you can display a message even if the display is turned off.
- The front panel display is automatically enabled when power is cycled, or after a Factory Reset (**\*RST** command). It is also enabled when you press the "Local" key. The OFF state is remembered if you return to remote mode.

### DISPlay:TEXT "<string>"

#### DISPlay:TEXT?

Displays a text on the instrument's front panel display.

Parameter	Typical return
"<string>" = A quoted string of up to 40 characters. You can use letters (A-Z), numbers (0-9), and special characters like "@", "%", "*", and so on. Use "#" character to display a degree symbol (°).	"Test in progress..."
Show text message on display: DISP:TEXT "Test in progress..."	

- While a text is displayed on the front panel, readings from a scan or monitor are not sent to the front panel display.
- To clear the displayed text, send the text clear command (**DISPlay:TEXT:CLEAr**).
- Sending a text message to the display (**DISPlay:TEXT** command) overrides the display state; this means that you can display a message even if the display is turned off.
- The display text is not stored as part of the instrument state by the **\*SAV** command.
- The front panel display is automatically cleared when power is cycled, or after a Factory Reset (**\*RST** command).

**DISPlay:TEXT:CLEAr**

Clears the text displayed on the front panel.

Parameter	Typical return
(none)	(none)

Clears the text message displayed on the front panel: DISP:TEXT:CLE

- Clearing a text message does not override the display state (**DISPlay:STATe** command). If the display was disabled prior to clearing the text message, the display will remain disabled.
- The front panel display is automatically cleared when power is cycled, or after a Factory Reset (**\*RST** command).

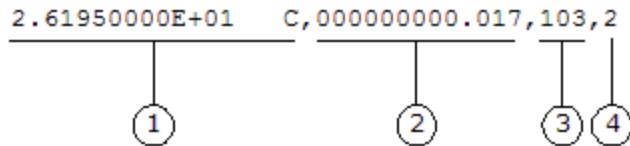
## FORMat Subsystem

During a scan, the instrument automatically adds a time stamp to all readings and stores them in reading memory. Each reading is also stored with measurement units, time stamp, channel number, and alarm status information. You can specify which information you want to return with the readings. Examples below show a reading in relative and absolute format with all fields enabled.

**NOTE**

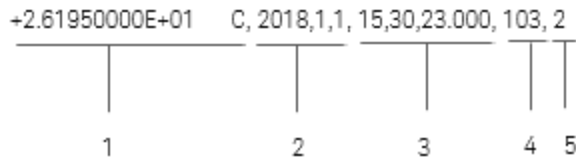
Reading format applies to all readings being retrieved from the instrument; you cannot set the format on a per-channel basis. **CONFigure** and **MEASure?** commands automatically disable the channel setting.

**Relative format** - shows the time since the start of the scan.



- 1 Reading with units (26.195 °C)
- 2 Elapsed time (17 ms)
- 3 Channel number
- 4 Alarm limit threshold crossed (0 = No alarm, 1 = LO, 2 = HI)

**Absolute format** - shows the time of the day with the date.



- 1 Reading with units (26.195 °C)
- 2 Date (January 1, 2018)
- 3 Time of day (3:30:23.000 PM)
- 4 Channel number
- 5 Alarm Limit Threshold Crossed (0 = No alarm, 1 = LO, 2 = HI)

### Command Summary

**FORMat:READing:ALARm**

**FORMat:READing:CHANnel**

**FORMat:READing:TIME**

**FORMat:READing:TIME:TYPE**

**FORMat:READing:UNIT**

**FORMat:READIng:ALARm {OFF|ON}****FORMat:READIng:ALARm?**

Enables (On) or disables (Off) the inclusion of alarm information in the reading format.

Parameter	Typical return
{OFF ON}	0 (OFF) or 1 (ON)
Default: OFF	

Enables the inclusion of alarm information in the reading format: `FORM:READ:ALAR ON`

- The alarm setting will be disabled (Off) after a Factory Reset (**\*RST** command).

**FORMat:READIng:CHANnel {OFF|ON}****FORMat:READIng:CHANnel?**

Enables (On) or disables (Off) the inclusion of channel number information in the reading format.

Parameter	Typical return
{OFF ON}	0 (OFF) or 1 (ON)
Default: OFF	

Enables the inclusion of channel number information in the reading format: `FORM:READ:CHAN ON`

- The channel setting will be disabled (Off) after a Factory Reset (**\*RST** command).

**FORMat:READIng:TIME {OFF|ON}****FORMat:READIng:TIME?**

Enables (On) or disables (Off) the inclusion of a time stamp in the reading format.

Parameter	Typical return
{OFF ON}	0 (OFF) or 1 (ON)
Default: OFF	

Enables the inclusion of a time stamp in the reading format: `FORM:READ:TIME ON`

- The time stamp setting will be disabled (Off) after a Factory Reset (**\*RST** command).
- If enabled, the time stamp information is shown either in absolute time or relative time as set by the **FORMat:READIng:TIME:TYPE** command.

## 2 SCPI Programming

### **FORMat:READing:TIME:TYPE {ABSolute|RELative}**

#### **FORMat:READing:TIME:TYPE?**

Selects the time format (absolute or relative) for time stamp returned when **FORMat:READing:TIME** is enabled.

Parameter	Typical return
{ABSolute RELative} Default: RELative	ABS or REL

Enables the absolute time format:

FORM:READ:TIME:TYPE ABS

FORM:READ:TIME ON

- The time format setting will be disabled (Off) after a Factory Reset (**\*RST** command).
- In terms of reading stored data from reading memory, the relative format is considerably faster than the absolute format.
- Absolute format is based on the instrument's real-time clock as set by the **SYSTem:DATE** and **SYSTem:TIME** commands.

### **FORMat:READing:UNIT {OFF|ON}**

#### **FORMat:READing:UNIT?**

Enables (On) or disables (Off) the inclusion of measurement units (VAC, VDC, OHM, etc.) in the reading format.

Parameter	Typical return
{OFF ON} Default: OFF	0 (OFF) or 1 (ON)

Enables the inclusion of measurement units in the reading format: FORM:READ:UNIT ON

- The unit setting will be disabled (Off) after a Factory Reset (**\*RST** command).



## HCOPy Subsystem

This subsystem produces display images ("screen shots").

### Command Summary

HCOPy:SDUMp:DATA?

HCOPy:SDUMp:DATA:FORMat

## 2 SCPI Programming

### HCOPY:SDUMp:DATA?

Returns the front panel display image.

Parameter	Typical return
(none)	(A definite-length binary block containing the image). A definite-length block allows data to be transmitted as a series of 8-bit data bytes. This is particularly useful for transferring large quantities of data or 8-bit extended ASCII codes.

Returns the front panel display image: `HCOP:SDUM:DATA?`

- The image format (PNG or BMP) is specified by `HCOPY:SDUMp:DATA:FORMat`.

### HCOPY:SDUMp:DATA:FORMat {PNG|BMP}

#### HCOPY:SDUMp:DATA:FORMat?

Specifies the format for images returned by `HCOPY:SDUMp:DATA?` as PNG (portable network graphics) or BMP (bitmap).

Parameter	Typical return
{PNG BMP} Default: PNG	PNG or BMP

Captures the display image in BMP format: `HCOP:SDUM:DATA:FORM BMP`

## IEEE-488.2 Common Commands

These commands and queries are associated with the IEEE-488.2 standard.

### Command Summary

\*CAL?

\*CLS

\*ESE

\*ESR?

\*IDN?

\*OPC

\*PSC

\*RCL

\*RST

\*SAV

\*SRE

\*STB?

\*TRG

\*TST?

\*WAI

## 2 SCPI Programming

### \*CAL?

#### NOTE

Only supported on DAQM907A multifunction module and internal DMM.

*Calibration Query.* Performs autocalibration (autocal) and returns the result.

Parameter	Typical return
(none)	+0 (no error), +1 (cal error)

---

Perform autocalibration: \*CAL?

- This command is equivalent to **SYSTEM:ACALibration? ALL**.
- Autocalibration takes just a few seconds to complete.
- Autocalibration compensates for internal drifts caused by time and temperature change. This can help to eliminate the errors to achieve a better performance.
- Following the autocalibration, the instrument returns to the instrument state that existed before the autocalibration.

### \*CLS

*Clear Status Command.* Clears the event registers in all register groups. It also clears the error queue and alarm queue.

Parameter	Typical return
(none)	(none)

---

Clear event register bits, error queue, and alarm queue: \*CLS

### \*ESE <enable>

### \*ESE?

*Event Status Enable Command and Query.* Enables bits in the enable register for the **Standard Event Register** group. An enable register defines which bits in the event register will be reported to the **Status Byte Register** group. You can write-to or read from an enable register.

Parameter	Typical return
Decimal sum of the bits in the register. For example, to enable bit 2 (decimal value = 4), bit 3 (decimal value = 8), and bit 7 (decimal value = 128), the decimal sum would be 140 (4 + 8 + 128). Default: 0	+16

---

Enables bit 4 (decimal value = 16) in the enable register: \*ESE16

- Use **\*PSC** to control whether the Standard Event enable register is cleared at power on. For example, \*PSC 0 preserves the enable register contents through power cycles.
- **\*CLS** clears the event register, but does not clear the enable register.

- The *<enable>* setting is non-volatile; it does not change after a Factory Reset (**\*RST** command), Instrument Preset (**SYSTem:PRESet** command), Status Preset (**STATus:PRESet** command) or Clear Status (**\*CLS** command).

### \*ESR?

*Standard Event Status Register Query.* Queries the event register for the **Standard Event Register** group. An event register is a read-only register that latches events from the condition register. While an event bit is set, subsequent events corresponding to that bit are ignored.

Parameter	Typical return
(none)	+24
Reads the event register (bits 3 and 4 are set): *ESR?	

- In order to be reported to the Status Register, the corresponding bits in the event register must be enabled using the **\*ESE** command.
- Once a bit is set, it remains set until cleared by reading the event register or execution of the Clear Status command (**\*CLS**).

### \*IDN?

*Identification Query.* Returns the instrument's identification string.

Parameter	Typical return
(none)	Keysight Technologies,DAQ970A,MY12345678,A.02.04-00.16-11.29-00.02-02-01
Returns the instrument's identification string: *IDN?	

- The identification string contains these four comma separated fields:  
Manufacturer name,Model number,Serial number,Revision code

In this instrument, query returns a string with the following format:  
Keysight Technologies,DAQ970A,<Serial Number>,h.ff.ff-pp.pp-mm.mm-gg.gg-bb-fp

Example, for revision code of "A.02.04-00.16-11.29-00.02-02-01",

h - Hardware revision (A)  
ff.ff - Main firmware revision (02.04)  
pp.pp - Front panel firmware revision (00.16)  
mm.mm - Measurement board firmware revision (11.29)  
gg.gg - Measurement board FPGA revision (00.02)  
bb - Measurement board revision (02)  
fp - Front panel board revision (01)

## 2 SCPI Programming

### \*OPC

### \*OPC?

*Operation Complete Command and Query.* \*OPC command sets "Operation Complete" (bit 0) in the **Standard Event Register** at the completion of the current operation. \*OPC? query returns 1 (decimal value of bit 0) to the output buffer after all pending commands complete. This query enables you to synchronize your application with the instrument.

Parameter	Typical return
(none)	+1

Sets the Operation Complete bit: \*OPC

Returns 1 when the command is complete: \*OPC?

- Other commands may be executed before \*OPC is set.
- Other commands cannot be executed until the \*OPC? completes.
- The differences between \*OPC and \*OPC? is that \*OPC sets a status bit when the operation completes, and \*OPC? outputs "1" when the operation completes.

### \*PSC {0|1}

### \*PSC?

*Power-On Status Clear Command and Query.* Enables (1) or disables (0) the clearing of certain enable registers at power-on:

- Questionable Data Register (**STATus:QUEStionable:ENABle** command)
- Standard Operation Register (**STATus:OPERation:ENABle** command)
- Alarm Register (**STATus:ALARm:ENABle** command)
- Standard Event Register (**\*SRE** command)
- Status Byte Register (**\*ESE** command)

#### NOTE

The \*PSC command does not affect the clearing of the condition or event registers. Only the enabled registers will be cleared.

Parameter	Typical return
{0 1}	0 or 1

Default: 1

Disables the power-on clearing of the affected registers: \*PSC 0

**\*RST**

*Reset Command.* Resets the instrument to the Factory configuration. See **Factory Reset State** for a complete listing of the instrument's Factory configuration.

Parameter	Typical return
(none)	(none)
Resets the instrument: <b>*RST</b>	

- This command does not affect any stored instrument states (**\*SAV**), and non-volatile settings such as I/O configuration, user preferences, or the calibration security state.

**\*SAV {0|1|2|3|4|5}****\*RCL {0|1|2|3|4|5}**

*Save and recall command.* Save the current instrument state to, or recalls the instrument state from, the state file `STATE_<n>.sta` in the root folder of the internal flash file system, where <n> is the location number specified.

Parameter	Typical return
{0 1 2 3 4 5}	(none)
Save the instrument state to location 1: <b>*SAV 1</b>	

- **\*SAV <n>** is equivalent to **MMEMory:STORe:STATe "INT:\STATE\_<n>.sta"**.
- **\*RCL <n>** is equivalent to **MMEMory:LOAD:STATe "INT:\STATE\_<n>.sta"**.
- LAN I/O configuration is not saved by a **\*SAV** operation or recalled by a **\*RCL**. Only instrument configuration is recalled.
- State "0" is the state of the instrument at power down. The state file created by **\*SAV 0**, called `STATE_0.sta`, is overwritten with the power-down state of the instrument when power is cycled.
- The instrument state enable settings are saved in non-volatile memory. They do not change when power has been off, after a Factory Reset (**\*RST**), or after an Instrument Preset (**SYSTem:PRESet**).

**\*SRE <enable>****\*SRE?**

*Service Request Enable Command and Query.* Enable register for the **Status Byte Register**. Once enabled, the corresponding bits may generate a Request for Service (RQS) in the Status Byte. This RQS event may generate a "call back" to your application as a type of asynchronous interrupt.

Parameter	Typical return
Decimal sum of the bits in the register. For example, to enable bit 2 (decimal value = 4), bit 3 (decimal value = 8), and bit 7 (decimal value = 128), the decimal sum would be 140 (4 + 8 + 128). Default: 0	+16

## 2 SCPI Programming

Parameter	Typical return
Enables bit 4 (decimal value = 16) in the enable register: *SRE 16	

- To enable specific bits, specify the decimal value corresponding to the binary-weighted sum of the bits in the register. The selected bits are summarized in the "Master Summary" bit (bit 6) of the Status Byte Register. If any of the selected bits change from 0 to 1, the instrument generates a Service Request signal.
- **\*CLS** command clears the event register, but does not clear the enable register. An event register is a read-only register that latches events from the condition register. While an event bit is set, subsequent events corresponding to that bit are ignored.
- Use **\*PSC** to control whether the Status Byte enable register is cleared at power-on. For example, \*PSC 0 preserves the enable register contents through power cycles.
- The `<enable>` setting is non-volatile; it does not change after a Factory Reset (**\*RST** command), Instrument Preset (**SYSTem:PRESet** command), Status Preset (**STATus:PRESet** command) or Clear Status (**\*CLS** command).

### \*STB?

*Read Status Byte Query.* Queries the condition register for the **Status Byte Register** group and returns a decimal value equal to the binary-weighted sum of all bits set in the register. A condition register continuously monitors the state of the instrument. Condition register bits are updated in real time; they are neither latched nor buffered.

Parameter	Typical return
(none)	+40
Reads the condition register when bits 3 and 5 are set: *STB?	

- This query returns the same results as a Serial Poll but the "Master Summary" bit (bit 6) is not cleared if a Serial Poll has occurred.
- Unlike how a reset clears the condition register, a factory reset (**\*RST**) does not clear the Status Byte Register.

### \*TRG

*Trigger command.* Triggers the instrument when **TRIGger:SOURce BUS** is selected.

Parameter	Typical return
(none)	(none)
Triggers the instrument:	
TRIG:SOUR BUS	
INIT	
*TRG	



- After setting the trigger source, send **INITiate** command to place the instrument into "wait-for-trigger" state. The \*TRG command is not accepted unless the instrument is in the "wait-for-trigger" state.
- \*TRG does not work with **READ?** command.

### \*TST?

*Self-test query.* Runs a standard self-test which is invoked at power-on. It will take few seconds to complete. If all tests pass, you can have high confidence that the instrument is operational.

Parameter	Typical return
(none)	+0 (pass) or +1 (one or more tests failed)

Runs a standard self-test: \*TST?

- The **TEST:ALL?** self-test query is more comprehensive than the \*TST? self-test query.
- When sending the \*TST? query, you may need to increase the timeout period for your IO Library read response time to allow the command to complete without causing a timeout error.
- Upon completion, \*TST? restores the instrument to its factory reset state.
- For a complete listing of the error messages related to self-test failures, see **Self-test Errors**.

### \*WAI

*Wait command.* Waits for all pending operations to complete before executing any additional commands over the remote interface.

Parameter	Typical return
(none)	(none)

Waits for all pending operations to complete: \*WAI

- Configuration changes and measurements are considered pending operations. Therefore, \*WAI causes these changes to occur and complete.

## 2 SCPI Programming

### LXI Subsystem

This subsystem supports LAN eXtensions for Instrumentation (LXI) functionality.

#### Command Summary

LXI:IDENtify:STATe

LXI:MDNS:ENABle

LXI:MDNS:HNAME[:RESolved]?

LXI:MDNS:SNAME:DESired

LXI:MDNS:SNAME[:RESolved]?

LXI:MDNS[:STATe]

LXI:RESet

LXI:REStart

**LXI:IDENTify {OFF|ON}****LXI:IDENTify?**

Enables (On) or disables (Off) the LXI Identify Indicator on the front panel display.

Parameter	Typical return
{OFF ON} Default: OFF	0 (OFF) or 1 (ON)
Enables the LXI Identify Indicator: LXI:IDEN ON	

- You can press the "Local" key or send **\*RST** to turn off the LXI Identify Indicator.

**LXI:MDNS:ENABLE {OFF|ON}****LXI:MDNS:ENABLE?**

Enables (On) or disables (Off) the multicast Domain Name System (mDNS), which provides the capabilities of a DNS server for service discovery in a small network that without a DNS server.

Parameter	Typical return
{OFF ON} Default: ON	0 (OFF) or 1 (ON)
Enables mDNS: LXI:MDNS ENAB ON	

- This setting is non-volatile; it is not changed by power cycling, a Factory Reset (**\*RST**), or an Instrument Preset (**SYSTem:PRESet**).
- This parameter is set to its default value when the instrument is shipped from the factory and after **SYSTem:SECurity:IMMediate**.

**LXI:MDNS:HNAME[:RESolved]?**

Returns the resolved (unique) mDNS hostname in the form "K-<model number>-<serial>-N", where <serial> is the last 4 digits of the instrument's serial number. The N is an integer appended if necessary to make the name unique. The desired name may be truncated, if necessary, to make room for the appended integer.

Parameter	Typical return
(none)	"K-DAQ970A-yyyyy", where yyyy is the last four digits of the serial number.
Returns the resolved mDNS hostname:	
LXI:MDNS:HNAME:RESolved?	
Typical response: "K-DAQ970A-0010"	

## 2 SCPI Programming

### LXI:MDNS:SNAMe:DESired "name"

#### LXI:MDNS:SNAMe:DESired?

Sets the desired mDNS service name.

Parameter	Typical return
Quoted string of up to 63 characters.	"Keysight Technologies<model number> Data Acquisition System - <serial>", where <serial> is the last 5 digits of the instrument's serial number.

Sets the desired mDNS service name:

```
LXI:MDNS:SNAM:DES "DAQ970A"
```

- This setting is non-volatile; it is not changed by power cycling, a Factory Reset (**\*RST**), or an Instrument Preset (**SYSTem:PRESet**).
- This parameter is set to its default value when the instrument is shipped from the factory and after **SYSTem:SECurity:IMMEDIATE**.

#### LXI:MDNS:SNAMe[:RESolved]?

The resolved mDNS service name will be the desired service name (**LXI:MDNS:SNAMe:DESired** command), possibly with "<N>" appended. The N is an integer appended if necessary to make the name unique. The desired name may be truncated, if necessary, to make room for the appended integer.

Parameter	Typical return
(none)	"Keysight Technologies DAQ970A Data Acquisition System - 00123"

Returns the resolved mDNS service name: `LXI:MDNS:SNAMe:RESolved?`

### LXI:MDNS[:STATe] {OFF|ON}

#### LXI:MDNS[:STATe]?

Enables (On) or disables (Off) the multicast Domain Name System (mDNS), which provides the capabilities of a DNS server for service discovery in a small network without a DNS server.

Parameter	Typical return
{OFF ON} Default: ON	0 (OFF) or 1 (ON)

Enables mDNS: `LXI:MDNS ON`

- This setting is non-volatile; it is not changed by power cycling, a Factory Reset (**\*RST**), or an Instrument Preset (**SYSTem:PRESet**).
- This parameter is set to its default value when the instrument is shipped from the factory and after **SYSTem:SECurity:IMMEDIATE**.

**LXI:RESet**

Resets LAN interface to a known operating state, beginning with DHCP, and clears the Web Interface password. If DHCP fails, it uses Auto-IP.

Parameter	Typical return
(none)	(none)
Resets the LAN interface: LXI:RES	

- Depending on your network, the LAN interface may take several seconds to restart after this command is sent.
- If the LAN interface or specific LAN services (VXI-11, Sockets, and so on) have been disabled by **SYSTem:COMMunicate:ENABLE**, you must separately re-enable the interface or services and cycle instrument power for the LAN to be operational.

**LXI:REStart**

Restarts the LAN interface with the current settings as specified by the **SYSTem:COMMunicate:LAN** commands.

Parameter	Typical return
(none)	(none)
Restart the LAN interface: LXI:REST	

- Depending on your network, the LAN interface may take several seconds to restart after this command is sent.
- If the LAN interface or specific LAN services (VXI-11, Sockets, and so on) have been disabled by **SYSTem:COMMunicate:ENABLE**, you must separately re-enable the interface or services and cycle instrument power for the LAN to be operational.

### MEASure Subsystem

The MEASure queries are the easiest way to program measurements because they always use default measurement parameters. You set the function, range, and resolution in one command and the results are sent directly to the instrument's output buffer.

#### NOTE

A MEASure query is functionally equivalent to sending CONFigure followed immediately by READ?. The difference is that CONFigure commands allow you to change parameters between the CONFigure and the READ?, but you cannot change other parameters from their default values in MEASure commands.

---

#### Command Summary

MEASure:CAPacitance?

MEASure:CURRent:{AC|DC}?

MEASure:DAC:OUTPut?

MEASure:DAC:SENSe?

MEASure:DIgital[:BYTE]?

MEASure:DIODE?

MEASure:{FREQuency|PERiod}?

MEASure:{RESistance|RESistance}?

MEASure:STRain Subsystem

MEASure:TEMPerature?

MEASure:TOTalize?

MEASure[:VOLTage]:{AC|DC}

#### Default Settings for MEASure?

With the MEASure? queries, you can select the function, range and resolution in one command. All other parameters are set to their default values as defined in **Factory Reset State**.

#### Using the MEASure? Query

*Example 1 - Using default range and default resolution*

Configures DC voltage measurements, internally triggers the instrument to take a measurement, and reads the measurement. Without specifying any range and resolution, *default range (autorange)* and *default resolution (10 PLC)* are used for the measurement.

```
MEAS:VOLT DC?
```

Typical response: +4.23450000E-03

*Example 2 - Using specific range and specific resolution*

Configures the instrument for 2-wire resistance measurements, triggers the instrument to take a measurement, and reads the measurement. The  $1\text{ k}\Omega$  range is selected with  $0.1\ \Omega$  resolution.

```
MEAS:RES? 1000,0.1
```

Typical response: +3.27150000E+02

**MEASure:CAPacitance? [{<range>|AUTO|MIN|MAX|DEF}, [{<resolution>|MIN|MAX|DEF},]] (@<scan\_list>)****NOTE**

Only supported on DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for capacitance measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
<range> = { 1 nF   10 nF   100 nF   1 $\mu$ F   10 $\mu$ F   100 $\mu$ F }. Default: AUTO.	(none)

<resolution> = Optional and ignored; fixed at 4½ digits

Configures a default capacitance measurements on channel 101:

MEAS:CAP? (@101)

Typical response: +3.01574316E-10

- You can let autoranging select the measurement range, or you can manually select a fixed range. Autoranging conveniently selects the range for each measurement based on the input signal. For fastest measurements, use manual ranging (autoranging may require additional time for range selection).
- Autoranging (AUTO or DEFault), will generate an error if you specify a <resolution> because the instrument cannot accurately resolve the integration time (especially if the input continuously changes). If your application requires autoranging, specify DEFault for the <resolution> or omit the <resolution> altogether.
- Autoranging goes down a range at less than 10% of range and up a range at greater than 120% of range. For capacitance measurements only, when autorange is off, the instrument does not report an overload for readings greater than 120% of range. Overload only occurs when the algorithm times out because the applied capacitance is too large for the algorithm to measure. If you apply a DC voltage or a short to the input terminals in capacitance measurement mode, the instrument reports an overload.
- If the input signal is greater than can be measured on the specified manual range, the instrument displays the word Overload on front panel and returns "9.9E37" from the remote interface.

**MEASure:CURRent:{AC|DC}? [{<range>|AUTO|MIN|MAX|DEF}, [{<resolution>|MIN|MAX|DEF},]] (@<scan\_list>)****NOTE**

Only supported on DAQM901A multiplexer module (channel 21 and 22).

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for AC and DC current measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.



Parameter	Typical return
<code>&lt;range&gt;</code> AC current: {100 $\mu$ A   1 mA   10 mA   100 mA   1 A} DC current: {1 $\mu$ A   10 $\mu$ A   100 $\mu$ A   1 mA   10 mA   100 mA   1 A} Default: AUTO	(none)
<code>&lt;resolution&gt;</code> AC current: Optional and ignored; fixed at 6½ digits DC current: 1 PLC	
Configure AC current measurements using the 1 A range on channel 101:	
<code>MEAS:CURR:AC? 1 (@101)</code> Typical Response: +8.54430000E-01	

- You can let autoranging select the measurement range, or you can manually select a fixed range. Autoranging conveniently selects the range for each measurement based on the input signal. For fastest measurements, use manual ranging (autoranging may require additional time for range selection).
- Autoranging (AUTO or DEFault), will generate an error if you specify a `<resolution>` because the instrument cannot accurately resolve the integration time (especially if the input continuously changes). If your application requires autoranging, specify DEFault for the `<resolution>` or omit the `<resolution>` altogether.
- Autoranging goes down a range at less than 10% of range and up a range at greater than 120% of range.
- If the input signal is greater than can be measured on the specified manual range, the instrument displays the word Overload on front panel and returns "9.9E37" from the remote interface.

### MEASure:DAC:OUTPut? (@<scan\_list>)

#### NOTE

Only supported on DAC output channels (channel 04 and 05) in DAQM907A multifunction module.

Configures the specified DAC output channels for unbuffered (no memory) input operations and immediately sweeps through the channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
(none)	(none)
Configure a default DAC output measurement on channel 104:	
<code>MEAS:DAC:OUTP? (@104)</code> Typical Response: +1.32130000E-01	

- There is no actual measurement on this command. Executing this command will simply return the "PROGRAMMED" DAC settings. For example, sets the value to 1.234 V will exactly return 1.234 V on the

## 2 SCPI Programming

subsequent sweep of scanning.

- This command is useful when using DAC to control the measurements, varying the output from time-to-time, and record the sweep data of DAC settings in fact for that sweep.

### MEASure:DAC:SENSe? (@<scan\_list>)

#### NOTE

Only supported on DAC output sense channels (channel 06 and 07) in DAQM907A multifunction module.

Configures the specified DAC output sense channels for unbuffered (no memory) input operations and immediately sweeps through the channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
(none)	(none)

Configure a default DAC sense measurement on channel 106:

```
MEAS:DAC:SENS? (@106)
```

Typical Response: +1.32130000E-01

- This command does makes an actual measurement. The range and resolution are fixed at 1 PLC on the 10 VDC range.
- Channel 06 will make the measurement based on the output mode set in channel 04 of DAC output channel; channel 07 will make the actual measurement based on the output mode set in channel 05 of DAC output channel.

### MEASure:DIgital[:BYTE]? (@<scan\_list>)

#### NOTE

Only supported on Digital I/O channels (channel 01 and 02) in DAQM907A multifunction module.

Configures the specified digital I/O channels for unbuffered (no memory) input operations and immediately sweeps through the channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
(none)	(none)

Configures a default byte data measurement on channel 101:

```
MEAS:DIg:BYTE? (@101)
```

Typical response:

- Note that if you include both digital input channels in the scan list, the instrument will read data from both ports simultaneously with the same time stamp. This allows you to externally combine the two 8-

bit value into one 16-bit value.

### MEASure:DIODe? (@<scan\_list>)

#### NOTE

Only supported on DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for diode measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
(none)	(none)

Configure a default diode measurement:

MEAS:DIOD? (@101)

Typical Response: +1.32130000E-01

- The range and resolution for diode test are fixed at 1 VDC, with a 1 mA current source output.
- The voltage is displayed on the front panel if it is between 0 and 5.05 V. If the signal exceeds 5.05 V, the front panel shows "OPEN" when **Monitor** is selected (or "Overload" when **View** is selected), and the value returned from SCPI is 9.9E37.

### MEASure:{FREQuency|PERiod}? [{<range>|AUTO|MIN|MAX|DEF}, {<resolution>|MIN|MAX|DEF},] (@<scan\_list>)

#### NOTE

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for frequency and period measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
<range> Frequency: 3 Hz to 300 kHz. Default: 20 Hz Period: 3.33 $\mu$ s to 333.33 ms. Default: 50 ms Default: AUTO	(none)
<resolution> = 1 PLC (0.000003 x Range)	

Configure frequency measurements using the default aperture. Then make and read one measurement:

MEAS:FREQ?

Typical Response: +1.32130000E+03

## 2 SCPI Programming

- The input signal for frequency or period measurements has an AC voltage component. By default, this command uses autorange to select the voltage range.
- With no signal applied, 0 is returned

**MEASure:{FRESistance|RESistance}? [{<range>|AUTO|MIN|MAX|DEF},  
[{{<resolution>|MIN|MAX|DEF},]}] (@<scan\_list>)**

### NOTE

RESistance measurements only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

FRESistance measurements only supported on DAQM900A, DAQM901A, and DAQM902A multiplexer modules.

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for 2-wire and 4-wire resistance measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
<range>	+8.54530000E+01
RESistance: { 100 $\Omega$   1 k $\Omega$   10 k $\Omega$   100 k $\Omega$   1 M $\Omega$   10 M $\Omega$   100 M $\Omega$   1 G $\Omega$ }. Default: 1 k $\Omega$	
FRESistance: { 100 $\Omega$   1 k $\Omega$   10 k $\Omega$   100 k $\Omega$   1 M $\Omega$   10 M $\Omega$   100 M $\Omega$   1 G $\Omega$ }. Default: 1 k $\Omega$	
<resolution> = 1 PLC (0.000003 x Range)	

Configure 4-wire resistance measurements using the 100  $\Omega$  range with default resolution. Then make and read one measurement:

MEAS:FRES? 100

Typical response:+8.54530000E+01

- You can let autoranging select the measurement range, or you can manually select a fixed range. Autoranging conveniently selects the range for each measurement based on the input signal. For fastest measurements, use manual ranging (autoranging may require additional time for range selection).
- Autoranging (AUTO or DEFault), will generate an error if you specify a <resolution> because the instrument cannot accurately resolve the integration time (especially if the input continuously changes). If your application requires autoranging, specify DEFault for the <resolution> or omit the <resolution> altogether.
- Autoranging goes down a range at less than 10% of range and up a range at greater than 120% of range.

- If the input signal is greater than can be measured on the specified manual range, the instrument displays the word Overload on front panel and returns "9.9E37" from the remote interface.

**MEASure:STRain Subsystem****MEASure:STRain:{DIRect|FDIRect}?****MEASure:STRain:{FULL|HALF}:BENDing?****MEASure:STRain:{FULL|HALF}:POISson?****MEASure:STRain:FULL:BENDing:POISson?****MEASure:STRain:QUARter?**

**MEASure:STRain:{DIRect|FDIRect}? [{<gage\_ohms>|MIN|MAX|DEF}, [{<gage\_factor>|MIN|MAX|DEF}, [{<range>|MIN|MAX|DEF}, [{<resolution>|MIN|MAX|DEF},]]]] (@<scan\_list>)**

**NOTE**

DIRect measurements only supported on DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

FDIRect measurements only supported on DAQM901A and DAQM902A multiplexer modules.

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for direct 2-wire and 4-wire strain gage measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
<gage_ohms> = Any numeric value between 80 and 1,100 ohms Default = 120 ohms	(none)
<gage_factor> = Any numeric value between 0.5 and 5 Default = 2	
<range> = {100 Ω   1kΩ   10 kΩ   100 kΩ   1 MΩ   10 MΩ   100 MΩ   1 GΩ} Default = 1 kΩ	
<resolution> = 1 PLC (0.000003 x Range)	

**MEASure:STRain:{FULL|HALF}:BENDing? [{<gage\_factor>|MIN|MAX|DEF}, [{<range>|MIN|MAX|DEF}, [{<resolution>|MIN|MAX|DEF},]]]] (@<scan\_list>)**

**NOTE**

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for full and half bending bridge strain gage measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
<i>&lt;gage_factor&gt;</i> = Any numeric value between 0.5 and 5 Default = 2	None
<i>&lt;range&gt;</i> = {Auto   100 mV   1V   10 V   100V   300V} Default = AUTO	
<i>&lt;resolution&gt;</i> = 1 PLC (0.000003 x Range)	

**MEASure:STRain:{FULL|HALF}:POISson? [{<gage\_factor> | MIN | MAX | DEF}, [{<poisson\_ratio> | MIN | MAX | DEF}, [{<range> | MIN | MAX | DEF}, [{<resolution> | MIN | MAX | DEF},]]]]] (@<scan\_list>)**

**NOTE**

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for full and half poisson bridge strain gage measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
<i>&lt;gage_factor&gt;</i> = Any numeric value between 0.5 and 5 Default = 2	(none)
<i>&lt;poisson_ratio&gt;</i> = Any numeric value between -0.9999 and +0.5 Default = 0.3	
<i>&lt;range&gt;</i> = {Auto   100 mV   1V   10 V   100V   300V} Default = AUTO	
<i>&lt;resolution&gt;</i> = 1 PLC (0.000003 x Range)	

**MEASure:STRain:FULL:BENDING:POISson? [{<gage\_factor> | MIN | MAX | DEF}, [{<poisson\_ratio> | MIN | MAX | DEF}, [{<range> | MIN | MAX | DEF}, [{<resolution> | MIN | MAX | DEF},]]]]] (@<scan\_list>)**

**NOTE**

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for full bending poisson bridge strain gage measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

## 2 SCPI Programming

Parameter	Typical return
<gage_factor> = Any numeric value between 0.5 and 5 Default = 2	(none)
<poisson_ratio> = Any numeric value between -0.9999 and +0.5 Default = 0.3	
<range> = {Auto   100 mV   1V   10 V   100V   300V} Default = AUTO	
<resolution> = 1 PLC (0.000003 x Range)	

**MEASure:STRain:QUARter? {<gage\_factor> | MIN | MAX | DEF}, [{<range> | MIN | MAX | DEF}, [{<resolution> | MIN | MAX | DEF},]]] (@<scan\_list>)**

### NOTE

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for quarter bridge strain gage measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
<gage_factor> = Any numeric value between 0.5 and 5 Default = 2	(none)
<range> = {Auto   100 mV   1V   10 V   100V   300V} Default = AUTO	
<resolution> = 1 PLC (0.000003 x Range)	

**MEASure:TEMPerature:<probe\_type>? [{<type> | DEF}, [{<resolution>|MIN|MAX|DEF},]] (@<scan\_list>)**

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for temperature measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Table below shows transducer types that are supported on each multiplexer module.

Multiplexer module	Transducer types				
	Thermocouple	2-wire RTD	4-wire RTD	2-wire thermistor	4-wire thermistor
DAQM900A	√				
DAQM901A	√	√	√	√	√
DAQM902A	√	√	√	√	√
DAQM908A		√		√	



Parameter	Typical return
<probe_type>: {FRTD   RTD   FTHermistor   THERmistor   TCouple   DEF}. Default: TCouple	(none)
<type>: For FRTD and RTD: Type 85 For FTHermistor and THERmistor: Type 2252, 5000, and 10,000 For TCouple: Type B, E, J, K, N, R, S, and T	
<resolution>: Default: 1 PLC	
Configure a 4-wire RTD measurement with default resolution. Then make and read one measurement:	
MEAS:TEMP? FRTD,85	
Typical Response: +2.12320000E+01	

- For temperature measurements, the instrument internally selects the range; you cannot select which range is used.
- To change temperature units, use **UNIT:TEMPerature**.
- For RTD and thermistor measurements, the instrument autoranges to the correct range for the transducer resistance measurement. For thermocouple measurements, the 100 mV range is selected.
- For thermocouple measurements, the internal reference is selected. See **SENSe:TEMPerature:TCouple:RJUNction:TYPE**.
- If the input signal is greater than can be measured on the specified manual range, the instrument displays the word Overload on front panel and returns "9.9E37" from the remote interface.

### MEASure:TOTalize? {READ|RRESet}, (@<scan\_list>)

#### NOTE

Only supported on totalizer channel (channel 03) in DAQM907A multifunction module.

Configures the totalizer channel and immediately sweeps through the list one time. You can read the totalizer either with or without resetting the count. The results are sent directly to the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
{READ   RRESet} Default: READ	READ or RRES
Configures totalizer channel to be read without resetting its count, and read the measurement on channel 103:	
MEAS:TOT? READ (@103)	

- The totalizer channel is always of the form **s03** in the multifunction module, where **s** is the first digit of the slot number.

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- The maximum count is 67,108,863 ( $2^{26} - 1$ ). The count rolls over to 0 after reaching the maximum allowed value.
- If the count rolls over to 0, the "Totalizer Overflow" bit (bit 11) is set in the Questionable Data register. For more information on the Status System for the instrument, see [Status System Introduction](#).
- Selecting the RRESet mode performs a synchronized read and reset operation on the specified totalizer channels. If you were to use discrete commands, such as **READ?** and **[SENSe:]TOTAlize:CLEAr:IMMediate**, you would likely lose counts occurring between the two commands.
- The **\*RST** command will clear the scan list and set all measurement parameters to their factory settings. The Instrument Preset (**SYSTem:PRESet** command) will not clear the scan list; however, this command will clear reading memory and all stored statistical data.

**MEASure[:VOLTage]:{AC|DC}? [{<range>|AUTO|MIN|MAX|DEF},  
[<resolution>|MIN|MAX|DEF],] (@<scan\_list>)**

### NOTE

AC voltage measurements only supported on DAQM901A multiplexer module.

DC voltage measurements only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Resets all measurement parameters on the specified channels to their default values. Then, configures the channels for AC and DC voltage measurements and immediately sweeps through the specified channels one time (independent of the present scan list). The results are sent directly to reading memory and the instrument's output buffer. This command redefines the scan list.

Parameter	Typical return
<range>: {100 mV 1 V 10 V 100 V 300 V}. Default: AUTO	(none)
<resolution> AC voltage: Optional and ignored; fixed at 6½ digits DC voltage: 1 PLC	
Configure DC voltage measurements using the 10 V range with 1 mV resolution on channel 101. Then make and read one measurement:	
MEAS:VOLT:DC? 10,0.001 (@101) Typical Response: +8.54530000E+01	

- When you specify a range of channels with this command, any channels that are invalid will be ignored (no error will be generated) but the selected function must be valid for at least one channel in the range, or an error will be generated.

- You can allow the instrument to automatically select the measurement range using *autoranging* or you can select a fixed range using manual ranging. Autoranging is convenient because the instrument decides which range to use for each measurement based on the input signal. For fastest scanning operation, use manual ranging on each measurement (some additional time is required for autoranging since the instrument has to make a range selection).
- If you select autoranging (by specifying "AUTO" or "DEF") and specify a discrete value for the *<resolution>* parameter, the integration time selected based on the default range for the function (1 A for AC or DC current measurements).
- Autorange thresholds:
  - Down range at: <10% of range
  - Up range at: >120% of range
- Because this command resets all measurement parameters on the specified channels to their **default values**, be sure to send the CONFigure command *before* setting any other measurement parameters.
- If the input signal is greater than can be measured on the selected AC voltage range (manual ranging, see FREQuency:VOLTage:RANGe command), the instrument gives an overload indication: "±OVLd" from the front panel or "±9.9E+37" from the remote interface.
- For AC measurements, the resolution is fixed at 6½ digits. The only way to control the reading rate for AC measurements is by changing the **channel delay** or by setting the **AC filter** to the highest frequency limit. The *<resolution>* parameter only affects the number of digits shown on the front panel.
- The **\*RST** command will clear the scan list and set all measurement parameters to their factory settings. The Instrument Preset (**SYSTem:PRESet** command) will not clear the scan list; however, this command will clear reading memory and all stored statistical data.

## 2 SCPI Programming

### MMEMory Subsystem

MMEMory (mass memory) subsystem can be divided into three categories, as below:

General Purpose File Management Commands

Data Transfer Commands

STATe and PREFerence File Management Commands

## General Purpose File Management Commands

### Command Summary

MMEMory:CATalog[:ALL]?

MMEMory:CDIRectory

MMEMory:MDIRectory

MMEMory:RDIRectory

MMEMory:COpy

MMEMory:DELeTe

MMEMory:LOG[:ENABle]

MMEMory:LOG:NEw

MMEMory:MOVE

### Folder and File Formats

Most of the MMEMory commands refer to the folders and files. These have specific structures, described below:

#### Format for a <folder>

- The format for <folder> is "[[<drive>:]<path>]<file\_spec>", where <drive> can be INTernal or USB, <path> is a folder path, and <filespec> specifies a subset of files.
- INTernal specifies the internal flash file system. USB specifies a front panel USB storage device.
- If <drive> is specified, <path> is interpreted as an absolute folder path. Absolute paths begin with "\" or "/" and start at the root folder of <drive>.
- If <drive> is omitted, <path> is relative to the folder specified by **MMEMory:CDIRectory**. Relative paths must NOT begin with \ or /.
- Folder and file names cannot contain the following characters: \ / : \* ? " < > |
- The <folder> parameter cannot exceed 240 characters.
- The specified folder must exist and cannot be marked as hidden or system. The exception is **MMEMory:MDIRectory**, which creates a folder. For MMEMory:MDIRectory, all folder levels above the new one must exist.

#### Format for a <file>

- The format for a <file> is "[[<drive>:]<path>]<file\_name>", where <drive> can be INTernal or USB, and <path> is a folder path.
- INTernal specifies the internal flash file system. USB specifies a front panel USB storage device.
- If <drive> is specified, <path> is interpreted as an absolute folder path. Absolute paths begin with "\" or "/" and start at the root folder of <drive>.

## 2 SCPI Programming

- If *<drive>* is omitted, *<path>* is relative to the folder specified by **MMEMory:CDIRectory**. Relative paths must NOT begin with \ or /.
- Folder and file names cannot contain the following characters: \ / : \* ? " < > |
- The combination of folder and file name cannot exceed 240 characters.

**MMEMory:CATalog[:ALL]? [<folder>]**

Returns a list of files in the specified folder.

Parameter	Typical return
<folder> Any valid folder name. Defaults to folder selected by <b>MMEMory:CDIRectory</b>	+1000000000,+327168572, "command.exe,,375808", "MyDCVMeas.sta,STAT,8192",MyData.csv,ASC,11265"

List all files in the folder MyData on the front panel USB storage device: `MMEM:CAT? "USB:\MyData"`

List all state files in the root directory of internal memory: `MMEM:CAT? "INT:\*.sta"`

- If <folder> is omitted or is \*.\* , the command or query acts on all files. You can also use the \* as a generic wildcard: \*.sta, abc\*.\* , and so on.
- The catalog takes the following form:

```
<mem_used>,<mem_free>{,"<file_listing>"}
```

The instrument returns two numbers and a string for each file in the folder. The first number is the number of bytes used on the drive. The second indicates the number of bytes available. Each <file\_listing> is in the format "<file\_name>,<file\_type>,<file\_size>" (including the quotation marks), where <file\_name> is the name of the file including file extension, if any; <file\_type> is either STAT for STATe (.sta) files, ASC for DATA (.csv) files, PREF for PREFERence (.prf) files, FOLD for folders, or null for all other file extensions; <file\_size> is the file size in bytes.

- If no files exist, only <mem\_used>,<mem\_free> is returned.

**MMEMory:CDIRectory <folder>****MMEMory:CDIRectory?****MMEMory:MDIRectory <folder>****MMEMory:RDIRectory <folder>**

*MMEMory:CDIRectory* selects the default folder for MMEMory subsystem commands. This folder must exist and is used when folder or file names do not include a drive and folder name. Query returns the current default folder.

*MMEMory:MDIRectory* makes a new directory (folder) on the mass storage medium.

*MMEMory:RDIRectory* removes a directory (folder) on the mass storage medium.

Parameter	Typical return
<folder> Any directory name, including the mass storage unit specifier. Default: INT:\.	"INT:\BACKUP"

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Parameter	Typical return
Makes a new directory named "test" on the internal mass memory system: <code>MMEM:MDIR "test"</code>	
Removes a new directory named "test" on the internal mass memory system: <code>MMEM:RDIR "test"</code>	
Selects the \BACKUP folder on the internal flash file system as the default folder: <code>MMEM:CDIR "INT:\BACKUP"</code>	
Returns the default folder for MMEMory subsystem commands: <code>MMEM:CDIR?</code>	

- This parameter is set to its default value after a Factory Reset (**\*RST**) or Instrument Present (**SYSTem:PRESet**).
- You can only remove an empty folder. Else, instrument generates a "Directory not empty" error.

### MMEMory:COpy <file1>,<file2>

Copies <file1> to <file2>. Each file name must include the file extension.

Parameter	Typical return
Any valid file name for both <file1> and <file2>	(none)
Copy state file from the root directory to the folder "Backup" on the internal flash file system:  <code>MMEM:COpy "INT:\MyDAQ.sta","INT:\Backup"</code>	

- This source file and folder, <file1>, must exist and cannot be marked as hidden or system.
- The destination folder, <file2>, must exist and cannot be marked as hidden or system.
- If the destination file exists, it will be overwritten, unless marked as hidden or system.
- To copy a file to a file of the same name in a different folder, specify just the <drive> and/or <path> for <destination>.

### MMEMory:DElete <file>

Deletes a file. To delete a folder, use **MMEMory:RDIRectory** command.

Parameter	Typical return
Any valid file name for <file>	(none)
Delete a file from the root directory of the internal flash file system: <code>MMEM:DEL "INT:\MySetup.sta"</code>	

- The specific folder must exist and cannot be marked as hidden or system.
- **SYSTem:SECurity:IMMediate** deletes and sanitizes all files.

### MMEMory:LOG[:ENABLE] {OFF | ON}

### MMEMory:LOG[:ENABLE]?



Enables (On) or disables (Off) logging of the scanned memory readings to a USB drive connected to the front panel USB host port.

Parameter	Typical return
{OFF   ON} Default: OFF	0 (OFF) or 1 (ON)
Scanned readings are to be logged to the USB drive: <code>MMEM:LOG ON</code>	

- For short scans, a **READ?** or **MEASURE?** query may take some extra times to complete on logging to USB.
- Scanned readings will be saved in non-volatile on the instrument and will not be affected by a Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet** command).
- When USB data logging is enabled, readings are saved to files on the USB drive inserted in the front panel USB host port. When logging to USB, readings will not be restored to the instrument's reading store after a power cycle, regardless of whether the power-on state recall is enabled or disabled (see **MMEMory:STATe:RECall:AUTO** command).
- If you remove the USB drive during logging, logging will stop but the scan will continue. If you re-attach the USB drive, it will not cause logging to resume unless you follow the five-step procedure shown below. Otherwise, logging will resume at the next **INITiate**.
- To replace a USB stick on a system actively logging data to USB:
  1. Press and hold the **[Scan]** key to stop a scan, "Scan stopped" message will display.
  2. Remove the USB drive from the front panel.
  3. After the old USB drive is removed, wait for few seconds before inserting the new USB drive.
  4. Press the **[Scan]** key again to restart scanning and logging to the new USB drive.
- For typical USB drives, there is a file system limit of 999 timestamped folders. If you receive error message "-254, Media Full" while logging data, check to ensure that you have not hit the limit of 999 timestamped folders for your instrument. You may receive error -254 even if additional space is available on the drive.

### MMEMory:LOG:NEW

Force the data logging to log into a new file.

Parameter	Typical return
(none)	(none)
Force the data logging to log into a new file: <code>MMEM:LOG:NEW</code>	

- Data logging will create a new file each time when this command is executed.

### MMEMory:MOVE <file1>,<file2>

Moves and/or renames <file1> to <file2>. Each file name must include the file extension.

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Parameter	Typical return
Any valid file name for both <i>&lt;file1&gt;</i> and <i>&lt;file2&gt;</i>	(none)

Move the specified state file from the currently selected default directory to the folder "Backup" on the internal flash file system:

```
MMEM:MOVE "MyDAQ.sta","INT:\Backup"
```

- To rename a file, specify the same folder for *<file1>* and *<file2>*.
- To move a file to a file of the same name in a different folder, you can specify just the *<drive>:<path>* for *<file2>*.

## Data Transfer Commands

These commands transfer files into and out of the instrument's mass memory.

### Command Summary

**MMEMory:DOWNload:DATA**

**MMEMory:DOWNload:FNAME**

**MMEMory:FORMat:READing:CSEParator**

**MMEMory:FORMat:READing:RLIMit**

**MMEMory:FORMat:READing:RLIMit:COUNT**

**MMEMory:STORe:DATA**

**MMEMory:UPLoad?**

### **MMEMory:DOWNload:DATA <block>**

Download data from the host computer to a file whose name has been specified by **MMEMory:DOWNload:FNAME** command. The data in *<block>* is written to the selected file.

#### NOTE

Any data previously stored in the file is lost when you execute this command.

Parameter	Typical return
<i>&lt;block&gt;</i> = Any IEEE-488.2 definite- or indefinite-length block.	(none)
Write "Hello" to the file "\Myfile" on internal storage:	
MMEM:DOWN:FNAME "INT:\Myfile"	
MMEM:DOWN:DATA #15Hello	

### **MMEMory:DOWNload:FNAME <file>**

#### **MMEMory:DOWNload:FNAME?**

Creates or opens the specified file name prior to writing data to that file with **MMEMory:DOWNload:DATA**.

Parameter	Typical return
<i>&lt;file&gt;</i> = Any valid file name	(none)
Write "Hello" to the file "\Myfile" on internal storage:	
MMEM:DOWN:FNAME "INT:\Myfile"	
MMEM:DOWN:DATA #15Hello	

- The specified folder must exist and cannot be marked as hidden or system.
- If the destination file exists, it will be overwritten, unless marked as hidden or system.

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- The file is created if it does not already exist.

### **MMEMory:FORMat:READing:CSEParator {COMMa | SEMicolon | TAB}** **MMEMory:FORMat:READing:CSEParator?**

Specifies the character to use for separating the information on each row.

Parameter	Typical return
{COMMa   SEMicolon   TAB} Default: COMMa	COMM, SEM, or TAB
Specify tab as the column separator: <code>MMEM:FORM:READ:CSEP TAB</code>	

- The value of the column separator will be saved in non-volatile memory on the instrument and will not be affected by Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet**).
- This command will affect the format for the .csv file created by the **MMEMory:STORe:DATA** command.

### **MMEMory:FORMat:READing:RLIMit {OFF | ON}** **MMEMory:FORMat:READing:RLIMit?**

Specifies the row limit (maximum number of rows for sweep data) that will be written to each data logging file by the count set by **MMEMory:FORMat:READing:RLIMit:COUNT** command.

Parameter	Typical return
{OFF   ON} Default: ON	0 (OFF) or 1 (ON)
Disable row limits for the .csv file: <code>MMEM:FORM:READ:RLIM OFF</code>	

- This feature enables you to set a limit between 1,024 to 1,048,576 rows per file. This allows you to accommodate common spreadsheet, database, and data analysis programs that have limitations of 1 million rows per file.
- **ON** - Sweep data is stored in files named dat00001.csv, dat00002.csv, dat00003.csv, and so on.
- **OFF** - Sweep data is stored in a single file named dat00001.csv. The limit is the number of bytes allowed by the file system (up to 4 GBytes or available storage space).
- The value of the row limit will be saved in non-volatile memory on the instrument and will not be affected by Factory Reset (**\*RST**) or Instrument Preset (**SYSTem:PRESet**).

### **MMEMory:FORMat:READing:RLIMit:COUNT {65536 | 1048576 | MIN | MAX | DEF}** **MMEMory:FORMat:READing:RLIMit:COUNT? [{MIN | MAX | DEF}]**

Sets the row limits count when **MMEMory:FORMat:READing:LIMit ON** is set.

Parameter	Typical return
{65536   1048576   MIN   MAX   DEF} Default: DEF  Minimum: 65536 Maximum: 1048576 Default: 65536	(none)
Returns the number of rows limits taken: <code>MMEM:FORM:READ:RLIM:COUN?</code>	

### MMEMory:STORe:DATA {RDG\_STORE}, <file>

Stores all measurements in reading memory to the specified data file. The file name optionally includes the folder name and the .csv or .dat file extension.

Parameter	Typical return
<file> = Any valid file name with IEEE-488.2 definite-length block.	(none)
Store all measurements in reading memory to MyDAQ.csv in the root folder of the internal flash file system:	
<code>MMEM:STOR:DATA RDG_STORE,"INT:\MyDAQ"</code>	

- If a .csv file extension is specified, or if no file extension is specified, the data is stored in ASCII format. If the .dat file extension is specified, the data is stored in binary format.
- File format is affected by **MMEMory:FORMat:READing:CSEParator**.
- When the reading memory overflowed at 100,000 readings,
  - a. Any new readings will overwrite the first (oldest) readings saved; the most recent readings are always preserved.
  - b. Only the full-sweeps of scanned memory readings are storing in the file; partial-sweeps are ignored.
  - c. Sweep number stored in file is always starts from 1, which indicates the full-sweep of scanned memory readings.
- The destination folder must exist and cannot be marked as hidden or system.
- If the destination file exists, it will be overwritten, unless marked as hidden or system.

### MMEMory:UPLoad? <file>

Uploads the contents of a file from the instrument to the host computer.

Parameter	Typical return
<file> = Any valid file name with IEEE-488.2 definite-length block.	(none)
Upload the state file "Myfile.sta" in the root directory of the internal flash file system to the host computer:	
<code>MMEM:UPL? "INT:\Myfile.sta"</code>	

### **STATe and PREference Management Commands**

These MMEMory subsystem commands save and load instrument states (state files) and preferred settings for non-volatile parameters (preference files). In general, state files store volatile settings associated with measurements. Preferences are non-volatile parameters associated with the instrument, but not any specific measurement. The following table summarizes what information is in each file.

#### **Command Summary**

**MMEMory:LOAD:PREferences**

**MMEMory:STORe:PREferences**

**MMEMory:LOAD:STATe**

**MMEMory:STORe:STATe**

**MMEMory:STATe:RECall:AUTO**

**MMEMory:STATe:RECall:SElect**

**MMEMory:STATe:VALid?**

**MMEMory:LOAD:PREFerences <file>****MMEMory:STORe:PREFerences <file>**

*Load:* Reboots the instrument and loads the non-volatile I/O settings and user preferences from a file. The specified file cannot be empty or marked as hidden or system.

*Store:* Stores non-volatile I/O settings and user preferences to a file. If the destination file exists, it will be overwritten, unless marked as hidden or system.

Parameter	Typical return
<file> = Any valid file name. The .prf file extension is optional. If you do not include this extension, the instrument firmware will automatically append it.	(none)
Load non-volatile I/O settings and user preferences from the specified file: MMEM:LOAD:PREF "INT:\MyPreferences"	
Stores the current non-volatile I/O settings and user preferences into the specified file: MMEM:STOR:PREF "INT:\MyPreferences"	

- The specified folder must exist and cannot be marked as hidden or system.

**MMEMory:LOAD:STATe <file>****MMEMory:STORe:STATe <file>**

*Load:* Loads an instrument state from a state file.

*Store:* Saves the current instrument state to a state file.

The file name optionally includes the folder name and the .sta file extension. If you do not include this extension, the instrument firmware will automatically append it.

Parameter	Typical return
<file> Any valid file name.	(none)
Load the instrument state from MySetup.sta saved by the previous command: MMEM:LOAD:STAT "INT:\MySetup.sta"	
Store the current instrument state to the specified state file in the root directory of the internal flash file system: MMEM:STOR:STAT "INT:\MySetup"	


**MMEMory:STATe:RECall:AUTO {OFF|ON}****MMEMory:STATe:RECall:AUTO?**

Enables (On) or disables (Off) the automatic recall of a instrument state when the instrument is turned on.

Parameter	Typical return
{OFF   ON} Default: ON	0 (OFF) or 1 (ON)

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Parameter	Typical return
Select the power-down state to be used at power-on.	
MMEM:STAT:REC:SEL "INT:\STATE_0"	
MMEM:STAT:REC:AUTO ON	
Save the current state into a file in the root directory of the internal flash file system and load it at power-on:	
MMEM:STOR:STAT "INT:\MyDAQ"	
MMEM:STAT:REC:SEL "INT:\MyDAQ"	
MMEM:STAT:REC:AUTO ON	

- **ON** - Automatically recall the power-down state file (STATE\_0 in the root folder of the internal flash file system) or a user-specified state file (**MMEMory:STATe:RECall:SElect**), which means readings are saved to internal memory and will be restored to the instrument's reading buffer after a power cycle. However, this capability is disabled when USB data logging is enabled.
- Execute this command (MMEMory:STATe:RECall:AUTO ON) before the state of the triggering system changed from "idle" to "wait-for-trigger" (**INITiate** command), so that readings memory are able to recall from internal flash file system.
- **OFF** - Readings memory are unable to recover from internal flash file system by power cycling.
- When power-on state recall is enabled and logging to USB (see **MMEMory:LOG[:ENABle]** command) is disabled, readings in the reading store are saved to internal memory and will be restored after a power cycle. 
- When both power-on state recall and logging to USB are disabled, readings are not preserved across a power cycle.
- When shipped from the factory, the instrument is configured to automatically recall the power-down state file when power is restored.

### MMEMory:STATe:RECall:SElect <file> MMEMory:STATe:RECall:SElect?

Selects which instrument state to use at power-on if the automatic recall mode is enabled (**MMEMory:STATe:RECall:AUTO ON**). If the automatic recall mode is disabled (**MMEMory:STATe:RECall:AUTO OFF**), a Factory Reset (**\*RST**) is issued at power-on.

Parameter	Typical return
<file> = Any valid file name	"INT:\MyDAQ"
Select the power-down state to be used at power-on.	
MMEM:STAT:REC:SEL "INT:\STATE_0"	
MMEM:STAT:REC:AUTO ON	
Save the current state into a file in the root directory of the internal flash file system and load it at power-on:	
MMEM:STOR:STAT "INT:\MyDAQ"	
MMEM:STAT:REC:SEL "INT:\MyDAQ"	
MMEM:STAT:REC:AUTO ON	



- The specified folder must exist and cannot be marked as hidden or system.
- The state file created by \*SAV 0, called STATE\_0.sta, resides in the root folder of the internal flash file system. It is overwritten with the power-down state of the instrument when power is cycled.
- When shipped from the factory, the instrument is configured to automatically recall the power-down state file when power is restored.
- This setting is non-volatile; it is not changed by power cycling, a Factory Reset (**\*RST**), or an Instrument Preset (**SYSTem:PRESet**).

### MMEMory:STATe:VALid? <file>

Specify storage location to determine whether a valid state is currently stored in this location. During the validation process, the instrument verifies that the location is not empty. Query returns 0 if no state has been stored in the specified location or if it has been deleted. It returns 1 if a valid state is stored in the specified location.

Parameter	Typical return
<file> = Any valid file name	0 or 1

Return the status of MyState.sta in the root folder of the internal flash file system:

```
MMEM:STAT:VAL? "INT:\MyState.sta"
```

- This command does not guarantee that no errors will be generated when a stored state is recalled using the **\*RCL** command. Even if this command determines that the specified storage location is valid, individual modules may still be in states that will generate an error.
- You can use this command before sending the **\*RCL** command to determine whether a state has been previously stored in this location
- The specified folder must exist and cannot be marked as hidden or system.
- The specified file cannot be empty or marked as hidden or system.

## 2 SCPI Programming

### OUTPut Subsystem

#### Command Summary

OUTPut:ALARm:CLEar:ALL

OUTPut:ALARm{1|2|3|4}:CLEar

OUTPut:ALARm{1|2|3|4}:SOURce

OUTPut:ALARm:MODE

OUTPut:ALARm:SLOPe

OUTPut:TRIGger:SLOPe

**OUTPut:ALARm:CLEAr:ALL****NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

Clears the state of all four alarm output lines.

Parameter	Typical return
(none)	(none)

Clears all four alarm output lines: `OUTP:ALAR:CLE:ALL`

- A Factory Reset (**\*RST** command) clears all four alarm outputs but does not clear the alarm queue in either configuration.
- You can manually clear the output lines at any time (even during a scan) and the alarm data in reading memory is not cleared. However, data is cleared when you initiate a new scan.

**OUTPut:ALARm{1|2|3|4}:CLEAr****NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

Clears the state of a specified alarm output line.

Parameter	Typical return
(none)	(none)

Clears output line on alarm 2: `OUTP:ALAR2:CLE`

- A Factory Reset (**\*RST** command) clears all four alarm outputs but does not clear the alarm queue in either configuration.
- You can manually clear the output lines at any time (even during a scan) and the alarm data in reading memory is not cleared. However, data is cleared when you initiate a new scan.

**OUTPut:ALARm[{1|2|3|4}]:SOURce (@<ch\_list>)****OUTPut:ALARm[{1|2|3|4}]:SOURce?****NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

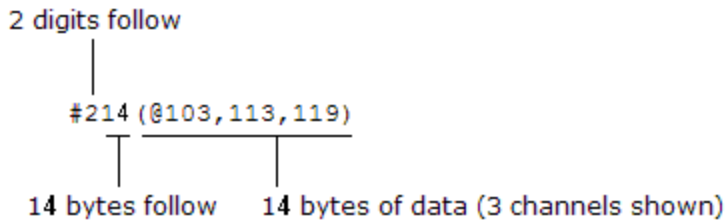
Assigns one of four alarm numbers to report any alarm conditions on the specified multiplexer or digital channels. On the digital modules, you can configure the instrument to generate an alarm when a specific bit pattern or bit pattern change is detected on a digital input channel or when a specific count is reached on a totalizer channel.

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Parameter	Typical return
(none)	#210

Assigns Alarm 2 to report any alarm conditions: `OUTP:ALAR2:SOUR`

The query returns a series of channel numbers in definite-length block format. The syntax is a pound sign (#) followed by a non-zero digit representing the number of digits in the decimal integer to follow. This digit is followed by a decimal integer indicating the number of 8-bit data bytes to follow. This is followed by a block of data containing the specified number of bytes, as below:



- An empty scan list (with no channels selected) will return "#13(@)".
- You can assign multiple channels to any of the four available alarms (numbered 1 through 4). For example, you can configure the instrument to generate an alarm on the Alarm 1 output when a limit is exceeded on any of channels 103, 205, or 310. You cannot, however, assign alarms on a specific channel to more than one alarm number.
- A Factory Reset (**\*RST** command) clears all alarm limits and turns off all alarms.

### OUTPut:ALARm:MODE {LATCH|TRACK}

### OUTPut:ALARm:MODE?

#### NOTE

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

Selects the output mode for all four alarm output lines.

**Latch Mode:** The alarm output is asserted when a channel's reading crosses a limit, and remains asserted until you clear it manually, start a new scan, or cycle power.

**Track Mode:** The alarm output is asserted when a channel's reading crosses a limit, and remains asserted only while subsequent readings remain outside the limit. When a reading returns within the limits, the output is automatically cleared.

Parameter	Typical return
{LATCH TRACK} Default: LATCH	LATC or TRAC

Enables the track mode on all four alarm output lines: `OUTP:ALAR:MODE TRAC`

- A Factory Reset (**\*RST** command) clears all four alarm outputs but does not clear the alarm queue in either configuration.

- You can manually clear the output lines at any time (even during a scan) and the alarm data in reading memory is not cleared. However, data is cleared when you initiate a new scan.

### OUTPut:ALARm:SLOPe {POSitive|NEGative}

#### OUTPut:ALARm:SLOPe?

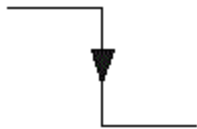
#### NOTE

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

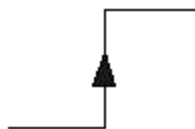
Configures the level for all four alarm output lines that indicates an alarm, either falling edge (NEG - 0 V), or rising edge (POS - 3.3 V).

#### NOTE

Changing the slope of the output lines may cause the lines to change state.



Falling Edge (NEGative)



Rising Edge (POSitive)

Parameter	Typical return
{NEGative POSitive}. Default: NEGative	NEG or POS
Selects the positive/rising edge on all four alarm output lines: <code>OUTP:ALAR:SLOP POS</code>	

- A Factory Reset (**\*RST** command) resets the slope to the negative/falling edge.

### OUTPut:TRIGger:SLOPe {POSitive|NEGative}

#### OUTPut:TRIGger:SLOPe?

Specifies the rising edge (POS) or falling edge (NEG) as the Channel Closed signal on the rear panel Ext Trig/Alarms connector. The signal operates differently during internal or external scan.

Parameter	Typical return
{POSitive   NEGative} Default: NEGative	POS or NEG
Sets trigger slope to NEGative (falling edge): <code>OUTP:TRIG:SLOP NEG</code>	

- For internal scans (**INSTrument:DMM ON** command), it is generated at the END of a sweep, not the beginning of a sweep.
- For external scans (**INSTrument:DMM OFF** command), it is generated when each channel is closed, and

## 2 SCPI Programming

can be used to trigger the measurement on the external DMM.

- A Factory Reset (**\*RST** command) resets the slope to the negative/falling edge.

## ROUTe Subsystem

### Command Summary

ROUTe:CHANnel:ADVance:SOURce

ROUTe:CHANnel:DELay

ROUTe:CHANnel:DELay:AUTO

ROUTe:CHANnel:FWIRe

ROUTe:CHANnel:LABel

ROUTe:CHANnel:LABel:CLEar:MODule

ROUTe:CLOSe

ROUTe:CLOSe:EXCLusive

ROUTe:DONE?

ROUTe:MONitor

ROUTe:MONitor:DATA?

ROUTe:MONitor:DATA:FULL?

ROUTe:MONitor:STATe

ROUTe:MONitor:VIEW

ROUTe:OPEN

ROUTe:SCAN

ROUTe:SCAN:SIZE?

**ROUTE:CHANnel:ADVance:SOURce {BUS | IMMEDIATE | EXTERNAL}****ROUTE:CHANnel:ADVance:SOURce?**

Selects the source of signal that advances to the next channel in the scan list when scanning with an external DMM (internal DMM disabled). When the channel advance signal is received, the instrument opens the currently selected channel and closes the next channel in the scan list. The instrument will accept a software command (BUS), continuous scan trigger (IMMEDIATE), or external TTL-compatible (EXTERNAL) trigger pulse.

**NOTE**

This command is valid only when the internal DMM is disabled (see **INSTrument:DMM** command).

DAQM907A channels are not allowed in the scan list when the internal DMM is disabled.

Parameter	Typical return
{BUS   IMMEDIATE   EXTERNAL}	BUS, IMM, or EXT
Default: EXTERNAL	

Configures the instrument for scanning using an external channel advance source. In this configuration, the instrument advances to the next channel in the scan list each time a low-true TTL-compatible pulse is received.

```

INST:DMM OFF !Disable internal DMM
ROUT:SCAN (@101:120) !Configure scan list
TRIG:SOUR IMM !Set trigger source
TRIG:COUN 5 !Set trigger count
ROUTE:CHAN:ADV:SOUR EXT !Set channel advance source

```

Typical response: EXT

- For the BUS (software) source, the instrument is triggered by the **\*TRG** command received over the remote interface. The **\*TRG** command will not be accepted unless the instrument is in the "wait-for-trigger" state (see **INITiate** command). If instrument receives an external trigger before the next "waiting for trigger" state, it will buffer one **\*TRG** command and then ignore any additional triggers received (no error is generated).
- For the IMMEDIATE (continuous) source, the channel advance signal is always present.
- For the EXTERNAL source, the instrument will accept a hardware trigger applied to the rear-panel Ext Trig/Alarms connector. The instrument advances to the next channel in the scan list each time a low-true TTL-compatible pulse is received.
- The channel advance signal is ignored unless you have initiated the scan (**INITiate** command) and have received a scan trigger (**TRIGger:SOURce** command). Although this command shares some of the same signals as the **TRIGger:SOURce** command, they cannot be set to the same source (except IMMEDIATE). If you attempt to select the same source, an error is generated and the **TRIGger:SOURce** is reset to IMMEDIATE.
- When the first trigger is received, the instrument closes the first channel in the scan list without waiting for the specified channel advance source. If the channel advance source is EXTERNAL and the instrument receives an event before it is ready, it will buffer one event and then ignore any additional events received (no error is generated).



- After the final channel in the scan list is closed, one more channel advance event must be received to complete the scan.

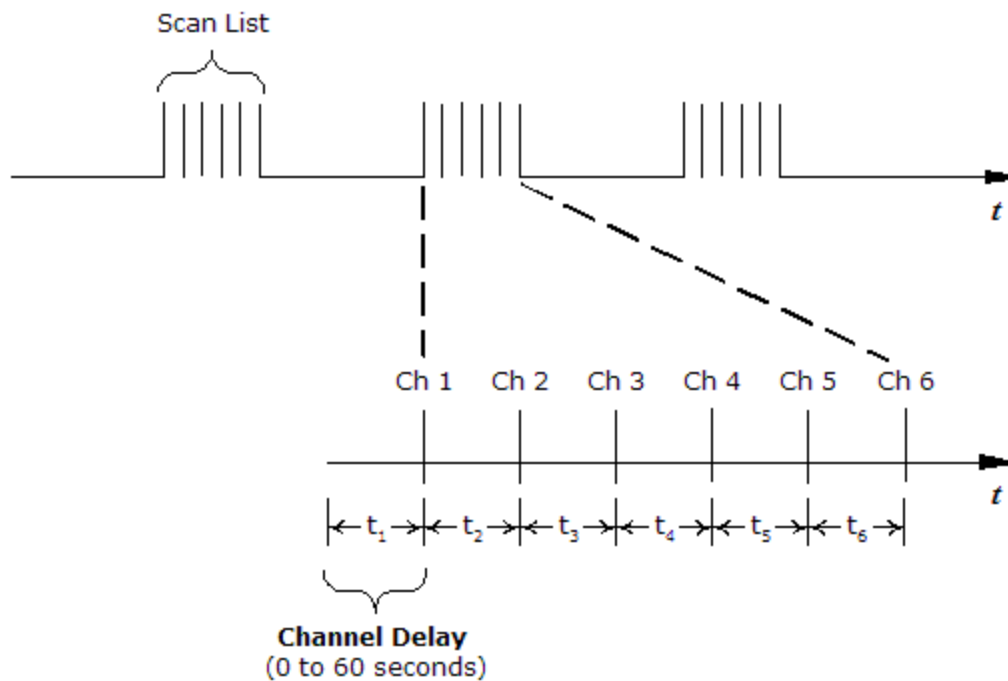
**ROUTE:CHANnel:DElay** {<seconds> | MIN | MAX} [, (@<ch\_list>)]

**ROUTE:CHANnel:DElay?** [{(@<ch\_list>) | MIN | MAX}]

Adds a delay between channels in the scan list (useful for high-impedance or high-capacitance circuits). The delay is inserted between the relay closure and the actual measurement on each channel, in addition to any delay that will implicitly occur due to relay settling time. The programmed channel delay overrides the default channel delay that the instrument automatically adds to each channel.

### NOTE

You can select a unique delay for each channel on the module, except DAQM907A multifunction module. Channel delay value is ignored for any channels on the DAQM907A multifunction module.



Parameter	Typical return
<seconds> = A number from 0 to 60, with 1 ms resolution Default: Automatic	+1.00000000E+00
Adds a 2-second channel delay to a specific channel: ROUT:CHAN:DEL 2,@103,113)	

- The instrument determines the delay based on function, range, integration time, and AC filter setting.
- The channel delay is valid only while scanning. If no channels have been assigned to the scan list (see **ROUTE:SCAN** command), the specified channel delay is ignored (no error is generated).

## 2 SCPI Programming

- To ensure you are getting the most accurate measurements possible, use care when setting the channel delay less than the default value (automatic). The default channel delay is designed to optimize parameters, such as settling time, for the most accurate measurements.
- The **CONFigure** and **MEASure?** commands set the channel delay to automatic.
- The instrument sets the channel delay to automatic after a Factory Reset (**\*RST** command).

**ROUTE:CHANnel:DElay:AUTO {OFF | ON} [, (@<ch\_list>)]**

**ROUTE:CHANnel:DElay:AUTO? [(@<ch\_list>)]**

Enables (On) or disables (Off) an automatic channel delay on the specified channels. If enabled, the instrument determines the delay based on function, range, integration time, and AC filter setting.

Parameter	Typical return
{OFF ON} Default: ON	0 (OFF) or 1 (ON)
Enables an automatic channel delay in specific channel: ROUT:CHAN:DEL:AUTO ON,(@103,113)	

- Selecting a specific channel delay using the **ROUTE:CHANnel:DElay** command disables the automatic channel delay.
- The **CONFigure** and **MEASure?** commands set the channel delay to automatic.
- The instrument sets the channel delay to automatic after a Factory Reset (**\*RST** command).

**ROUTE:CHANnel:FWIRe {OFF | ON} [, (@<ch\_list>)]**

**ROUTE:CHANnel:FWIRe? [(@<ch\_list>)]**

Configures the specified channels for 4-wire external scanning. When enabled, channel *n* is paired with channel *n+10* (DAQM900A or DAQM901A) or *n+8* (DAQM902A) to provide source and sense connections.

### NOTE

This command is valid only when the internal DMM is disabled (see **INSTrument:DMM** command).

Parameter	Typical return
{OFF ON} Default: OFF	0 (OFF) or 1 (ON)
Disable internal DMM, and enables 4-wire external scanning in specific channel.	
INST:DMM OFF ROUT:CHAN:FWIR ON,(@103,105)	

- When specifying the scan list using **ROUTE:SCAN**, only specify the lower channel number (*n*) for paired channels; the upper channel number (*n+10* or *n+8*) is not allowed in the scan list.
- The **ROUTE:CLOSE**, **ROUTE:CLOSE:EXCLUSIVE**, and **ROUTE:OPEN** commands ignore this SCPI setting (if no channels are in the scan list).

**ROUTE:CHANnel:LABel "<label>", (@<ch\_list>)**  
**ROUTE:CHANnel:LABel? [{USER | FACTory},] (@<ch\_list>)**

Assigns a user-defined label to the specified channels.

**NOTE**

User-defined channel labels are available for identification purposes only and cannot be used in place of a channel number within a command string.

Parameter	Typical return
<label> = Quoted string of up to 30 characters. You can use letters (A-Z), numbers (0-9), and special characters (@, %, etc). Use the "#" character to display a degree symbol ( ° ).  Note: Both single quote and double quotes of <label> are acceptable.	(none)
{USER   FACTory} USER: Read the user-defined label on the specified channel. FACTory: Read the factory-default label on the specified channel.  Default: USER	
Assigns a label "TEST" to channels 103 and 105: ROUT:CHAN:LAB "TEST", (@103,105) <b>OR</b> ROUT:CHAN:LAB 'TEST', (@103,105)	
Clears the user-defined label previously assigned to channel 103: ROUT:CHAN:LAB "", (@103)	
Query returns the factory-default labels for channels 103 and 105: ROUT:CHAN:LAB? FACT, (@103,105)	

- When shipped from the factory, each channel is assigned a unique factory-default label (cannot be overwritten). From the front panel, the factory-default labels are shown on the upper line of the display (for example, "Armature relay MUX Channel", "Reed relay MUX Switch", "DAC Output Sense Channel", "Current Channel MUX Switch", and so forth).
- If desired, you can assign the same user-defined label to multiple channels within the same module or on different modules (i.e., channel labels are not required to be unique).
- If you specify a label with more than the allowed 30 characters, it will be truncated (no error is generated).
- Use the **ROUTE:CHANnel:LABel:CLEar:MODule** command to clear all user-defined labels on all channels in a specified slot, or on all modules installed in the DAQ970A, and restores the factory-default labels.

## 2 SCPI Programming

- The instrument keeps a record of what module types are installed in each slot. If a different module type is detected in a specific slot at power on, all user-defined channel labels for that slot are discarded. If an empty slot is detected at power-on, any previously-defined labels for that slot are preserved and will be restored if the same module type is installed later; however, if a module of a different type is installed in that slot, the previously-defined labels will be discarded.
- All user-defined channel labels are stored in non-volatile memory, and do not change when power has been off, after a Factory Reset (**\*RST** command), after an Instrument Preset (**SYSTem:PRESet** command), or after a stored state is recalled (**\*RCL** command).

### **ROUTe:CHANnel:LABel:CLEAr:MODule {<slot>|ALL}**

Clears all user-defined labels on all channels in the specified slot, or on all modules installed in the DAQ970A, and restores the factory-default labels.

#### **NOTE**

User-defined channel labels are available for identification purposes only and cannot be used in place of a channel number within a command string.

Parameter	Typical return
<slot> = {1 2 3}	(none)
ALL = All 3 slots	

---

Clears all user-defined channel labels on the module in slot 1:  
ROUT:CHAN:LAB:CLEAR:MOD 1

---

Clear all user-defined channel labels on all modules installed in the DAQ970A:  
ROUT:CHAN:LAB:CLEAR:MOD ALL

---

- This command does not clear the factory-default channel labels. The factory-default labels are always preserved.
- To clear user-defined labels on an individual channel or range of channels (and reassign the factory-default labels), specify a null string for the <label> parameter in the **ROUTe:CHANnel:LABel** command.
- The instrument keeps a record of what module types are installed in each slot. If a different module type is detected in a specific slot at power on, all user-defined channel labels for that slot are discarded. If an empty slot is detected at power-on, any previously-defined labels for that slot are preserved and will be restored if the same module type is installed later; however, if a module of a different type is installed in that slot, the previously-defined labels will be discarded.
- All user-defined channel labels are stored in non-volatile memory, and do not change when power has been off, after a Factory Reset (**\*RST** command), after an Instrument Preset (**SYSTem:PRESet** command), or after a stored state is recalled (**\*RCL** command).

**ROUTE:CLOSE (@<ch\_list>)****ROUTE:CLOSE? (@<ch\_list>)**

Closes the specified channels on a multiplexer or switch module. On the multiplexer modules, if any channel on the module is defined to be part of the scan list, attempting to send this command will result in an error.

Parameter	Typical return
(none)	1 (Closed) or 0 (Open)
Closes specific channels on the module: ROUT:CLOS (@103,113)	

- For the matrix module (DAQM904A), the channel number represents the intersection of the desired row and column. For example, channel 234 represents the intersection of row 3 and column 4 on the module in slot 2 (assumes two-wire mode). For more information, see the simplified schematic in [DAQM904A Module Summary](#).
- The DAQM905A module will not respond to the **ROUTE:OPEN** command (an error is generated). To "open" a channel on these modules, send the ROUTE:CLOSE command to a different channel in the same bank.
- As part of the scan setup, the **ROUTE:SCAN** command examines the scan list and determines which channel relays and Analog Bus relays will be impacted by the scan. The following rules will apply once the scan is initiated and will impact what relays can be manually opened and closed.
  - a. When the scan is initiated, the instrument will open all channels in modules that contain one or more channels in the scan list.
  - b. While the scan is running, the instrument prohibits use of all channels in modules that contain one or more channels in the specified <ch\_list> (these channels are dedicated to the scan).

**ROUTE:CLOSE:EXCLUSIVE (@<ch\_list>)**

Opens all channels on a multiplexer or switch module and then closes the specified channels. On the multiplexer modules, if any channel on the module is defined to be part of the scan list, attempting to send this command will result in an error.

Parameter	Typical return
(none)	1 (Open) or 0 (Closed)
Opens all channels and closes specific channels on the module: ROUT:CLOS:EXCL (@303)	

- For the matrix module (DAQM904A), the channel number represents the intersection of the desired row and column. For example, channel 234 represents the intersection of row 3 and column 4 on the module in slot 2 (assumes two-wire mode). For more information, see the simplified schematic in [DAQM904A Module Summary](#).
- This command opens all channels first, and then closes the channels in the <ch\_list>, one at a time. Before it closes each channel, it opens all previous channels.

## 2 SCPI Programming

- The RF multiplexer module (DAQM905A) will not respond to the **ROUTE:OPEN** command (an error is generated). To "open" a channel on these modules, send the ROUTe:CLOSe:EXCLusive command to a different channel in the same bank.

**ROUTe:DONE?**

Returns the status of all relay operations on modules that not involved in the scan and returns a 1 when finished (even during a scan).

Parameter	Typical return
(none)	1 (Finished) or 0 (Unfinished)
Query returns a 1 when all relay operations are finished: ROUT:DONE?	

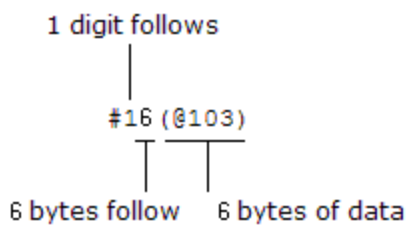
**ROUTe:MONitor (@<channel>)****ROUTe:MONitor?**

Selects the channel to be displayed on the front panel. Only one channel can be monitored at a time.

Parameter	Typical return
<channel> = A single channel	#16(@103)
Configures channel 103 for DC voltage measurements, enables monitoring on the channel, and turns on the Monitor mode.	
CONF:VOLT:DC (@103)	
ROUT:MON (@103)	
ROUT:MON:STAT ON	

The query returns the Monitor channel in Definite-Length Block format. The syntax is a pound sign (#) followed by a non-zero digit representing the number of characters to follow. This digit is followed by a decimal integer indicating the number of data bytes to follow. This is followed by a block of data containing the specified number of bytes. The query always returns the channel currently displayed on the front panel.

For example:



- Channels must be configured for a measurement in order to be monitored (see **CONFigure** and **SENSe** commands). Configuring a channel for a measurement makes it monitorable and makes it part of the scan list.
- A scan always has priority over the Monitor function (see **ROUTe:SCAN** command).
- Any channel that can be "read" by the instrument can be monitored. This includes any combination of temperature, voltage, resistance, current, frequency, or period measurements on multiplexer channels. You can also monitor any channel on the digital modules.

## 2 SCPI Programming

- Monitoring of computed channel is only available during scanning and will only display the reading from the most recent sweep.
- Measurement scaling and alarm limits are applied to the selected channel during a Monitor and all alarm data is stored in the alarm queue (which will be cleared if power fails).
- For 4-wire resistance measurements, the instrument automatically pairs channel  $n$  in Bank 1 with channel  $n+10$  (DAQM900A or DAQM901A) or  $n+8$  (DAQM902A) to provide the source and sense connections.
- The count on a totalizer channel is not reset when it is being monitored (the Monitor ignores the totalizer reset mode).

### ROUTe:MONitor:DATA?

Reads the monitor data from the selected channel. It returns the reading only; the units, time, channel, and alarm information are not returned (the **FORMat:READIng** commands do not apply to monitor readings). If no data is available for the specified channel, instrument returns 9.91 E37 (not a number).

Parameter	Typical return
(none)	+8.71549423E-05

---

Query returns reading from the monitor channel: ROUT:MON:DATA?

- If the Monitor mode is not currently enabled, this query returns 9.91 E37 (not a number).
- Readings acquired during a Monitor are not stored in reading memory but they are displayed on the front panel; however, all readings from a scan in progress at the same time are stored in reading memory.

### ROUTe:MONitor:DATA:FULL?

Reads the monitor data from the selected channel. It returns all the reading with the units, time, channel, and alarm information (all the **FORMat:READIng** enabled commands apply to this monitor readings). If no data is available for the specified channel, the instrument returns 9.91 E37 (not a number).

Parameter	Typical return
(none)	(none)

---

Query returns full reading from the monitor channel: ROUT:MON:DATA:FULL?

- If the Monitor mode is not currently enabled, this query returns 9.91 E37 (not a number).
- Readings acquired during a Monitor are not stored in reading memory but they are displayed on the front panel; however, all readings from a scan in progress at the same time are stored in reading memory.

### ROUTe:MONitor:STATe {OFF | ON} ROUTe:MONitor:STATe?



Enables (On) or disables (Off) the Monitor mode. The Monitor mode is equivalent to making continuous measurements on a single channel with an infinite scan count. Only one channel can be monitored at a time but you can change the channel being monitored at any time. This feature is useful for troubleshooting your system before a test or for observing an important signal.

Parameter	Typical return
{OFF ON} Default: OFF	0 (OFF) or 1 (ON)
Configures specified channel for DC voltage measurements, enables monitoring on the channel, and turns on the Monitor mode.	
CONF:VOLT:DC ROUT:MON ROUT:MON:STAT ON	

- Channels must be configured for a measurement in order to be monitored (see **CONFigure** and **SENSe** commands). Configuring a channel for a measurement makes it monitorable and makes it part of the scan list.
- The Monitor mode is automatically enabled on all channels that are part of the active scan list (see **ROUTe:SCAN** command).
- A scan always has priority over the Monitor function (see **ROUTe:SCAN** command).
- The Monitor mode ignores all trigger settings (see **TRIGger:SOURce** command) and takes continuous readings on the selected channel using the IMMEDIATE (continuous) source.
- Any channel that can be "read" by the instrument can be monitored. You can also monitor a digital input channel or the totalizer count on the digital modules.
- Measurement scaling and alarm limits are applied to the selected channel during a Monitor and all alarm data is stored in the alarm queue (which will be cleared if power fails).
- The count on a totalizer channel is not reset when it is being monitored (the Monitor ignores the totalizer reset mode).
- Readings acquired during a Monitor are not stored in reading memory but they are displayed on the front panel; however, all readings from a scan in progress at the same time are stored in reading memory.

### **ROUTe:MONitor:VIEW {NUMeric | TCHart | HISTogram | METer}** **ROUTe:MONitor:VIEW?**

Selects how measurement data is displayed (numeric, trend chart, histogram, and bar meter format) in monitoring mode.

Parameter	Typical return
{NUMeric   TCHart   HISTogram   METer} Default: NUMeric	NUM, TCH, HIST, or MET
Selects to view measurement data in histogram format: ROUT:MON:VIEW HIST	

## 2 SCPI Programming

- The front-panel display is automatically enabled when power is cycled, or after a Factory Reset (**\*RST** command).

### **ROUTe:OPEN (@<ch\_list>)**

### **ROUTe:OPEN? (@<ch\_list>)**

Opens the specified channels on a multiplexer or switch module. On the multiplexer modules, if any channel on the module is defined to be part of the scan list, attempting to send this command will result in an error.

Parameter	Typical return
(none)	1 (Open) or 0 (Closed)
Opens specific channels on the module: ROUT:OPEN (@103,113)	

- For the matrix module (DAQM904A), the channel number represents the intersection of the desired row and column. For example, channel 234 represents the intersection of row 3 and column 4 on the module in slot 2 (assumes two-wire mode). For more information, see the simplified schematic in [DAQM904A Module Summary](#).
- The DAQM905A module will not respond to the ROUTe:OPEN command (an error is generated). To "open" a channel on these modules, send the **ROUTe:CLOSe** command to a different channel in the same bank.
- As part of the scan setup, the **ROUTe:SCAN** command examines the scan list and determines which channel relays and Analog Bus relays will be impacted by the scan. The following rules will apply once the scan is initiated and will impact what relays can be manually opened and closed.
  - a. When the scan is initiated, the instrument will open all channels in modules that contain one or more channels in the scan list.
  - b. While the scan is running, the instrument prohibits use of all channels in modules that contain one or more channels in the specified <ch\_list> (these channels are dedicated to the scan).

**ROUTE:SCAN (@<scan\_list>)****ROUTE:SCAN?**

Selects the channels to be included in the scan list. This command is used in conjunction with the **CONFigure** commands to set up an automated scan. The specified channels supersede any channels previously defined to be part of the scan list. To start the scan, use the **INITiate** or **READ?** command.

Parameter	Typical return
(none)	(none)

Use **CONFigure** command to configure two channels for DC voltage measurements. The **ROUTE:SCAN** command puts the two channels into the scan list (and redefines the scan list). The **INITiate** command places the instrument in the "wait-for-trigger" state and then sends the readings to reading memory. The **FETCh?** command transfers the readings from reading memory to the instrument's output buffer.

```
CONF:VOLT:DC 10,0.003,(@103,108)
```

```
ROUT:SCAN (@103,108)
```

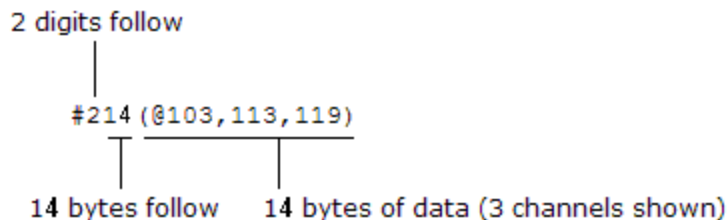
```
INIT
```

```
FETC?
```

Typical response: +4.27150000E-03,+1.32130000E-03

The query returns a list of channel numbers in definite-length block format. The syntax is a pound sign (#) followed by a non-zero digit representing the number of characters to follow. This digit is followed by a decimal integer indicating the number of data bytes to follow. This is followed by a block of data containing the specified number of bytes. An empty scan list (one with no channels selected) will be indicated by "#13(@)".

For example:



- To remove all channels from the present scan list, issue the command **ROUT:SCAN (@)**.
- The instrument scans the list of channels in ascending order from slot 1 through slot 3 (channels are re-ordered as needed). When you specify a range of channels in the *<ch\_list>*, the channels are always sorted in ascending order. Therefore, **(@109:101)** will always be interpreted as 101, 102, 103, ..., 109.
- You can use either the internal DMM or an external instrument to make measurements of your configured channels. However, the DAQ970A allows only one scan list at a time; you cannot scan some channels using the internal DMM and others using an external instrument. Readings are stored in DAQ970A reading memory only when the internal DMM is used.

## 2 SCPI Programming

- You can store at least 100,000 readings in reading memory and all readings are automatically time stamped. If memory overflows, the new readings will overwrite the first (oldest) readings stored; the most recent readings are always preserved. You can read the contents of memory at any time, even during a scan. Reading memory is not cleared when you read it.
- Each time you start a new scan, the instrument clears all readings (including alarm data) stored in reading memory from the previous measurement. Therefore, the contents of memory are always from the most recent scan.
- If you abort a scan that is running (**ABORT** command), the instrument will terminate any reading in progress (readings are not cleared from memory). If a scan is in progress when the command is received, the scan will not be completed and you cannot resume the scan from where it left off. Note that if you initiate a new scan, all readings are cleared from memory.
- The **CONFigure** and **MEASure?** commands overwrite the scan list.
- The present scan list is stored in non-volatile memory and will be retained when power is turned off.

### **ROUTe:SCAN:SIZE?**

Returns the number of channels in the scan list as defined by the **ROUTe:SCAN** command.

Parameter	Typical return
(none)	Number of channels as a signed integer from 0 to maximum number of scanned channels (up to 120 channels)

Returns the number of channels in the scan list:

ROUT:SCAN (@101:120)  
ROUT:SCAN:SIZE?

Typical response: +20

- The present scan list is stored in non-volatile memory and will be retained when power is turned off.

## SENSe Subsystem

The SENSe subsystem configures measurements. The most basic SENSe command is **[SENSe:]FUNcTion[:ON]**, which selects the measurement function. All other SENSe commands are associated with specific measurement types as following:

**[SENSe:]DIGital**

**[SENSe:]CAPacitance Subsystem**

**[SENSe:]CURRent Subsystem**

**[SENSe:]{FREQuency|PERiod} Subsystem**

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

**[SENSe:]STRain Subsystem**

**[SENSe:]TEMPerature Subsystem**

**[SENSe:]VOLTage Subsystem**

**[SENSe:]TOTalize Subsystem**

**[SENSe:]FUNcTion[:ON] "<function>" [, (@<ch\_list>)]**

**[SENSe:]FUNcTion[:ON]? [(@<ch\_list>)]**

### NOTE

Only supported for all the measurement functions on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

---

Selects the measurement function on the selected channels (all function-related measurement attributes are retained).

## 2 SCPI Programming

Parameter	Typical return
CAPacitance CURRent:AC CURRent[:DC]	The short form of the selected function is returned in quotation marks, with no optional keywords:
DIODE FREQuency PERiod FRESistance RESistance STRain:DIRect STRain:FDIRect STRain:QUARter STRain:HALF:BENDIng STRain:HALF:POISson STRain:FULL:BENDIng STRain:FULL:BENDIng:POISson STRain:FULL:POISson TEMPerature[:TC] TEMPerature:FRTD TEMPerature:RTD TEMPerature:FTHERmistor TEMPerature:THERmistor VOLTage:AC VOLTage[:DC]	"CAP", "CURR:AC", "DIOD", "TEMP", and so on.
Default: VOLTage[:DC]	
Selects the AC voltage function: FUNC "VOLT:AC"	

- The function name must be enclosed in quotes in the command string.
- If you change the measurement function, all measurement attributes of the previous function (range, resolution, etc) are returned to the default values. If you return to the original function, those attributes are restored.
- Changing the measurement function disables scaling and limit testing (**CALC:SCAL:STAT** and **CALC:LIM:STAT** set to OFF).
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

**[SENSe:]DIGital:DATA[:BYTE]? (@<ch\_list>)**

**[SENSe:]DIGital:DATA:WORD? (@<ch\_list>)**

### NOTE

Only supported on DAQM907A multifunction modules (channel 01 and 02).

Configures the specified channels as inputs and reads an 8-bit byte or a 16-bit word digital pattern from the specified digital input channels.

Parameter	Typical return
(none)	(none)
Reads the value on digital channel: DIG:DATA:WORD?	

- To read both ports simultaneously (WORD), you must send the command to channel 01 (LSB).
- The output from this command is affected by the **FORMat:READing** commands.

**[SENSe:]CAPacitance Subsystem**

This subsystem configures capacitance measurements.

**NOTE**

Only supported on DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

**Command Summary**

[SENSe:]CAPacitance:RANGe:AUTO

[SENSe:]CAPacitance:RANGe

[SENSe:]CAPacitance:RANGe:AUTO {OFF | ON} [, (@<ch\_list>)]

[SENSe:]CAPacitance:RANGe:AUTO? [(@<ch\_list>)]

Enables or disables autoranging for capacitance measurements.

Parameter	Typical return
{OFF   ON}. Default: ON	0 (OFF) or 1 (ON)

Configure capacitance measurements, and turn autorange on:

```
CONF:CAP
CAP:RANG:AUTO ON
```

- Autorange thresholds:
  - Down range at: <10% of range
  - Up range at: >120% of range
- For capacitance measurements only, when autorange is off, the instrument does not report an overload for readings greater than 120%. Overload only occurs when the algorithm times out because the applied capacitance is too large for the algorithm to measure. If you apply a DC voltage or a short to the input terminals in capacitance measurement mode, the instrument reports an overload.
- Select a fixed range (see [Sense:]CAPacitance:RANGe command) disables autoranging.
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSe:]CAPacitance:RANGe {<range> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]CAPacitance:RANGe? [(@<ch\_list>) | MIN | MAX | DEF]

Selects a fixed range for capacitance measurements.

Parameter	Typical return
<range>: {1 nF 10 nF 100 nF 1 μF 10 μF 100 μF}. Default: AUTO.	+1.00000000E-09

Configure capacitance measurements, and select 1nF range:

```
CONF:CAP
CAP:RANG 1 nF
```



- Selecting a fixed range ([SENSe:]<function>:RANGe) disables autoranging.
- If the input signal is greater than can be measured on the specified fixed range, the instrument displays *Overload* on front panel and returns "9.9E37" from the remote interface.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

**[SENSe:]CURRent Subsystem**

This subsystem configures AC and DC current measurements.

**NOTE**

Only supported on DAQM901A multiplexer module (channel 21 and 22 only).

**Command Summary**

[SENSe:]CURRent:AC:BANDwidth

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

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

[SENSe:]CURRent[:DC]:APERTure

[SENSe:]CURRent[:DC]:APERTure:ENABLE

[SENSe:]CURRent[:DC]:NPLCycles

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

[SENSe:]CURRent:AC:BANDwidth {<freq> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]CURRent:AC:BANDwidth? [(@<ch\_list>) | MIN | MAX | DEF]

Sets the bandwidth for AC current measurements.

The instrument uses three different AC filters that enable you to either optimize low frequency accuracy or achieve faster AC settling times following a change in input signal amplitude.

Parameter	Typical return
{3 Hz 20 Hz 200 Hz}. Default: 20 Hz.	+2.00000000E+01

Configure an AC current measurement. Use the 3 Hz filter bandwidth:

CONF:CURR:AC 1

CURR:AC:BAND 3

- For the <freq> parameter, specify the lowest frequency that you expect to encounter. Lower bandwidths result in longer settling delays, as shown:

Input frequency	Default settling delay
3 Hz - 300 kHz (Slow)	1.66 s/measurement
20 Hz - 300 kHz (Medium)	0.25 s/measurement
200 Hz - 300 kHz (Fast)	0.025 s/measurement

- This parameter is set to its default value after a Factory Reset (**\*RST** command).
- The settling delay is controlled by **ROUTe:CHANnel:DELay** command. You can get the default delay with **ROUTe:CHANnel:DELay:AUTO ON** command.

[SENSE:]CURRENT:{AC|DC}:RANGE:AUTO {OFF | ON} [, (@<ch\_list>)]

[SENSe:]CURRENT:{AC|DC}:RANGE:AUTO? [(@<ch\_list>)]

Enables or disables autoranging for AC and DC current measurements. Autoranging is convenient because the instrument automatically selects the range for each measurement based on the input signal detected.

**NOTE**

Parameters are independent for AC and DC measurements. It will not be shared between AC and DC measurements.

Parameter	Typical return
{OFF   ON}. Default: ON	0 (OFF) or 1 (ON)

Configure AC current measurements, and turn autorange on:

```
CONF:CURR:AC
CURR:AC:RANG:AUTO ON
```

- Autorange thresholds:
  - Down range at: <10% of range
  - Up range at: >120% of range.
- Selecting a fixed range (see [SENSE:]CURRENT:{AC|DC}:RANGE command) disables autoranging.
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSE:]CURRENT:{AC|DC}:RANGE {<range> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]CURRENT:{AC|DC}:RANGE? [(@<ch\_list>) | MIN | MAX | DEF]

Selects a fixed range for AC and DC current measurements.

Parameter	Typical return
<range>:	+1.00000000E-01
AC current: {100 $\mu$ A   1 mA   10 mA   100 mA   1 A}	
DC current: {1 $\mu$ A   10 $\mu$ A   100 $\mu$ A   1 mA   10 mA   100 mA   1 A}	
Default: AUTO	

Configure AC current measurements using the 1 A range:

```
CONF:CURR:AC
CURR:AC:RANG 1
```

- Selecting a fixed range ([SENSE:]<function>:RANGE) disables autoranging.
- If the input signal is greater than can be measured on the specified fixed range, the instrument displays *Overload* on front panel and returns "9.9E37" from the remote interface.
- Changing the value of this parameter always changes the measurement resolution. The number of PLCs (NPLC) stays fixed, and this results in a change of resolution in terms of the units of the measurement. For example, if you have a measurement with 1  $\mu$ A resolution on the 100 mA range, changing to the 1 A range results in a resolution of 10  $\mu$ A.
- This parameter is set to its default value after a Factory Reset (\*RST command).

## 2 SCPI Programming

[SENSe:]CURRent[:DC]:APERture {<seconds> | MIN | MAX | DEF} [, (@<ch\_list>)]  
[SENSe:]CURRent[:DC]:APERture? [(@<ch\_list>) | MIN | MAX | DEF]

Enables the aperture mode and sets the integration time in seconds (called *aperture time*) for DC current measurements.

Parameter	Typical return
200 $\mu$ s to 1 s (2 $\mu$ s resolution). Default: 100 ms	+1.00000000E-01

Enable aperture time mode, set the aperture time to 300 ms:

```
CURR:APER:ENAB ON  
CURR:DC:APER 300E-03
```

- You can specify MIN (smallest value accepted) or MAX (largest value accepted) instead of <seconds>.
- Only the integral number of power line cycles (1, 2, 10, 20, 100, or 200 PLCs) provide normal mode (line frequency noise) rejection.
- The **CONFigure:CURRent[:DC]**, **MEASure:CURRent[:DC]**, **[SENSe:]CURRent[:DC]:NPLCycles**, **[SENSe:]CURRent[:DC]:RESolution** commands automatically disable the aperture time mode, and select an integration time in number of power line cycles.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

[SENSe:]CURRent[:DC]:APERture:ENABLE {OFF | ON} [, (@<ch\_list>)]  
[SENSe:]CURRent[:DC]:APERture:ENABLE? [(@<ch\_list>)]

Enables the setting of integration time in seconds (called aperture time) for DC current measurements. If aperture time mode is disabled (default), the integration time is set in PLC (power-line cycles).

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)

Enable aperture time mode, set the aperture time to 300 ms:

```
CURR:APER:ENAB ON  
CURR:DC:APER 300E-03
```

- The **CONFigure:CURRent[:DC]**, **MEASure:CURRent[:DC]**, **[SENSe:]CURRent[:DC]:NPLCycles**, **[SENSe:]CURRent[:DC]:RESolution** commands automatically disable the aperture time mode, and select an integration time in number of power line cycles.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

[SENSe:]CURRent[:DC]:NPLCycles {<PLCs> | MIN | MAX | DEF} [, (@<ch\_list>)]  
[SENSe:]CURRent[:DC]:NPLCycles? [(@<ch\_list>) | MIN | MAX | DEF]

Sets the integration time in number of power line cycles (PLCs) for DC current measurements. Integration time is the period that the instrument's analog-to-digital (A/D) converter samples the input signal for a measurement. A longer integration time gives better measurement resolution but slower measurement speed.

Parameter	Typical return
<PLC> = { 0.02   0.06   0.2   1   2   10   20   100   200 }	+1.00000000E+00
Default: 10	

Configure DC current measurements using a 10 PLC integration time. Then make and read one measurement:

```
CONF:CURREN:DC
CURREN:DC:NPLC 10
READ?
```

Typical Response: +6.27530000E-01

- Only the integral number of power line cycles (1, 2, 10, 20, 100, or 200 PLCs) provide normal mode (line frequency noise) rejection.
- Setting the resolution also sets the integration time for the measurement. The following table shows the relationship between integration time, and measurement resolution.

Integration time	Resolution
0.02 PLC	0.000003 x Range
0.06 PLC	0.0000015 x Range
0.2 PLC	0.0000007 x Range
1 PLC	0.0000003 x Range
2 PLC	0.00000022 x Range
10 PLC	0.0000001 x Range
20 PLC	0.00000008 x Range
100 PLC	0.00000003 x Range
200 PLC	0.000000022 x Range

- The specified integration time is used for all measurements on the selected channels. If you have applied mX+b scaling or have assigned alarms to the selected channel, those measurements are also made using the specified integration time. Measurements taken during the Monitor function also use the specified integration time.
- You can also set the integration time by specifying an *aperture time* (see **[SENSe:]CURRENt[:DC]:APERTure** command). However, note that specifying integration time using NPLCs executes faster and offers better noise rejection characteristics for values of NPLC greater than 1.
- The **CONFigure**, **MEASure?**, **[SENSe:]CURRENt[:DC]:NPLC**, **[SENSe:]CURRENt[:DC]:RESolution** commands automatically disable the aperture mode (these commands select an integration time in NPLCs).
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

## 2 SCPI Programming

[SENSe:]CURRent[:DC]:ZERO:AUTO {OFF | ON} [, (@<ch\_list>)]

[SENSe:]CURRent[:DC]:ZERO:AUTO? [(@<ch\_list>)]

Enables or disables the autozero mode for DC current measurements.

Parameter	Typical return
{OFF   ON}. Default: ON	0 (OFF) or 1 (ON)

Configure DC current measurements and perform autozero:

```
CONF:CURR:DC 1  
CURR:DC:ZERO:AUTO ON
```

- **ON (Default):** Internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset readings present on the instrument's input circuitry from affecting measurement accuracy.
- **OFF:** The instrument uses the last measured zero measurement and subtracts it from each measurement. It takes a new zero measurement each time you change the function, range or integration time.
- The autozero mode is set indirectly when you set the resolution and integration time with CONFigure and MEASure? commands. Autozero is automatically turned OFF when you select an integration time less than 1 PLC with these commands.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

## [SENSe:]{FREQuency|PERiod} Subsystem

This subsystem configures frequency and period measurements.

### NOTE

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

### Command Summary

[SENSe:]{FREQuency|PERiod}:APERture

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

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

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

[SENSe:]{FREQuency|PERiod}:APERture {<seconds> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]{FREQuency|PERiod}:APERture? [(@<ch\_list>) | MIN | MAX | DEF]

Sets the aperture time (gate time) for frequency and period measurements.

### NOTE

Parameter is shared between frequency and period measurements. Setting or querying the parameter with the FREQuency version of this command is identical to setting or querying it with the PERiod version.

Parameter	Typical return
{1 ms 10 ms 100 ms 1 s}. Default: 100 ms	+1.00000000E-01

Configure frequency measurements using a 1 s aperture, make a measurement:

```
CONF:FREQ
FREQ:APER 1
```

- You can specify MIN (smallest value accepted) or MAX (largest value accepted) instead of <seconds>.

Resolution	Aperture
100 ppm × <range> (MAXimum)	1 ms
10 ppm × <range>	10 ms
1 ppm × <range> (DEFault)	100 ms
0.1 ppm × <range> (MINimum)	1 s

- Aperture for frequency and period measurements does not autorange.
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSe:]{FREQuency|PERiod}:RANGe:LOWer {<freq> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]{FREQuency|PERiod}:RANGe:LOWer? [(@<ch\_list>) | MIN | MAX | DEF]

## 2 SCPI Programming

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

### NOTE

Parameter is shared between frequency and period measurements. Setting or querying the parameter with the FREQUENCY version of this command is identical to setting or querying it with the PERIOD version.

The instrument uses three different AC filters that enable you to either optimize low frequency accuracy or achieve faster AC settling times following a change in input signal amplitude.

Parameter	Typical return
{3 Hz 20 Hz 200 Hz}. Default: 20 Hz.	+6.27530000E+03

Configure a frequency measurement. Use the 3 Hz filter bandwidth:

```
CONF:FREQ  
FREQ:RANG:LOW 3
```

- For the *<freq>* parameter, specify the lowest frequency that you expect to encounter. Lower bandwidths result in longer settling delays, as shown:

Input frequency	Default settling delay
3 Hz - 300 kHz (Slow)	1.66 s/measurement
20 Hz - 300 kHz (Medium)	0.25 s/measurement
200 Hz - 300 kHz (Fast)	0.025 s/measurement

- The settling delay is controlled by **ROUTe:CHANnel:DELay** command. You can get the default delay with **ROUTe:CHANnel:DELay:AUTO ON** command.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

```
[SENSe:]{FREQUency|PERiod}:VOLTage:RANGe {<range> | MIN | MAX | DEF} [, (@<ch_list>)]  
[SENSe:]{FREQUency|PERiod}:VOLTage:RANGe? [(@<ch_list>) | MIN | MAX | DEF]
```

Selects a fixed *voltage* range for frequency and period measurements.

### NOTE

Parameter is shared between frequency and period measurements. Setting or querying the parameter with the FREQUENCY version of this command is identical to setting or querying it with the PERIOD version.

Parameter	Typical return
<range>: {100 mV 1 V 10 V 100 V 300 V}. Default: 10 V	+1.04530000E+03

Configure frequency measurements, and select 10 VAC range.

```
CONF:FREQ  
FREQ:VOLT:RANG 10
```



- The input signal for frequency or period measurements has an *AC voltage* component. Use this command to select a fixed voltage range for frequency and period measurements. Use **[SENSe:] {FREQuency|PERiod}:VOLTage:RANGe:AUTO** to disable or enable voltage autoranging or use **CONFigure:{ FREQuency|PERiod}** to select voltage autoranging by default.
- Selecting a fixed range ([SENSe:]<function>:RANGe) disables autoranging.
- If the input signal is greater than can be measured on the specified fixed range, the instrument displays *Overload* on front panel and returns "9.9E37" from the remote interface. Autoranging can be enabled for the input voltage.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

**[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe:AUTO {OFF | ON} [, (@<ch\_list>)]**  
**[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe:AUTO? [(@<ch\_list>)]**

Enables or disables *voltage* autoranging for frequency and period measurements. Autoranging is convenient because the instrument automatically selects the range for each measurement based on the input signal detected.

**NOTE**

Parameter is shared between frequency and period measurements. Setting or querying the parameter with the **FREQuency** version of this command is identical to setting or querying it with the **PERiod** version.

Parameter	Typical return
{OFF   ON}. Default: ON	0 (OFF) or 1 (ON)

Configure frequency measurements, and turn autorange on.

```
CONF:FREQ
FREQ:VOLT:RANG:AUTO ON
```

- Autorange thresholds:
  - Down range at: <10% of range
  - Up range at: >120% of range.
- The input signal for frequency or period measurements has an *AC voltage* component. Use this command to select a fixed voltage range for frequency and period measurements. Use **[SENSe:] {FREQuency|PERiod}:VOLTage:RANGe:AUTO** to disable or enable voltage autoranging or use **CONFigure:{ FREQuency|PERiod}** to select voltage autoranging by default.
- Selecting a fixed range (see **[SENSe:]CURRENT:{AC|DC}:RANGe** command) disables autoranging.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

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

This subsystem configures 2-wire resistance (RESistance) and 4-wire resistance (FRESistance) measurements.

**NOTE**

RESistance measurements only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

FRESistance measurements only supported on DAQM900A, DAQM901A, and DAQM902A multiplexer modules.

**Command Summary**

[SENSe:]{RESistance|FRESistance}:APERture

[SENSe:]{RESistance|FRESistance}:APERture:ENABLE

[SENSe:]{RESistance|FRESistance}:NPLCycles

[SENSe:]{RESistance|FRESistance}:OCOMpensated

[SENSe:]{RESistance|FRESistance}:POWER:LIMit[::STATe]

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

[SENSe:]{RESistance|FRESistance}:RANGe

[SENSe:]RESistance:ZERO:AUTO

[SENSe:]{RESistance|FRESistance}:APERture {<seconds> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]{RESistance|FRESistance}:APERture? [{"(@<ch\_list>) | MIN | MAX | DEF}]

Enables the aperture mode and sets the integration time in seconds (called *aperture time*) for 2-wire and 4-wire resistance measurements.

**NOTE**

Used this command for precise control for the DMM's integration time. Use NPLC for better power-line noise rejection characteristics (NPLC >1) (see [SENSe:]{RESistance|FRESistance}:NPLC command).

Parameter is shared between RESistance and FRESistance measurements. Setting or querying the parameter with the RESistance version of this command is identical to setting or querying it with the FRESistance version.

Parameter	Typical return
200 $\mu$ s to 1 s (2 $\mu$ s resolution). Default: 100 ms	+1.00000000E- 01

Parameter	Typical return
Enable aperture time mode, set the aperture time to 300 ms:  RES:APER:ENAB ON RES:APER 300E-03	
or	
FRES:APER:ENAB ON FRES:APER 300E-03	

- For 4-wire resistance measurements, the instrument automatically pairs channel  $n$  in Bank 1 with channel  $n+10$  in Bank 2 (DAQM900A or DAQM901A) or  $n+8$  (DAQM902A) to provide the source and sense connections. For example, make the source connections to the HI and LO terminals on channel 02 in Bank 1 and the sense connections to the HI and LO terminals on channel 12 (DAQM900A or DAQM901A) or 10 (DAQM902A) in Bank 2. Specify the paired channel in Bank 1 (source) as the  $\langle ch\_list \rangle$  channel (paired channels in Bank 2 are not allowed in the  $\langle ch\_list \rangle$ ).
- Only the integral number of power line cycles (1, 2, 10, 20, 100, or 200 PLCs) provide normal mode (line frequency noise) rejection.
- The **CONFigure**:{RESistance|FRESistance}, **MEASure**:{RESistance|FRESistance}, **[SENSe:]**{RESistance|FRESistance}:NPLCycles, and **[SENSe:]**{RESistance|FRESistance}:RESolution commands disable the aperture mode (these commands select an integration time in number of power line cycles).
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

[SENSe:]{RESistance|FRESistance}:APERTure:ENABLE {OFF | ON} [, (@<ch\_list>)]  
 [SENSe:]{RESistance|FRESistance}:APERTure:ENABLE? [(@<ch\_list>)]

Enables the setting of integration time in seconds (called aperture time) for 2-wire and 4-wire resistance measurements. If aperture time mode is disabled (default), the integration time is set in PLC (power-line cycles).

**NOTE**

Parameter is shared between RESistance and FRESistance measurements. Setting or querying the parameter with the RESistance version of this command is identical to setting or querying it with the FRESistance version.

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)

## 2 SCPI Programming

Parameter	Typical return
Enable aperture time mode, set the aperture time to 300 ms:  RES:APER:ENAB ON RES:APER 300E-03  or  FRES:APER:ENAB ON FRES:APER 300E-03	

- The **CONFigure:}{RESistance|FRESistance}**, **MEASure:}{RESistance|FRESistance}**, **[SENSe:] {RESistance|FRESistance}:NPLCycles**, and **[SENSe:] {RESistance|FRESistance}:RESolution** commands disable the aperture mode (these commands select an integration time in number of power line cycles).
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

**[SENSe:] {RESistance|FRESistance}:NPLCycles {<PLCs> | MIN | MAX | DEF} [, (@<ch\_list>)]**  
**[SENSe:] {RESistance|FRESistance}:NPLCycles? [(@<ch\_list>) | MIN | MAX | DEF]**

Sets the integration time in number of power line cycles (PLCs) for 2-wire and 4-wire measurements. Integration time is the period that the instrument's analog-to-digital (A/D) converter samples the input signal for a measurement. A longer integration time gives better measurement resolution but slower measurement speed.

### NOTE

Parameter is shared between RESistance and FRESistance measurements. Setting or querying the parameter with the RESistance version of this command is identical to setting or querying it with the FRESistance version.

Parameter	Typical return
<PLCs>: {0.02   0.06   0.2   1   2   10   20   100   200}	+1.00000000E+00
Configure 4-wire measurements using a 10 PLC integration time. Then make and read one measurement:  CONF:FRES FRES:NPLC 10 READ?  Typical Response: +6.27530000E-01	

- Only the integral number of power line cycles (1, 2, 10, 20, 100, or 200 PLCs) provide normal mode (line frequency noise) rejection.

- Setting the resolution also sets the integration time for the measurement. The following table shows the relationship between integration time, and measurement resolution.

Integration time	Resolution
0.02 PLC	0.000003 x Range
0.06 PLC	0.0000015 x Range
0.2 PLC	0.0000007 x Range
1 PLC	0.0000003 x Range
2 PLC	0.00000022 x Range
10 PLC	0.0000001 x Range
20 PLC	0.00000008 x Range
100 PLC	0.00000003 x Range
200 PLC	0.000000022 x Range

- The specified integration time is used for all measurements on the selected channels. If you have applied  $mX+b$  scaling or have assigned alarms to the selected channel, those measurements are also made using the specified integration time. Measurements taken during the Monitor function also use the specified integration time.
- You can also set the integration time by specifying an aperture time. However, note that specifying integration time using NPLCs executes faster and offers better noise rejection characteristics for values of NPLC greater than 1.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

[SENSe:]{RESistance|FRESistance}:OCOMpensated {OFF | ON} [, (@<ch\_list>)]  
 [SENSe:]{RESistance|FRESistance}:OCOMpensated? [(@<ch\_list>)]

Enables or disables offset compensation. Offset compensation removes the effects of small DC voltages in the circuit being measured. The technique involves taking the difference between two resistance measurements, one with the current source set to the normal value, and one with the current source set to a lower value. Enabling offset compensation approximately doubles the reading time.

#### NOTE

Parameter is shared between RESistance and FRESistance measurements. Setting or querying the parameter with the RESistance version of this command is identical to setting or querying it with the FRESistance version.

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)

Configure low-power 2-wire resistance measurements, and enable offset compensation:

```
RES:POW:LIM ON
RES:OCOM ON
```

## 2 SCPI Programming

- For 4-wire resistance measurements, the instrument automatically pairs channel  $n$  in Bank 1 with channel  $n+10$  in Bank 2 (DAQM900A or DAQM901A) or  $n+8$  (DAQM902A) to provide the source and sense connections. For example, make the source connections to the HI and LO terminals on channel 02 in Bank 1 and the sense connections to the HI and LO terminals on channel 12 (DAQM900A or DAQM901A) or 10 (DAQM902A) in Bank 2. Specify the paired channel in Bank 1 (source) as the `<ch_list>` channel (paired channels in Bank 2 are not allowed in the `<ch_list>`).
- The **CONFigure** and **MEASure?** commands automatically disable offset compensation.
- Applies only to resistance measurements on the 100  $\Omega$ , 1 k $\Omega$ , 10 k $\Omega$ , and 100 k $\Omega$  ranges.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

```
[SENSe:]{RESistance|FRESistance}:POWer:LIMit[:STATe] {OFF | ON} [, (@<ch_list>)]  
[SENSe:]{RESistance|FRESistance}:POWer:LIMit[:STATe]? [(@<ch_list>)]
```

Enables or disables low-power for 2-wire and 4-wire resistance measurements.

### NOTE

Parameter is shared between RESistance and FRESistance measurements. Setting or querying the parameter with the RESistance version of this command is identical to setting or querying it with the FRESistance version.

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)

Configure 4-wire resistance measurements using a 10 PLC integration time. Enable low-power 4-wire resistance measurements. Then make and read one measurement:

```
CONF:FRES  
FRES:NPLC 10  
FRES:POW:LIM ON  
READ?
```

Typical Response: +6.27530000E+01

- Low-power resistance measurements apply to the 100  $\Omega$  through 100 k $\Omega$  ranges only. The 1 M $\Omega$  through 1 G $\Omega$  ranges source the same current regardless of the low-power setting.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

```
[SENSe:]{RESistance|FRESistance}:RANGe {<range> | MIN | MAX | DEF} [, (@<ch_list>)]  
[SENSe:]{RESistance|FRESistance}:RANGe? [(@<ch_list>) | MIN | MAX | DEF]
```

Selects a fixed range for 2-wire and 4-wire resistance measurements.

**NOTE**

Parameter is shared between RESistance and FRESistance measurements. Setting or querying the parameter with the RESistance version of this command is identical to setting or querying it with the FRESistance version.

Parameter	Typical return
<range>: {100 Ω 1 kΩ 10 kΩ 100 kΩ 1 MΩ 10 MΩ 100 MΩ 1 GΩ}. Default: 1 kΩ	+1.00000000E+03

Configure 2-wire resistance measurements, and select 10 kΩ range:

```
CONF:RES
RES:RANG
```

- Selecting a fixed range ([SENSe:]<function>:RANGe) disables autoranging.
- If the input signal is greater than can be measured on the specified fixed range, the instrument displays *Overload* on front panel and returns "9.9E37" from the remote interface.
- For 4-wire resistance measurements, the instrument automatically pairs channel *n* in Bank 1 with channel *n+10* in Bank 2 (DAQM900A or DAQM901A) or *n+8* (DAQM902A) to provide the source and sense connections. For example, make the source connections to the HI and LO terminals on channel 02 in Bank 1 and the sense connections to the HI and LO terminals on channel 12 (DAQM900A or DAQM901A) or 10 (DAQM902A) in Bank 2. Specify the paired channel in Bank 1 (source) as the <ch\_list> channel (paired channels in Bank 2 are not allowed in the <ch\_list>).
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSe:]{RESistance|FRESistance}:RANGe:AUTO {OFF | ON} [, (@<ch\_list>)]

[SENSe:]{RESistance|FRESistance}:RANGe:AUTO? [(@<ch\_list>)]

Enables or disables autoranging for 2-wire and 4-wire resistance measurements. Autoranging is convenient because the instrument automatically selects the range for each measurement based on the input signal detected.

**NOTE**

Parameter is shared between RESistance and FRESistance measurements. Setting or querying the parameter with the RESistance version of this command is identical to setting or querying it with the FRESistance version.

Parameter	Typical return
{OFF   ON}. Default: ON	0 (OFF) or 1 (ON)

Configure 2-wire resistance measurements, and turn autorange on:

```
CONF:RES
RES:RANG:AUTO ON
```

- Autorange thresholds:
  - Down range at: <10% of range
  - Up range at: >120% of range.

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- Selecting a fixed range (see `[SENSe:][RESistance|FRESistance]:RANGe` command) disables auto-ranging.
- This parameter is set to its default value after a Factory Reset (`*RST` command).

`[SENSe:]RESistance:ZERO:AUTO {OFF | ON} [, (@<ch_list>)]`

`[SENSe:]RESistance:ZERO:AUTO? [(@<ch_list>)]`

Enables or disables the autozero mode for 2-wire resistance measurements.

Parameter	Typical return
{OFF   ON}. Default: ON	0 (OFF) or 1 (ON)

Configure 2-wire resistance measurements and perform autozero:

```
CONF:CURR:DC 1
CURR:DC:ZERO:AUTO ON
```

- **ON (Default):** Internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset readings present on the instrument's input circuitry from affecting measurement accuracy.
- **OFF:** The instrument uses the last measured zero measurement and subtracts it from each measurement. It takes a new zero measurement each time you change the function, range or integration time.
- The autozero mode is set indirectly when you set the resolution and integration time with `CONFigure` and `MEASure?` commands. Autozero is automatically turned OFF when you select an integration time less than 1 PLC with these commands.
- This parameter is set to its default value after a Factory Reset (`*RST` command).



## [SENSe:]STRain Subsystem

This subsystem configures strain measurements.

### NOTE

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

### Command Summary

[SENSe:]STRain:APERture

[SENSe:]STRain:APERture:ENABle

[SENSe:]STRain:EXCitation

[SENSe:]STRain:EXCitation:TYPE

[SENSe:]STRain:GFACTOR

[SENSe:]STRain:NPLCycles

[SENSe:]STRain:OCOMPensated

[SENSe:]STRain:POISSon

[SENSe:]STRain:RESistance

[SENSe:]STRain:UNSTrained

[SENSe:]STRain:UNSTrained:IMMediate

[SENSe:]STRain:VOLTage:RANGe:AUTO

[SENSe:]STRain:VOLTage:RANGe

[SENSe:]STRain:ZERO:AUTO

[SENSe:]STRain:APERture {<seconds> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]STRain:APERture? [(@<ch\_list>) | MIN | MAX | DEF]

Enables the aperture mode and sets the integration time in seconds for strain measurements.

Parameter	Typical return
<seconds> = 200 $\mu$ s to 1 s (2 $\mu$ s resolution) Default: 100 ms	+1.00000000E- 01
Enable aperture time mode, set the aperture time to 300 ms:	
STR:APER:ENAB ON	
STR:APER 300E-03	

- You can specify MIN (smallest value accepted) or MAX (largest value accepted) instead of <seconds>.
- Only the integral number of power line cycles (1, 2, 10, 20, 100, or 200 PLCs) provide normal mode (line frequency noise) rejection.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

[SENSe:]STRain:APERture:ENABLE {OFF | ON} [, (@<ch\_list>)]

[SENSe:]STRain:APERture:ENABLE? [(@<ch\_list>)]

Enables the setting of integration time in seconds (called aperture time) for strain measurements. If aperture time mode is disabled (default), the integration time is set in PLC (power-line cycles).

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)

Enable aperture time mode, set the aperture time to 300 ms:

```
STR:APER:ENAB ON
```

```
STR:APER 300E-03
```

- The CONFigure, MEASure?, [SENSe:]STRain:NPLCycles commands automatically disable the aperture mode, and select an integration time in number of power line cycles.
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSe:]STRain:EXCitation {<voltage> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]STRain:EXCitation? [(@<ch\_list>) | MIN | MAX | DEF]

Specifies the excitation voltage applied to the bridge by an external DC voltage source. This value will be used to convert strain bridge measurements on the specified channel.

Parameter	Typical return
<voltage> = Any numeric value between 1 to 12 V. Default = 5.0	None

Specifies the excitation voltage as 5 V in channel 101:

```
STR:EXC 5 (@101)
```

- The external DC voltage reference channel must be the next lowest channel than the subsequent strain channel.

[SENSe:]STRain:EXCitation:TYPE {EXTErnal | FIXed} [, (@<ch\_list>)]

[SENSe:]STRain:EXCitation:TYPE? [(@<ch\_list>)]

Strain bridge conversions require the value of the external bridge excitation voltage. For this voltage, you can dedicate a multiplexer channel to measure the excitation voltage, or can specify a known fixed voltage value.

When you select "FIXed", the excitation voltage specified by **SENSe:STRain:EXCitation** will be used for the strain conversion.

When you select "EXTernal", the next-lowest channel configured for DCV measurements with reference mode enabled (see **SENSe:VOLTage:DC:REFerence** command) will be used as the excitation voltage reference in the strain conversion.

Parameter	Typical return
{EXTernal   FIXed} Default: FIX	EXT or FIX

- Query returns the type of excitation voltage reference currently set for the sense channel specified by `<ch_list>`.
- If you select an external reference, the instrument makes strain measurements relative to a previously-stored excitation voltage measurement stored in the reference register. To store an excitation voltage, first configure a multiplexer channel for an DC voltage measurement (see **CONFigure:VOLTage:DC** command). Then assign the measurement from that channel as the external reference using the **SENSe:VOLTage:DC:REFerence** command.
- When you initiate a measurement on an excitation voltage channel (see **INITiate** or **READ?** command), the acquired value is stored in volatile memory in the reference register. Subsequent strain measurements use the stored value as their reference. The value remains in the reference register until you measure a subsequent excitation voltage value in the reference register or remove the mainframe power.

[SENSe:]STRain:GFACTOR {<gage\_factor> | MIN | MAX | DEF} [, (@<ch\_list>)]  
 [SENSe:]STRain:GFACTOR? [(@<ch\_list>) | MIN | MAX | DEF]

Specifies the gage factor to be used to convert direct strain and strain bridge readings on the specified channel. Gage factor is defined as the ratio of the fractional change in resistance to the fractional change in length (strain) along the axis of the edge.

Parameter	Typical return
<gage_factor> = Numeric value between 0.5 and 5 Default: 2	(none)

Set gage factor as 2 for channe 101

STR:GFAC 2 (@101)

- Gage factor is a dimensionless quantity. The larger the value, the more sensitive strain gage.

[SENSe:]STRain:NPLCycles {<PLCs> | MIN | MAX | DEF} [, (@<ch\_list>)]  
 [SENSe:]STRain:NPLCycles? [(@<ch\_list>) | MIN | MAX | DEF]

Sets the integration time in number of power line cycles (PLCs) for strain measurements. Integration time is the period that the instrument's analog-to-digital (A/D) converter samples the input signal for a measurement. A longer integration time gives better measurement resolution but slower measurement speed.

## 2 SCPI Programming

Parameter	Typical return
<PLCs>: {0.02   0.06   0.2   1   2   10   20   100   200}	+1.00000000E+00

Configure strain measurements using a 10 PLC integration time. Then make and read one measurement:

```
CONF:STR:QUAR (@101)
STR:NPLC 10, (@101)
READ?
```

Typical Response: +6.27530000E-01

- Only the integral number of power line cycles (1, 2, 10, 20, 100, or 200 PLCs) provide normal mode (line frequency noise) rejection.
- Setting the resolution also sets the integration time for the measurement. The following table shows the relationship between integration time, and measurement resolution.

Integration time	Resolution
0.02 PLC	0.000003 x Range
0.06 PLC	0.0000015 x Range
0.2 PLC	0.0000007 x Range
1 PLC	0.0000003 x Range
2 PLC	0.00000022 x Range
10 PLC	0.0000001 x Range
20 PLC	0.00000008 x Range
100 PLC	0.00000003 x Range
200 PLC	0.000000022 x Range

- The specified integration time is used for all measurements on the selected channels. If you have applied  $mX+b$  scaling or have assigned alarms to the selected channel, those measurements are also made using the specified integration time. Measurements taken during the Monitor function also use the specified integration time.
- You can also set the integration time by specifying an *aperture time* (see `[SENSe:]STRain:APERture` command). However, note that specifying integration time using NPLCs executes faster and offers better noise rejection characteristics for values of NPLC greater than 1.
- The `CONFigure`, `MEASure?`, and `[SENSe:]STRain:NPLCycles` commands automatically disable the aperture time mode, and select an integration time in number of power line cycles.
- This parameter is set to its default value after a Factory Reset (`*RST` command).

```
[SENSe:]STRain:OCOMpensated {OFF | ON} [, (@<ch_list>)]
```

```
[SENSe:]STRain:OCOMpensated? [(@<ch_list>)]
```

Enables or disables offset compensation. Offset compensation removes the effects of small DC voltages in the circuit being measured. The technique involves taking the difference between two resistance

measurements, one with the current source set to the normal value, and one with the current source set to a lower value. Enabling offset compensation approximately doubles the reading time.

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)

- For 4-wire resistance measurements, the instrument automatically pairs channel  $n$  in Bank 1 with channel  $n+10$  in Bank 2 (DAQM900A or DAQM901A) or  $n+8$  (DAQM902A) to provide the source and sense connections. For example, make the source connections to the HI and LO terminals on channel 02 in Bank 1 and the sense connections to the HI and LO terminals on channel 12 (DAQM900A or DAQM901A) or 10 (DAQM902A) in Bank 2. Specify the paired channel in Bank 1 (source) as the `<ch_list>` channel (paired channels in Bank 2 are not allowed in the `<ch_list>`).
- The **CONFigure** and **MEASure?** commands automatically disable offset compensation.
- Applies only to resistance measurements on the 100  $\Omega$ , 1 k $\Omega$ , 10 k $\Omega$ , and 100 k $\Omega$  ranges.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

[SENSE:]STRain:POISSon {<poisson\_ratio> | MIN | MAX | DEF} [, (@<ch\_list>)]  
 [SENSE:]STRain:POISSon? [(@<ch\_list>) | MIN | MAX | DEF]

This command sets the poisson ratio to be used to convert strain bridge readings on the specified channels. Poisson ratio is defined as the negative ratio of the strain the transverse direction to the strain the longitudinal direction.

Parameter	Typical return
<poisson_ratio> = Numeric value between -0.9999 and +0.5 Default: 0.3	(none)
Set poisson ratio as 0.3 for channel 101: STR:POIS 0.3 (@101)	

[SENSE:]STRain:RESistance {<gage\_ohms> | MIN | MAX | DEF} [, (@<ch\_list>)]  
 [SENSE:]STRain:RESistance? [(@<ch\_list>) | MIN | MAX | DEF]

This command specifies the gage ohm value to be used to convert direct strain measurements on the specified channel.

Parameter	Typical return
<gage_ohms> = Any numeric value between 80 and 1,100 ohms Default = 120 ohms	(none)
Specifies the gage ohm value to 120 in channel 101:  STR:RES 120 (@101)	

## 2 SCPI Programming

[SENSe:]STRain:UNSTrained {<offset> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]STRain:UNSTrained? [(@<ch\_list>) | MIN | MAX | DEF]

This command specifies the unstrained bridge offset (can be either voltage or resistance) that will be subtracted from the strain bridge measurements before the strain conversion is performed strain bridge measurements. You can select specific channel to read back the initial DUT (device-under-test basic offset or set/clear the needed offset value.

Parameter	Typical return
<offset> = Any numeric value between $\pm 90$ Default = 0.0	None

- Query returns the type of excitation voltage reference currently set for the sense channel specified by <ch\_list>.
- You can measure and specify the offset manually for each channel, or you can use the SENSe:STRain:UNSTrained:IMMEDIATE command to automatically measure and store the offset for each channel.

[SENSe:]STRain:UNSTrained:IMMEDIATE [(@<ch\_list>)]

This command immediately measures and stores the bridge offset voltages on the specified channel.

Parameter	Typical return
<voltage> = Any numeric value between 1 to 12 V. Default = 5.0	None

- You can measure and specify the offset manually for each channel, or you can use the SENSe:STRain:UNSTrained:IMMEDIATE command to automatically measure and store the offset for each channel.

[SENSe:]STRain:VOLTage:RANGe:AUTO {OFF | ON} [, (@<ch\_list>)]

[SENSe:]STRain:VOLTage:RANGe:AUTO? [(@<ch\_list>)]

Enables or disables autoranging for strain measurements. Autoranging is convenient because the instrument automatically selects the range for each measurement based on the input signal detected.

Parameter	Typical return
{OFF   ON}. Default: ON	0 (OFF) or 1 (ON)

- Autorange thresholds:
  - Down range at: <10% of range
  - Up range at: >120% of range.
- Selecting a fixed range (see [SENSe:]STRain:VOLTage:RANGe command) disables autoranging.
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSe:]STRain:VOLTage:RANGe {<range> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]STRain:VOLTage:RANGe? [(@<ch\_list>) | MIN | MAX | DEF]

Selects a fixed *voltage* range for strain measurements.

### NOTE

This parameter setting is not shared between AC and DC measurements. The parameters are independent for AC and DC measurements.

Parameter	Typical return
<range> = {0.1   300   0.1} Default = 0.1	+1.00000000E+01

- Selecting a fixed range ([SENSe:]<function>:RANGe) disables autoranging.
- If the input signal is greater than can be measured on the specified fixed range, the instrument displays *Overload* on front panel and returns "9.9E37" from the remote interface.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

[SENSe:]STRain:ZERO:AUTO {OFF | ON} [, (@<ch\_list>)]

[SENSe:]STRain:ZERO:AUTO? [(@<ch\_list>)]

Enables or disables the autozero mode for strain measurements.

Parameter	Typical return
{OFF   ON} Default: ON	0 (OFF) or 1 (ON)

- **ON (Default):** Internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset readings present on the instrument's input circuitry from affecting measurement accuracy.
- **OFF:** The instrument uses the last measured zero measurement and subtracts it from each measurement. It takes a new zero measurement each time you change the function, range or integration time.
- The autozero mode is set indirectly when you set the resolution and integration time with CONFigure and MEASure? commands. Autozero is automatically turned OFF when you select an integration time less than 1 PLC with these commands.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

**[SENSe:]TEMPerature Subsystem**

This subsystem configures temperature measurements.

**Command Summary**

[SENSe:]TEMPerature:APERture

[SENSe:]TEMPerature:APERture:ENABLE

[SENSe:]TEMPerature:NPLCycles

[SENSe:]TEMPerature:RJUNction?

[SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:OCOMpensated

[SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:POWER:LIMit[:STATe]

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

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

[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:POWER:LIMit[:STATe]

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

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

[SENSe:]TEMPerature:TRANsducer:TCouple:CHECK

[SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction

[SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction:TYPE

[SENSe:]TEMPerature:TRANsducer:TCouple:TYPE

[SENSe:]TEMPerature:TRANsducer:TYPE

[SENSe:]TEMPerature:ZERO:AUTO

[SENSe:]TEMPerature:APERture {<seconds> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]TEMPerature:APERture? [({@<ch\_list>}) | MIN | MAX | DEF]

Enables the aperture mode and sets the integration time in seconds (called *aperture time*) for temperature measurements.

**NOTE**

Only supported in DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Used this command for precise control for the DMM's integration time. Use NPLC for better power-line noise rejection characteristics (NPLC >1) (see [SENSe:]TEMPerature:NPLCycles command).

Parameter	Typical return
200 $\mu$ s to 1 s (2 $\mu$ s resolution). Default: 100 ms	+1.00000000E- 01



Parameter	Typical return
-----------	----------------

Enable aperture time mode, set the aperture time to 300 ms:

```
TEMP:APER:ENAB ON
TEMP:APER 300E-03
```

- You can specify MIN (smallest value accepted) or MAX (largest value accepted) instead of `<seconds>`.
- Only the integral number of power line cycles (1, 2, 10, 20, 100, or 200 PLCs) provide normal mode (line frequency noise) rejection.
- The **CONFigure:TEMPerature**, **MEASure:TEMPerature?**, and **[SENSe:]TEMPerature:NPLCycles** commands automatically disable the aperture time mode, and select an integration time in number of power line cycles.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

```
[SENSe:]TEMPerature:APERture:ENABle {OFF | ON} [, (@<ch_list>)]
[SENSe:]TEMPerature:APERture:ENABle? [(@<ch_list>)]
```

Enables the setting of integration time in seconds (called aperture time) for temperature measurements. If aperture time mode is disabled (default), the integration time is set in PLC (power-line cycles).

#### NOTE

Only supported in DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Parameter	Typical return
-----------	----------------

{OFF | ON}. Default: OFF

0 (OFF) or 1 (ON)

Enable aperture time mode, set the aperture time to 300 ms:

```
TEMP:APER:ENAB ON
TEMP:APER 300E-03
```

- The **CONFigure:TEMPerature**, **MEASure:TEMPerature?**, and **[SENSe:]TEMPerature:NPLCycles** commands automatically disable the aperture time mode, and select an integration time in number of power line cycles.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

```
[SENSe:]TEMPerature:NPLCycles {<PLCs> | MIN | MAX | DEF} [, (@<ch_list>)]
[SENSe:]TEMPerature:NPLCycles? [(@<ch_list>) | MIN | MAX | DEF]
```

Sets the integration time in number of power line cycles (PLCs) for temperature measurements. Integration time is the period that the instrument's analog-to-digital (A/D) converter samples the input signal for a measurement. A longer integration time gives better measurement resolution but slower measurement speed.

## 2 SCPI Programming

### NOTE

Only supported in DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Parameter	Typical return
<PLCs>: {0.02   0.06   0.2   1   2   10   20   100   200}	+1.00000000E+00

Configure temperature measurements using a 10 PLC integration time. Then make and read one measurement:

```
CONF:TEMP
TEMP:NPLC 10
READ?
```

Typical Response: +6.27530000E-01

- Only the integral number of power line cycles (1, 2, 10, 20, 100, or 200 PLCs) provide normal mode (line frequency noise) rejection.
- Setting the resolution also sets the integration time for the measurement. The following table shows the relationship between integration time, and measurement resolution.

Integration time	Resolution
0.02 PLC	0.000003 x Range
0.06 PLC	0.000015 x Range
0.2 PLC	0.000007 x Range
1 PLC	0.000003 x Range
2 PLC	0.0000022 x Range
10 PLC	0.000001 x Range
20 PLC	0.0000008 x Range
100 PLC	0.0000003 x Range
200 PLC	0.00000022 x Range

- The specified integration time is used for all measurements on the selected channels. If you have applied mX+b scaling or have assigned alarms to the selected channel, those measurements are also made using the specified integration time. Measurements taken during the Monitor function also use the specified integration time.
- You can also set the integration time by specifying an *aperture time* (see **[SENSe:]TEMPerature:APERture** command). However, note that specifying integration time using NPLCs executes faster and offers better noise rejection characteristics for values of NPLC greater than 1.
- The **CONFigure:TEMPerature**, **MEASure:TEMPerature?**, and **[SENSe:]TEMPerature:NPLCycles** commands automatically disable the aperture time mode, and select an integration time in number of power line cycles.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

**[SENSe:]TEMPerature:RJUNction? [(@<ch\_list>)]**

Returns the internal reference junction temperature on the specified channels in degrees Celsius, regardless of the temperature units currently selected (see **UNIT:TEMPerature** command). This is useful only for an internal reference source.

**NOTE**

Only supported in DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Parameter	Typical return
(none)	+2.89753100E+01
Returns the internal reference junction temperature: TEMP:RJUN?	

**[SENSe:]TEMPerature:TRANsducer:{RTD | FRTD}:OCOMPensated {OFF | ON} [, (@<ch\_list>)]**  
**[SENSe:]TEMPerature:TRANsducer:{RTD | FRTD}:OCOMPensated? [(@<ch\_list>)]**

Enables or disables offset compensation. Offset compensation removes the effects of small DC voltages in the circuit being measured. The technique involves taking the difference between two resistance measurements, one with the current source set to the normal value, and one with the current source set to a lower value. Enabling offset compensation approximately doubles the reading time.

**NOTE**

Only supported in DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Parameter is shared between RTD and FRTD measurements. Setting or querying the parameter with the RTD version of this command is identical to setting or querying it with the FRTD version.

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)
Enables offset compensation on channels 3 and 13 in slot 1: TEMP:TRAN:FRTD:OCOM ON,(@103,113)	

- This command applies only to 2-wire and 4-wire RTD measurements on the 100  $\Omega$ , 1 k $\Omega$ , and 10 k $\Omega$  ranges. Once enabled, offset compensation is applied to both 2-wire and 4-wire RTD measurements on the specified channels.
- For 4-wire resistance measurements, the instrument automatically pairs channel  $n$  in Bank 1 with channel  $n+10$  in Bank 2 (DAQM900A or DAQM901A) or  $n+8$  (DAQM902A) to provide the source and sense connections. For example, make the source connections to the HI and LO terminals on channel 02 in Bank 1 and the sense connections to the HI and LO terminals on channel 12 (DAQM900A or DAQM901A) or 10 (DAQM902A) in Bank 2. Specify the paired channel in Bank 1 (source) as the <ch\_list> channel (paired channels in Bank 2 are not allowed in the <ch\_list>).
- The **CONFigure** and **MEASure?** commands automatically disable offset compensation.
- Applies only to resistance measurements on the 100  $\Omega$ , 1 k $\Omega$ , 10 k $\Omega$ , and 100 k $\Omega$  ranges.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

## 2 SCPI Programming

[SENSe:]TEMPerature:TRANsducer:{RTD | FRTD}:POWer:LIMit[:STATe] {OFF | ON} [, (@<ch\_list>)]

[SENSe:]TEMPerature:TRANsducer:{RTD | FRTD}:POWer:LIMit[:STATe]? [(@<ch\_list>)]

Enables or disables low-power for 2-wire and 4-wire resistance measurements.

### NOTE

Only supported in DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Parameter is shared between RTD and FRTD measurements. Setting or querying the parameter with the RTD version of this command is identical to setting or querying it with the FRTD version.

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)

Configure 4-wire resistance measurements using a 10 PLC integration time. Enable low-power 4-wire resistance measurements. Then make and read one measurement:

```
CONF:TEMP:FRTD
TEMP:TRANS:FRTD:NPLC 10
TEMP:TRANS:FRTD:POW:LIM ON
READ?
```

Typical Response: +6.27530000E+01

- Low-power resistance measurements apply to the 100  $\Omega$  through 100 k $\Omega$  ranges only. The 1 M $\Omega$  through 1 G $\Omega$  ranges source the same current regardless of the low-power setting.
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSe:]TEMPerature:TRANsducer:{RTD | FRTD}:REFerence {OFF | ON} [, (@<ch\_list>)]

[SENSe:]TEMPerature:TRANsducer:{RTD | FRTD}:REFerence? [(@<ch\_list>)]

### NOTE

Only supported in DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Parameter is shared between RTD and FRTD measurements. Setting or querying the parameter with the RTD version of this command is identical to setting or querying it with the FRTD version.

Enables (On) or disables (Off) the specified 2-wire RTD and 4-wire RTD channels to be used as the reference channel for subsequent thermocouple measurements that specify an external reference source (see [SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction:TYPE command). The query returns the reference state as 0 or 1.

Parameter	Typical return
{OFF   ON} Default: OFF	0 (OFF) or 1 (ON)

For the below examples, you can replace the RTD node with FRTD for a similar explanation on 4-wire RTD.

**Example : Makes an externally-referenced thermocouple measurements with multiplexer channels**

The following commands configure multiplexer channel 3 in slot 1 for thermocouple measurements and select an external reference junction for that channel.

```
CONF:TEMP TC,J,@103
TEMP:TRAN:TC:RJUN:TYPE EXT,@103
```

The following commands configure multiplexer channel 1 in slot 1 for 2-wire RTD measurements and assign this channel as the reference channel. For this 2-wire measurement, the instrument automatically pairs this channel in Bank 1 with the corresponding channel in Bank 2.

```
CONF:TEMP RTD,85,@101
TEMP:TRAN:RTD:REF ON,@101
```

The following commands set up a scan list that contains both the reference channel (channel 1) and the thermocouple channel (channel 3). If you do not include the reference channel in the active scan list, the instrument uses the temperature previously saved in the reference register. The INITiate command initiates the scan.

```
ROUT:SCAN (@101:105)
INIT
```

- If you omit the optional *<ch\_list>* parameter, this command applies to the internal DMM, independent of any channels or a scan list. An error is generated if the internal DMM is disabled.
- For 4-wire resistance measurements, the instrument automatically pairs channel *n* in Bank 1 with channel *n+10* in Bank 2 (DAQM900A or DAQM901A) or *n+8* (DAQM902A) to provide the source and sense connections. For example, make the source connections to the HI and LO terminals on channel 02 in Bank 1 and the sense connections to the HI and LO terminals on channel 12 (DAQM900A or DAQM901A) or 10 (DAQM902A) in Bank 2. Specify the paired channel in Bank 1 (source) as the *<ch\_list>* channel (paired channels in Bank 2 are not allowed in the *<ch\_list>*).
- When you initiated a measurement on the selected channels, the acquired temperature is saved in reading memory in the reference register. Subsequent thermocouple measurements use the saved temperature as their reference.
- At power-on, the reference register is loaded with "9.9E+37". Note that after you have saved a reference temperature, all thermocouple measurements that specify an external reference source will be returned as "9.9E+37". Use the **[SENSe:]TEMPerature:TRANsdncer:TCouple:RJUNction:TYPE EXTERNAL?** command to read the most-recently saved reference temperature value.

```
[SENSe:]TEMPerature:TRANsdncer:{RTD | FRTD}:RESistance[:REFerence] {<resistance> | MIN | MAX | DEF} [, (@<ch_list>)]
[SENSe:]TEMPerature:TRANsdncer:{RTD | FRTD}:RESistance[:REFerence]? [{(@<ch_list>) | MIN | MAX | DEF}]
```

**NOTE**

Only supported in DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

## 2 SCPI Programming

Parameter is shared between RTD and FRTD measurements. Setting or querying the parameter with the RTD version of this command is identical to setting or querying it with the FRTD version.

---

Selects the nominal resistance ( $R_0$ ) for 2-wire and 4-wire RTD measurements.  $R_0$  is the nominal resistance of an RTD at 0 °C.

Parameter	Typical return
<code>&lt;resistance&gt;</code> : 100 ohms ± 1% or 1000 ohms ± 1% Default: 100	+1.00000000E+02
Sets the nominal resistance to 100 Ω: <code>TEMP:TRAN:RTD:RES:REF 100</code>	

- For 4-wire resistance measurements, the instrument automatically pairs channel  $n$  in Bank 1 with channel  $n+10$  in Bank 2 (DAQM900A or DAQM901A) or  $n+8$  (DAQM902A) to provide the source and sense connections. For example, make the source connections to the HI and LO terminals on channel 02 in Bank 1 and the sense connections to the HI and LO terminals on channel 12 (DAQM900A or DAQM901A) or 10 (DAQM902A) in Bank 2. Specify the paired channel in Bank 1 (source) as the `<ch_list>` channel (paired channels in Bank 2 are not allowed in the `<ch_list>`).
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

`[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:POWER:LIMit[:STATe] {OFF | ON} [, (@<ch_list>)]`

`[SENSe:]TEMPerature:TRANsdsucer:{FTHermistor|THERmistor}:POWER:LIMit[:STATe]? [(@<ch_list>)]`

Enables or disables low-power for 2-wire and 4-wire thermistor in temperature measurements.

### NOTE

Only supported in DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Parameter is shared between FTHermistor and THERmistor measurements. Setting or querying the parameter with the FTHermistor version of this command is identical to setting or querying it with the THERmistor version.

---

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)

Configure 4-wire thermistor for temperature measurements using a 10 PLC integration time. Enable low-power 4-wire thermistor for temperature measurements. Then make and read one measurement:

```
CONF:TEMP:FRTD
TEMP:TRANS:FRTD:NPLC 10
TEMP:TRANS:FRTD:POW:LIM ON
READ?
```

Typical Response: +6.27530000E+01

---

- Low-power resistance measurements apply to the 100  $\Omega$  through 100 k $\Omega$  ranges only. The 1 M $\Omega$  through 1 G $\Omega$  ranges source the same current regardless of the low-power setting.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

```
[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:REFerence {OFF | ON} [,
(@<ch_list>)]
[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:REFerence? [(@<ch_list>)]
```

**NOTE**

Only supported in DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Parameter is shared between FTHermistor and THERmistor measurements. Setting or querying the parameter with the FTHermistor version of this command is identical to setting or querying it with the THERmistor version.

Enables (On) or disables (Off) the specified 2-wire and 4-wire thermistor channels to be used as the reference channel for subsequent thermocouple measurements that specify an external reference source (see **[SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction:TYPE** command). The query returns the reference state as 0 or 1.

Parameter	Typical return
{OFF   ON} Default: OFF	0 (OFF) or 1 (ON)

For the below examples, you can replace the THER node with FTH for a similar explanation on 4-wire thermistor.

**Example : Makes an externally-referenced thermocouple measurements with multiplexer channels**

The following commands configure multiplexer channel 3 in slot 1 for thermocouple measurements and select an external reference junction for that channel.

```
CONF:TEMP TC,J,(@103)
TEMP:TRAN:TC:RJUN:TYPE EXT,(@103)
```

The following commands configure multiplexer channel 1 in slot 1 for thermistor measurements and assign this channel as the reference channel.

```
CONF:TEMP THER,5000,(@101)
TEMP:TRAN:THER:REF ON,(@101)
```

The following commands set up a scan list that contains both the reference channel (channel 1) and the thermocouple channel (channel 3). If you do not include the reference channel in the active scan list, the instrument uses the temperature previously saved in the reference register. The INITiate command initiates the scan.

```
ROUT:SCAN (@101:105)
INIT
```

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- If you omit the optional `<ch_list>` parameter, this command applies to the internal DMM, independent of any channels or a scan list. An error is generated if the internal DMM is disabled.
- For 4-wire resistance measurements, the instrument automatically pairs channel  $n$  in Bank 1 with channel  $n+10$  in Bank 2 (DAQM900A or DAQM901A) or  $n+8$  (DAQM902A) to provide the source and sense connections. For example, make the source connections to the HI and LO terminals on channel 02 in Bank 1 and the sense connections to the HI and LO terminals on channel 12 (DAQM900A or DAQM901A) or 10 (DAQM902A) in Bank 2. Specify the paired channel in Bank 1 (source) as the `<ch_list>` channel (paired channels in Bank 2 are not allowed in the `<ch_list>`).
- When you initiated a measurement on the selected channels, the acquired temperature is saved in reading memory in the reference register. Subsequent thermocouple measurements use the saved temperature as their reference.
- At power-on, the reference register is loaded with "9.9E+37". Note that after you have saved a reference temperature, all thermocouple measurements that specify an external reference source will be returned as "9.9E+37". Use the `[SENSe:]TEMPerature:TRANsdUcer:TCouple:RJUNction:TYPE EXternal?` command to read the most-recently saved reference temperature value.

```
[SENSe:]TEMPerature:TRANsdUcer:{FTHermistor|THERmistor}:TYPE {2252 | 5000 | 10000 | MIN | MAX | DEF} [, (@<ch_list>)]
```

```
[SENSe:]TEMPerature:TRANsdUcer:{FTHermistor|THERmistor}:TYPE? [{"@<ch_list>" | MIN | MAX | DEF}]
```

### NOTE

Only supported in DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Parameter is shared between FTHermistor and THERmistor measurements. Setting or querying the parameter with the FTHermistor version of this command is identical to setting or querying it with the THERmistor version.

Selects the thermistor type for 2-wire and 4-wire temperature measurements.

Parameter	Typical return
{2252 5000 10000} Default: 5000	2252, 5000, or 10000
Sets the 2-wire thermistor type as 5000: <code>TEMP:TRAN:THER:TYPE 5000</code>	

- The instrument supports 2.2 k $\Omega$  (YSI 44004 Series), 5 k $\Omega$  (YSI 44007 Series), and 10 k $\Omega$  (YSI 44006 Series) thermistors.
- This parameter is set to its default value after a Factory Reset (`*RST` command).

```
[SENSe:]TEMPerature:TRANsdUcer:TCouple:CHECK {OFF | ON} [, (@<ch_list>)]
```

```
[SENSe:]TEMPerature:TRANsdUcer:TCouple:CHECK? [{"@<ch_list>"}]
```

### NOTE

Only supported in DAQM900A, DAQM901A, and DAQM902A multiplexer modules.



Enables or disables the thermocouple check feature to verify that your thermocouples are properly connected for measurements. When enabled, the instrument measures the resistance after each thermocouple measurement to ensure a proper connection. If an open connection is detected (greater than 5 k $\Omega$  on the 10 k $\Omega$  range), the instrument reports an overload condition.

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)
Enables the thermocouple check feature: TEMP:TRAN:TC:CHECK ON	

- Enabling the thermocouple check feature slows measurement rates because two measurements have to be made for each temperature measurement values produced.
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSe:]TEMPerature:TRANsdruce:r:TCouple:RJUNction {<temperature> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]TEMPerature:TRANsdruce:r:TCouple:RJUNction? [(@<ch\_list>) | MIN | MAX | DEF]

#### NOTE

Only supported in DAQM900A, DAQM901A, and DAQM902A multiplexer modules.

Sets the fixed reference junction temperature in degrees Celsius ( $^{\circ}$ C) for thermocouple measurements on the specified channels.

Parameter	Typical return
<temperature>: A number representing the temperature from -20 $^{\circ}$ C to +80 $^{\circ}$ C Default: 0 $^{\circ}$ C	+1.12345678E+01
Sets the fixed junction temperature in degrees Celsius for thermocouple measurements:	
TEMPerature:TRANsdruce:r:TCouple:RJUNction 27.3	
Typical response: 2.73000000E+01	

- For this command, you must always specify the temperature in degrees Celsius regardless of the temperature units currently selected (see UNIT:TEMPerature command).
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSe:]TEMPerature:TRANsdruce:r:TCouple:RJUNction:TYPE {INTernal | EXTernal | FIXed} [, (@<ch\_list>)]

[SENSe:]TEMPerature:TRANsdruce:r:TCouple:RJUNction:TYPE? [(@<ch\_list>)]

#### NOTE

Only supported in DAQM900A, DAQM901A, and DAQM902A multiplexer modules.

Thermocouple measurements require a reference junction temperature. For the reference junction temperature, you can use an internal measurement on the module's terminal block, an external thermistor or

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RTD measurement, or a known fixed junction temperature. This command selects the reference junction source for thermocouple measurements on the specified channels.

Parameter	Typical return
{INTernal   EXTernal   FIXed} Default: INT	INT, EXT, or FIX
Sets the reference junction type to an external thermistor on specified channel: TEMP:TRANS:TC:RJUN:TYPE EXT	

- The accuracy of the measurement is highly dependent upon the thermocouple connections and the type of reference junction used. Use a fixed temperature reference for the highest accuracy measurements (you must maintain the known junction temperature). The internal isothermal block reference requires no external wiring but provides lower accuracy measurements than a fixed reference.
- If you select an external reference, the instrument makes thermocouple measurements relative to a previously-stored RTD or thermistor measurement stored in the reference register. To store a reference temperature, first configure a multiplexer channel for an RTD or thermistor measurement (see **CONFigure:TEMPerature** command). Then assign the measurement from that channel as the external reference using one of the following commands:
  1. **[SENSe:]TEMPerature:TRANsducer:{RTD|FRTD}:REFerence**
  2. **[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:REFerence**
- When you initiate a measurement on an external reference channel (see **INITiate** or **READ?** command), subsequent thermocouple measurements use the stored temperature as their reference. The temperature is used for all subsequent thermocouple measurements on that card.
- If you select a fixed reference junction source, you can specify a value between -20 °C and +80 °C using the **[SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction** command. You must always specify the temperature in degrees Celsius regardless of the temperature units currently selected (see **UNIT:TEMPerature** command).
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

**[SENSe:]TEMPerature:TRANsducer:TCouple:TYPE {B | E | J | K | N | R | S | T | DEF} [, (@<ch\_list>)]**

**[SENSe:]TEMPerature:TRANsducer:TCouple:TYPE? [(@<ch\_list>)]**

### NOTE

Only supported in DAQM900A, DAQM901A, and DAQM902A multiplexer modules.

Selects the thermocouple type for thermocouple measurements. Query returns the thermocouple type as a quoted letter.

Parameter	Typical return
{B E J K N R S T} Default: J	B, E, J, K, N, R, S, or T
Sets the thermocouple to J: TEMP:TRAN:TC:TYPE J	

- Thermocouple measurements require a reference junction temperature (see `[SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction:TYPE` command). For the reference junction temperature, you can use an internal measurement on the module (DAQM900A, DAQM901A, and DAQM902A), an external thermistor or RTD measurement, or a known fixed junction temperature. By default, a fixed reference junction temperature of 0.0 °C is used.
- This parameter is set to its default value after a Factory Reset (`*RST` command).

```
[SENSe:]TEMPerature:TRANsducer:TYPE {<probe_type> [, (@<ch_list>)]
[SENSe:]TEMPerature:TRANsducer:TYPE? [(@<ch_list>)]
```

Selects the transducer probe type to use for temperature measurements. The supported probes are thermocouples (type J, K, E, T, N, R, B and S), 2-wire and 4-wire RTDs, 2-wire and 4-wire thermistors.

**NOTE**

Only supported in DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Table below shows transducer types that are supported on each multiplexer module.

Multiplexer module	Transducer types				
	Thermocouple	2-wire RTD	4-wire RTD	2-wire thermistor	4-wire thermistor
DAQM900A	√				
DAQM901A	√	√	√	√	√
DAQM902A	√	√	√	√	√
DAQM908A		√		√	

Parameter	Typical return
<code>&lt;probe_type&gt;</code> : {FRTD   RTD   FTHermistor   THERmistor   TCouple   DEF}. Default: TCouple	TC, FRTD, RTD, FTH, or THER
Sets the temperature transducer type to FRTD: <code>TEMP:TRANS:TYPE FRTD</code>	

- This parameter is set to its default value after a Factory Reset (`*RST` command).

```
[SENSe:]TEMPerature:ZERO:AUTO {OFF | ON} [, (@<ch_list>)]
[SENSe:]TEMPerature:ZERO:AUTO? [(@<ch_list>)]
```

Enables or disables the autozero mode for temperature measurements.

**NOTE**

Only supported in DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

Parameter	Typical return
{OFF   ON}. Default: ON	0 (OFF) or 1 (ON)

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Parameter	Typical return
CONF:TEMP RTD	
TEMP:ZERO:AUTO ON	

- **ON (Default):** Internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset readings present on the instrument's input circuitry from affecting measurement accuracy.
- **OFF:** The instrument uses the last measured zero measurement and subtracts it from each measurement. It takes a new zero measurement each time you change the function, range or integration time.
- The autozero mode is set indirectly when you set the resolution and integration time with CONFigure and MEASure? commands. Autozero is automatically turned OFF when you select an integration time less than 1 PLC with these commands.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

## [SENSe:]VOLTage Subsystem

This subsystem configures AC and DC voltage measurements.

### NOTE

Only supported on DAQM900A, DAQM901A, DAQM902A, and DAQM908A multiplexer modules.

### Command Summary

[SENSe:]VOLTage:AC:BANDwidth

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

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

[SENSe:]VOLTage[:DC]:APERture

[SENSe:]VOLTage[:DC]:APERture:ENABLE

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

[SENSe:]VOLTage[:DC]:NPLCycles

[SENSe:]VOLTage[:DC]:REFerence

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

[SENSe:]VOLTage:AC:BANDwidth {<freq> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]VOLTage:AC:BANDwidth? [(@<ch\_list>) | MIN | MAX | DEF]

Sets the bandwidth for AC voltage measurements.

The instrument uses three different AC filters that enable you to either optimize low frequency accuracy or achieve faster AC settling times following a change in input signal amplitude.

Parameter	Typical return
{3 Hz 20 Hz 200 Hz}. Default: 20 Hz.	+2.00000000E+01

Configure an AC voltage measurement. Use the 3 Hz filter bandwidth:

```
CONF:VOLT:AC 1
```

```
VOLT:AC:BAND 3
```

- For the <freq> parameter, specify the lowest frequency that you expect to encounter. Lower bandwidths result in longer settling delays, as shown:

Input frequency	Default settling delay
3 Hz - 300 kHz (Slow)	1.66 s/measurement
20 Hz - 300 kHz (Medium)	0.25 s/measurement
200 Hz - 300 kHz (Fast)	0.025 s/measurement

- This parameter is set to its default value after a Factory Reset (**\*RST** command).

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- The settling delay is controlled by **ROUTe:CHANnel:DELay** command. You can get the default delay with **ROUTe:CHANnel:DELay:AUTO ON** command.

[SENSe:]VOLTage:{AC|DC}:RANGe:AUTO {OFF | ON} [, (@<ch\_list>)]

[SENSe:]VOLTage:{AC|DC}:RANGe:AUTO? [(@<ch\_list>)]

Enables or disables autoranging for AC and DC voltage measurements. Autoranging is convenient because the instrument automatically selects the range for each measurement based on the input signal detected.

### NOTE

This parameter setting is not shared between AC and DC measurements. The parameters are independent for AC and DC measurements.

### WARNING

See Safety and Regulatory Information in Keysight DAQ970A Data Acquisition System User's Guide for more information on the safety features and the safe operation of this instrument.

Parameter	Typical return
{OFF   ON}. Default: ON	0 (OFF) or 1 (ON)

Configure AC voltage measurements, and turn autorange on:

```
CONF:VOLT:AC  
VOLT:AC:RANG:AUTO ON
```

- Autorange thresholds:
  - Down range at: < 10% of range
  - Up range at: > 120% of range.
- Selecting a fixed range (see **[SENSe:]VOLTage:{AC|DC}:RANGe** command) disables autoranging.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

[SENSe:]VOLTage:{AC|DC}:RANGe {<range> | MIN | MAX | DEF} [, (@<ch\_list>)]

[SENSe:]VOLTage:{AC|DC}:RANGe? [(@<ch\_list>) | MIN | MAX | DEF]

Selects a fixed range for AC and DC voltage measurements.

### NOTE

This parameter setting is not shared between AC and DC measurements. The parameters are independent for AC and DC measurements.

Parameter	Typical return
<range>: {100 mV 1 V 10 V 100 V 300 V}. Default: AUTO	+1.00000000E+01

Configure AC voltage measurements, and select 10 V range:

```
CONF:VOLT:AC  
VOLT:AC:RANG 10
```

- Selecting a fixed range ([SENSe:]<function>:RANGe) disables autoranging.
- If the input signal is greater than can be measured on the specified fixed range, the instrument displays *Overload* on front panel and returns "9.9E37" from the remote interface.
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSe:]VOLTage[:DC]:APERture {<seconds> | MIN | MAX | DEF} [, (@<ch\_list>)]  
 [SENSe:]VOLTage[:DC]:APERture? [(@<ch\_list>) | MIN | MAX | DEF]

Enables the aperture mode and sets the integration time in seconds (called *aperture time*) for DC voltage measurements.

**NOTE**

Used this command for precise control for the DMM's integration time. Use NPLC for better power-line noise rejection characteristics (NPLC >1) (see [SENSe:]VOLTage[:DC]:NPLCycles command).

Parameter	Typical return
200 $\mu$ s to 1 s (2 $\mu$ s resolution). Default: 100 ms	+1.00000000E- 01
Enable aperture time mode, set the aperture time to 300 ms:	
VOLT:DC:APER:ENAB ON VOLT:DC:APER 300E-03	

- You can specify MIN (smallest value accepted) or MAX (largest value accepted) instead of <seconds>.
- Only the integral number of power line cycles (1, 2, 10, 20, 100, or 200 PLCs) provide normal mode (line frequency noise) rejection.
- The CONFigure:VOLTage[:DC], MEASure:VOLTage[:DC], [SENSe:]VOLTage[:DC]:NPLCycles, [SENSe:]VOLTage[:DC]:RESolution commands automatically disable the aperture time mode, and select an integration time in number of power line cycles.
- This parameter is set to its default value after a Factory Reset (\*RST command).

[SENSe:]VOLTage[:DC]:APERture:ENABLE {OFF | ON} [, (@<ch\_list>)]  
 [SENSe:]VOLTage[:DC]:APERture:ENABLE? [(@<ch\_list>)]

Enables the setting of integration time in seconds (called aperture time) for DC voltage measurements. If aperture time mode is disabled (default), the integration time is set in PLC (power-line cycles).

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)
Enable aperture time mode, set the aperture time to 300 ms:	
VOLT:DC:APER:ENAB ON VOLT:DC:APER 300E-03	

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- The **CONFigure:VOLTage[:DC]**, **MEASure:VOLTage[:DC]**, **[SENSe:]VOLTage[:DC]:NPLCycles**, **[SENSe:]VOLTage[:DC]:RESolution** commands automatically disable the aperture time mode, and select an integration time in number of power line cycles.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

**[SENSe:]VOLTage[:DC]:IMPedance:AUTO {OFF | ON} [, (@<ch\_list>)]**  
**[SENSe:]VOLTage[:DC]:IMPedance:AUTO? [(@<ch\_list>)]**

Enables or disables automatic input impedance mode for DC voltage measurements.

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)
Make all DC voltage measurements with a 10 M $\Omega$ input impedance: <b>VOLT:IMP:AUTO OFF</b>	

- **OFF**: The input impedance for DC voltage measurements is fixed at 10 M $\Omega$  for all ranges to minimize noise pickup.
- **ON**: The input impedance for DC voltage measurements varies by range. It is set to "HI-Z" (>10 G $\Omega$ ) for the 100 mV, 1 V, and 10 V ranges to reduce the effects of measurement loading errors on these lower ranges. The 100 V and 300 V ranges remain at a 10 M $\Omega$  input impedance.
- The **CONFigure:VOLTage[:DC]** and **MEASure:VOLTage[:DC]** commands automatically select "AUTO OFF".
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

**[SENSe:]VOLTage[:DC]:NPLCycles {<PLCs> | MIN | MAX | DEF} [, (@<ch\_list>)]**  
**[SENSe:]VOLTage[:DC]:NPLCycles? [(@<ch\_list>) | MIN | MAX | DEF]**

Sets the integration time in number of power line cycles (PLCs) for DC voltage measurements. Integration time is the period that the instrument's analog-to-digital (A/D) converter samples the input signal for a measurement. A longer integration time gives better measurement resolution but slower measurement speed.

Parameter	Typical return
<PLCs>: {0.02   0.06   0.2   1   2   10   20   100   200}	+1.00000000E+00

Configure DC voltage measurements using a 10 PLC integration time. Then make and read one measurement:

```
CONF:VOLT:DC
VOLT:DC:NPLC 10
READ?
```

Typical Response: +6.27530000E-01

- Only the integral number of power line cycles (1, 2, 10, 20, 100, or 200 PLCs) provide normal mode (line frequency noise) rejection.



- Setting the resolution also sets the integration time for the measurement. The following table shows the relationship between integration time, and measurement resolution.

Integration time	Resolution
0.02 PLC	0.000003 x Range
0.06 PLC	0.0000015 x Range
0.2 PLC	0.0000007 x Range
1 PLC	0.0000003 x Range
2 PLC	0.00000022 x Range
10 PLC	0.0000001 x Range
20 PLC	0.00000008 x Range
100 PLC	0.00000003 x Range
200 PLC	0.000000022 x Range

- The specified integration time is used for all measurements on the selected channels. If you have applied  $mX+b$  scaling or have assigned alarms to the selected channel, those measurements are also made using the specified integration time. Measurements taken during the Monitor function also use the specified integration time.
- You can also set the integration time by specifying an *aperture time* (see `[SENSe:]VOLTage[:DC]:APERture` command). However, note that specifying integration time using NPLCs executes faster and offers better noise rejection characteristics for values of NPLC greater than 1.
- The `CONFigure:VOLTage[:DC]`, `MEASure:VOLTage[:DC]`, `[SENSe:]VOLTage[:DC]:NPLCycles`, `[SENSe:]VOLTage[:DC]:RESolution` commands automatically disable the aperture time mode, and select an integration time in number of power line cycles.
- This parameter is set to its default value after a Factory Reset (`*RST` command).

`[SENSe:]VOLTage[:DC]:REFerence {OFF | ON} [, (@<ch_list>)]`  
`[SENSe:]VOLTage[:DC]:REFerence? [(@<ch_list>)]`

Enables (On) or disables (Off) the specified DC voltage channels to be used as the reference channel for subsequent strain bridge measurements that specify an external excitation reference voltage source (see `[SENSe:]STRain:EXCitation:TYPE` command). The query returns the reference state as 0 or 1.

Parameter	Typical return
{OFF   ON} Default: OFF	0 (OFF) or 1 (ON)

- The external DC voltage reference channel must be one channel lower than the subsequent strain channel.

`[SENSe:]VOLTage[:DC]:ZERO:AUTO {OFF | ON} [, (@<ch_list>)]`  
`[SENSe:]VOLTage[:DC]:ZERO:AUTO? [(@<ch_list>)]`

## 2 SCPI Programming

Enables or disables the autozero mode for DC voltage measurements.

Parameter	Typical return
{OFF   ON}. Default: ON	0 (OFF) or 1 (ON)

Configure DC voltage measurements and perform autozero:

```
CONF:VOLT:DC 1  
VOLT:DC:ZERO:AUTO ON
```

- **ON (Default):** Internally measures the offset following each measurement. It then subtracts that measurement from the preceding reading. This prevents offset readings present on the instrument's input circuitry from affecting measurement accuracy.
- **OFF:** The instrument uses the last measured zero measurement and subtracts it from each measurement. It takes a new zero measurement each time you change the function, range or integration time.
- The autozero mode is set indirectly when you set the resolution and integration time with `CONF` and `MEASure?` commands. Autozero is automatically turned OFF when you select an integration time less than 1 PLC with these commands.
- This parameter is set to its default value after a Factory Reset (**\*RST** command).

## [SENSe:]TOTalize Subsystem

This subsystem configures totalizer measurements.

### NOTE

Only supported on DAQM907A multifunction module (totalizer channel).

### Command Summary

[SENSe:]TOTalize:CLEar:IMMEDIATE

[SENSe:]TOTalize:DATA?

[SENSe:]TOTalize:SLOPe

[SENSe:]TOTalize:START

[SENSe:]TOTalize:STOP

[SENSe:]TOTalize:TYPE

### [SENSe:]TOTalize:CLEar:IMMEDIATE [(@<ch\_list>)]

Clears the count on the specified totalizer channels immediately.

Parameter	Typical return
(none)	(none)
Clears the count on totalizer channel immediately: TOT:CLEAR:IMM	

### [SENSe:]TOTalize:DATA? [(@<ch\_list>)]

This query reads the count on the specified totalizer channels. If you have configured the count to be reset when it is read (see **CONFigure:TOTalize** and **[SENSe:]TOTalize:TYPE** commands), then this command will reset the count to 0 after it is read. The count is reset regardless of whether the specified channels are in a scan list or even whether a scan is in progress.

Parameter	Typical return
(none)	1.32130000E+03
Reads the count on totalizer channel: TOT:DATA?	

- The maximum count is 67,108,863 ( $2^{26} - 1$ ). The count rolls over to 0 after reaching the maximum allowed value.
- The output from this command is affected by the settings of the **FORMat:READing** commands. Depending on the formats selected, each reading may or may not be stored with measurement units, time stamp, channel number, and alarm status information.

### [SENSe:]TOTalize:SLOPe {POSitive | NEGative} [, (@<ch\_list>)]

### [SENSe:]TOTalize:SLOPe? [(@<ch\_list>)]

## 2 SCPI Programming

Configures the specified totalizer channels to count on the rising edge (positive) or falling edge (negative) of the input signal.

Parameter	Typical return
{POSitive   NEGative} Default: POS	POS or NEG
Configures totalizer channel to count on the negative edge: TOT:SLOP NEG	

- This parameter is set to its default value after a Factory Reset (**\*RST** command).

### [SENSe:]TOTAlize:START [(@<ch\_list>)]

Starts totalizing on the specified totalizer channels.

Parameter	Typical return
(none)	(none)
Starts totalizing on totalizer channel: TOT:STAR:IMM	

### [SENSe:]TOTAlize:STOP [(@<ch\_list>)]

Stops totalizing on the specified totalizer channels.

Parameter	Typical return
(none)	(none)
Stops totalizing on totalizer channel: TOT:STOP:IMM	

### [SENSe:]TOTAlize:TYPE {READ | RRESet} [, (@<ch\_list>)]

### [SENSe:]TOTAlize:TYPE? [(@<ch\_list>)]

Enables or disables an automatic reset of the count on the specified totalizer channels.

*READ*: Read the totalizer during a scan without resetting the count.

*PRESet*: Read the totalizer during a scan and reset the count to 0 after it is read.

Parameter	Typical return
{READ RRESet} Default: READ	READ or PRES
Configures totalizer channel to be read without resetting its count: TOT:TYPE READ	

- The maximum count is 67,108,863 ( $2^{26} - 1$ ). The count rolls over to 0 after reaching the maximum allowed value.

## SOURce Subsystem

### Command Summary

SOURce:CURRent

SOURce:DIGital:DATA[:BYTE]

SOURce:DIGital:DATA:WORD

SOURce:DIGital:STATe?

SOURce:MODE

SOURce:MODE:LOCK

SOURce:VOLTage

**SOURce:CURRent** {<current> | MIN | MAX | DEF}, (@<ch\_list>)

**SOURce:CURRent?** {(@<ch\_list>) | MIN | MAX | DEF}

**NOTE**

Only supported on DAQM907A multifunction module (DAC output channels).

Sets the output mode in DAC output channels (channel 04 and 05) to current.

Parameter	Typical return
<current>	+2.5.00000000E+0
MIN: -0.024 A (-24 mA)	
DEF: 0 A	
MAX: 0.024 A (24 mA)	
Command outputs 0 A on DAC output channels 04 and 05 in slot 2:	
SOUR:CURR 0, (@204,205)	
OUTP:CURR ON, (@204,205)	

- This parameter is set to its default value after a Factory Reset (\*RST command).

**SOURce:DIGital:DATA[:BYTE]** <data>, (@<ch\_list>)}

**SOURce:DIGital:DATA[:BYTE]?** (@<ch\_list>)

**SOURce:DIGital:DATA:WORD** <data>, (@<ch\_list>)}

**SOURce:DIGital:DATA:WORD?** (@<ch\_list>)

**NOTE**

Only supported on DAQM907A multifunction module (Digital I/O channels).

Outputs a digital pattern as an 8-bit byte or 16-bit word to the specified digital I/O channels. The :BYTE? (or :WORD?) query returns the last byte or word sent as a decimal number in the form of +255.

Parameter	Typical return
<data>	+12345
(:BYTE) = Any integer from 0 to 255. Default: 0	
(:WORD) = Any integer from 0 to 65,535. Default: 65,535	
The following commands all output the number 12345 to channel 01 on the module in slot 2.	
SOUR:DIGital:DATA:WORD 12345,(@201) ! decimal integer 12345	
SOUR:DIGital:DATA:WORD #b0011000000111001,(@201) ! binary equivalent of decimal integer 12345	
SOUR:DIGital:DATA:WORD #h3039,(@201) ! hexadecimal equivalent of decimal integer 12345	

- You cannot configure a port for output operations if that port has been configured to be part of the scan list (digital input).
- You must specify an integer value, either as a decimal number (213), a binary number (#b11010101), or a hexadecimal number (#hD5).
- To write to both ports simultaneously (WORD), you must send the command to channel 01.

**SOURce:DIGital:STATe? (@<ch\_list>)****NOTE**

Only supported on DAQM907A multifunction module (digital I/O channels).

Returns the status (input or output) of the specified digital I/O channels. Query returns 0 if the specified channel is an input channel or 1 if the channel is an output channel.

Parameter	Typical return
{OFF   ON} Default: OFF	0 (OFF) or 1 (ON)
Returns the input or output state of channels 01 and 02 on the module in slot 3. In this case, both channels are configured for output: <code>SOUR:DIG:STAT? (@301,302)</code> Typical response: 1,1	

- A channel is set as an output channel when you send a `SOURce:DIGital:DATA[:{BYTE|WORD}]` command.
- A channel is set as an input channel when you place it in a scan list or send a `[SENSe:]DIGital:DATA:{BYTE|WORD}?` command.

**SOURce:MODE {CURRENT | VOLTage}, (@<ch\_list>)****SOURce:MODE? (@<ch\_list>)****NOTE**

Only supported on DAQM907A multifunction module (DAC output channels).

Sets the output mode in DAC output channels (channel 04 and 05) to current or voltage.

Parameter	Typical return
{CURRent   VOLTage} Default: VOLTage	CURR, VOLT
Sets the output mode as current in channel 204: <code>SOUR:MODE CURR, (@204)</code>	

- DAC sense output mode is set to voltage (if it is unlocked with `SOUR:MODE:LOCK OFF` command). If the output mode is locked to current with `SOUR:MODE:LOCK ON` command, an error will be generated.

**SOURce:MODE:LOCK {OFF | ON}, (@<ch\_list>)****SOURce:MODE:LOCK? (@<ch\_list>)****NOTE**

Only supported on DAQM907A multifunction module (DAC output channels).

Enables (On) or disables (Off) the locking of the DAC output channel mode (voltage or current). When enabled, the output mode cannot be changed without disabling the lock.

## 2 SCPI Programming

Parameter	Typical return
{OFF   ON}. Default: OFF	0 (OFF) or 1 (ON)
Enables locking of the DAC output mode: SOUR:MODE:LOCK ON	

- On - Output mode is unlocked.
- Off - Output mode is locked.
- Locking mode stored on the module in non-volatile memory.
- DAC output mode is set to voltage (if it is unlocked with **SOUR:MODE:LOCK OFF** command). If the output mode is locked to current with **SOUR:MODE:LOCK ON** command, an error will be generated.

**SOURce:VOLTage** {<voltage> | MIN | MAX | DEF}, (@<ch\_list>)  
**SOURce:VOLTage?** {(@<ch\_list>) | MIN | MAX | DEF}

### NOTE

Only supported on DAQM907A multifunction module (DAC output channels).

Sets the output mode in DAC output channels (channel 04 and 05) to voltage.

Parameter	Typical return
<voltage> MIN: -12 VDC DEF: 0 VDC MAX: +12 VDC	+2.5.00000000E+0
Command outputs +2.5 VDC on DAC output channels 04 and 05 in slot 2: SOUR:VOLT 2.5, (@204,205) OUTP:STAT ON, (@204,205)	

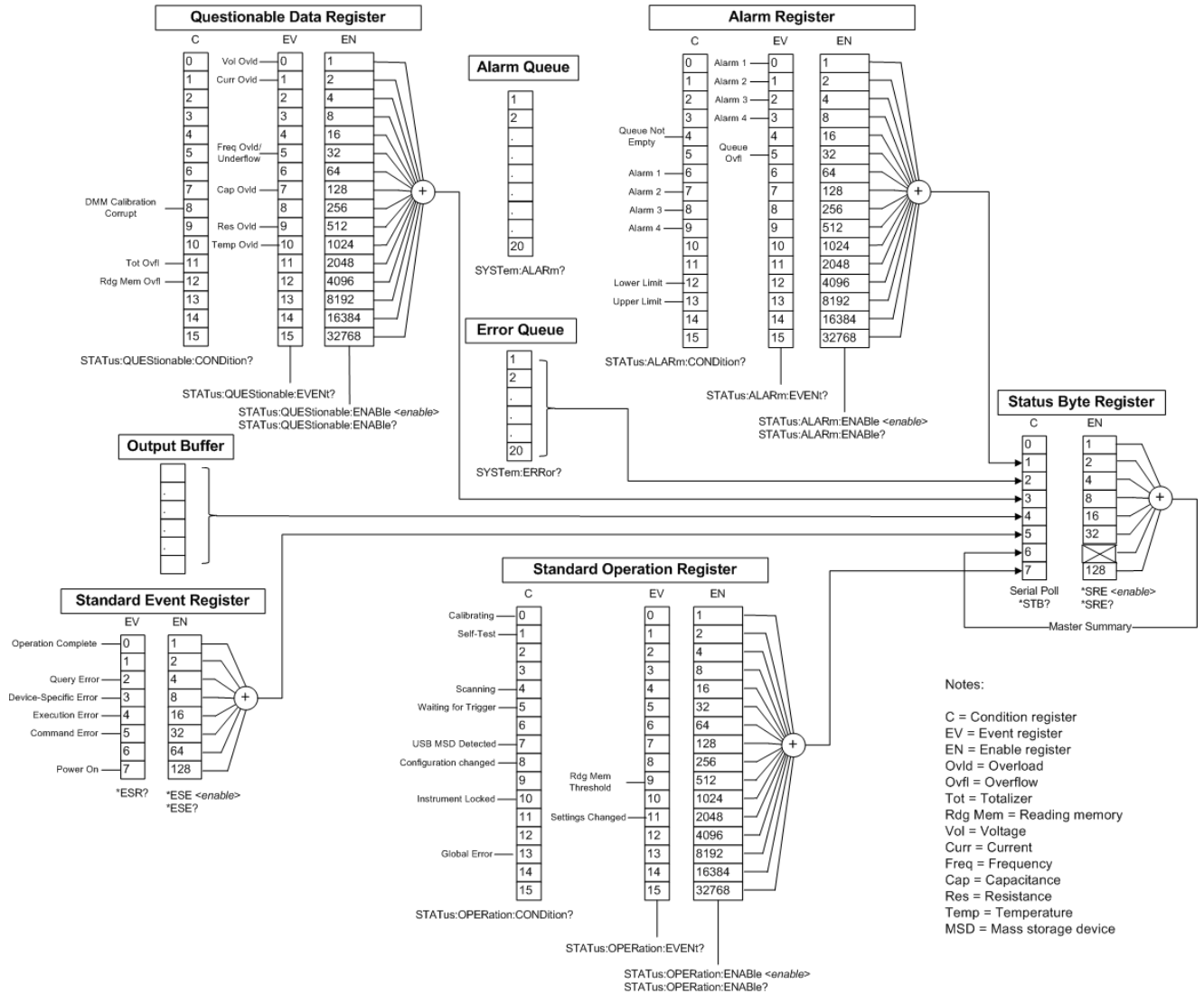
- This parameter is set to its default value after a Factory Reset (**\*RST** command).



# STATus Subsystem

This is the overall Status System diagram for DAQ970A. Refer tables below for further details on the bit definitions of each register used.

Keysight DAQ970A Status System Diagram



**Condition register (C)** – A condition register continuously monitors the state of the instrument. The bits in the condition register are updated in real time and the bits are not latched or buffered.

**Event register (EV)** – An event register latches the various events from the condition register. There is no buffering in this register; while an event bit is set, subsequent events corresponding to that bit are ignored. This is a read-only register.

**Enable register (EN)** – An enable register defines which bits in the event register will be reported to the Status Byte register group. You can write-to or read-from an enable register.

## 2 SCPI Programming

### Questionable Data Register

**NOTE**

The overload bits are set once per **INITiate** command. If you clear an overload bit, it is not set again until a new **INITiate** is sent.

Bit number	Bit name	Decimal value	Definition
0	Voltage Overload	1	A voltage measurement overloaded. Event only; condition register will return 0.
1	Current Overload	2	A current measurement overloaded. Event only; condition register will return 0.
2	Not Used	4	(Always returns 0)
3	Not Used	8	(Always returns 0)
4	Not Used	16	(Always returns 0)
5	Frequency Overload / Underflow	32	A frequency or period measurement overloaded or timed out due to no signal. Event only; condition register will return 0.
6	Not Used	64	(Always returns 0)
7	Capacitance Overload	128	A capacitance measurement overloaded. Event only; condition register will return 0.
8	DMM Calibration Corrupt	256	At least one DMM calibration constant is corrupt.
9	Resistance Overload	512	A resistance measurement overloaded. Event only; condition register will return 0.
10	Temperature Overload	1024	A temperature measurement overloaded. Event only; condition register will return 0.
11	Totalizer Overflow	2048	A totalizer channel has overflowed its maximum count. Event only; condition register will return 0.
12	Reading Memory Overflow	4096	Reading memory is full. One or more (oldest) measurements have been lost.
13	Not Used	8192	(Always returns 0)
14	Not Used	16384	(Always returns 0)
15	Not Used	32768	(Always returns 0)

**Alarm Register**

Bit number	Bit name	Decimal value	Definition
0	Alarm 1	1	An event has occurred on Alarm 1. Event only; condition register will return 0.
1	Alarm 2	2	An event has occurred on Alarm 2. Event only; condition register will return 0.
2	Alarm 3	4	An event has occurred on Alarm 3. Event only; condition register will return 0.
3	Alarm 4	8	An event has occurred on Alarm 4. Event only; condition register will return 0.
4	Queue Not Empty	16	The alarm queue is not empty.
5	Queue Overflow	32	An alarm queue overflowed. Event only; condition register will return 0.
6	Alarm 1	64	Alarm 1 is triggered.
7	Alarm 2	128	Alarm 2 is triggered.
8	Alarm 3	256	Alarm 3 is triggered.
9	Alarm 4	512	Alarm 4 is triggered.
10	Not Used	1024	(Always returns 0)
11	Not Used	2048	(Always returns 0)
12	Lower Limit	4096	A lower limit alarm has occurred.
13	Upper Limit	8192	An upper limit alarm has occurred.
14	Not Used	16384	(Always returns 0)
15	Not Used	32768	(Always returns 0)

**Standard Event Register**

Bit number	Bit name	Decimal value	Definition
0	Operation Complete	1	All commands prior to and including <b>*OPC</b> have been executed.
1	Not Used	Not Used	0 is returned.
2	Query Error	4	The instrument tried to read the output buffer but it was empty. Or, a new command line was received before a previous query has been read. Or, both the input and output buffers are full.
3	Device-Specific Error	8	A device-specific error, including a self-test error or calibration error, occurred (an error in the -300 range or any positive error has been generated). See <b>Device-Specific Errors</b> for the complete SCPI error message list.
4	Execution Error	16	An execution error occurred (an error in the -200 range has been generated). See <b>Execution Errors</b> for the complete SCPI error message list.
5	Command Error	32	A command syntax error occurred (an error in the -100 range has been generated). See <b>Command Errors</b> for the complete SCPI error message list.
6	Not Used	Not Used	0 is returned.

## 2 SCPI Programming

Bit number	Bit name	Decimal value	Definition
7	Power On	128	Power has been cycled since the last time the event register was read or cleared.

### Standard Operation Register

Bit number	Bit name	Decimal value	Definition
0	Calibrating	1	The instrument is calibrating.
1	Self Test	2	The instrument is doing a self-test.
2	Not Used	4	(Always returns 0)
3	Not Used	8	(Always returns 0)
4	Scanning	16	The instrument is scanning.
5	Waiting For Trigger	32	The instrument is waiting for a trigger.
6	Not Used	64	(Always returns 0)
7	USB MSD detected	128	A USB mass storage device (USB drive) has been detected.
8	Configuration Changed	256	The instrument configuration has changed via front panel since the last INIT, READ? or MEASure?.
9	Reading Memory Threshold	512	The number of readings in memory has exceeded the memory threshold setting ( <b>DATA:POINts:EVENT:THReshold</b> command)
10	Instrument Locked	1024	The instrument is locked ( <b>SYSTem:LOCK</b> command)
11	Settings Changed	2048	The instrument configuration has changed via front panel or SCPI since the last INIT, READ? or MEASure?. Event only, condition register returns 0.
12	Not Used	4096	(Always returns 0)
13	Global Error	8192	An error is in the global error queue.
14	Not Used	16384	(Always returns 0)
15	Not Used	32768	(Always returns 0)

### Status Byte Register

Bit number	Bit name	Decimal value	Definition
0	Not Used	1	Always zero.
1	Alarm Summary	2	One or more bits are set in the <b>Alarm Enable Register</b> . Bits must be enabled, see <b>STATus:ALARm:ENABLE</b> command.
2	Error Queue	4	One or more errors have been stored in the Error Queue. Use the <b>SYSTem:ERRor?</b> query to read and delete errors.
3	Questionable Data Summary	8	One or more bits are set in the <b>Questionable Data Register</b> . Bits must be enabled, see <b>STATus:QUESTionable:ENABLE</b> command.
4	Message Available	16	Data is available in the instrument's output buffer.

Bit number	Bit name	Decimal value	Definition
5	Standard Event Summary	32	One or more bits are set in the Standard Event Register. Bits must be enabled, see <b>*ESE</b> command.
6	Master Summary	X	One or more bits are set in the Status Byte Register and may generate a Request for Service (RQS). Bits must be enabled, see <b>*SRE</b> command.
7	Standard Operation Summary	128	One or more bits are set in the <b>Standard Operation Register</b> . Bits must be enabled, see <b>STATus:OPERation:ENABLE</b> command.

### Command Summary

**STATus:ALARm:CONDition?**

**STATus:ALARm:ENABLE**

**STATus:ALARm[:EVENT]?**

**STATus:OPERation:CONDition?**

**STATus:OPERation:ENABLE**

**STATus:OPERation[:EVENT]?**

**STATus:PRESet**

**STATus:QUEStionable:CONDition?**

**STATus:QUEStionable:ENABLE**

**STATus:QUEStionable[:EVENT]**

**STATus:ALARm:CONDition?****NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

Queries the condition register for the **Alarm Enable Register** group (note that this condition register uses only bit 4). This is a read-only register and the bits are not cleared when you read the register. The query reads the condition register and returns a decimal value which corresponds to the binary-weighted sum of all bits set in the register.

Parameter	Typical return
(none)	+448
Reads the condition register (bits 6 to 8 are set): STAT:ALAR:COND?	

- A Factory Reset (**\*RST** command) will clear the "Queue Not Empty" bit (bit 4) in the condition register.

**STATus:ALARm:ENABLE <enable>****STATus:ALARm:ENABLE?****NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

Enables bits in the enable register for the **Alarm Enable Register** group. The selected bits are then reported to the Status Byte Register. The query reads the enable register and returns a decimal value that corresponds to the binary-weighted sum of all bits set in the register.

Parameter	Typical return
Numeric. An integer from 0 to 65535.	+15
Enables alarm registers from bits 0 through 3: STAT:ALAR:ENAB 15	

**STATus:ALARm[:EVENT]?****NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

Returns the sum of the bits in the event register for the **Alarm Enable Register** group. This is a read-destructive register and these bits are cleared when you read the register. The query reads the enable register and returns a decimal value that corresponds to the binary-weighted sum of all bits set in the register.

Parameter	Typical return
(none)	+5
Indicates that alarm events have occurred on alarms 1 and 3: STAT:ALAR:EVEN?	

- Note that if any of bits 0 through 3 are set, bit 4 will also be set to indicate that the Alarm Queue is not empty (bit 4 is a queue not empty bit in **Alarm Enable Register** group).
- Once a bit is set, it remains set until cleared by reading the event register or the clear status command (**\*CLS**).

### STATus:OPERation:CONDition?

Queries the condition register for the **Standard Operation Register** group. This is a read-only register and the bits are not cleared when you read the register. The query reads the condition register and returns a decimal value that corresponds to the binary-weighted sum of all bits set in the register.

Parameter	Typical return
(none)	+256
Reads the condition register (bit 8 is set): STAT:OPER:COND?	

- The condition register bits reflect the current condition. If a condition is no longer true, the corresponding bit is cleared in the condition register.
- A Factory Reset (**\*RST** command) will set the "Configuration Changed" bit (bit 8) in the condition register.

### STATus:OPERation:ENABLE <enable>

#### STATus:OPERation:ENABLE?

Enables bits in the enable register for the **Standard Operation Register** group. The selected bits are then reported to the Status Byte. The query reads the enable register and returns a decimal value that corresponds to the binary-weighted sum of all bits set in the register.

Parameter	Typical return
Numeric. An integer from 0 to 65535.	+512
Enables bit 9 in the enable register. STAT:OPER:ENAB 512	

### STATus:OPERation[:EVENT]?

Returns the sum of the bits in the event register for the **Standard Operation Register** group. This is a read-destructive register and these bits are cleared when you read the register. The query reads the enable register and returns a decimal value that corresponds to the binary-weighted sum of all bits set in the register.

Parameter	Typical return
(none)	+512
Read the event register (bit 9 is set): STAT:OPER:EVEN?	

- This register is cleared when it is read, or when you issue a **\*CLS** command.

**STATus:PRESet**

Clears all enable register bits in **Alarm Register**, **Standard Operation Register**, and **Questionable Data Register**.

Parameter	Typical return
(none)	(none)
Clear enable register bits: STAT:PRES	

**STATus:QUEStionable:CONDition?**

Queries the condition register for the **Questionable Data Register** group. This is a read-destructive register and these bits are cleared when you read the register. The query reads the enable register and returns a decimal value that corresponds to the binary-weighted sum of all bits set in the register.

Parameter	Typical return
(none)	+2048
Reads the condition register (bit 11 is set): STAT:QUES:COND?	

- The condition register bits reflect the current condition. If a condition is no longer true, the corresponding bit is cleared in the condition register.
- A Factory Reset (**\*RST** command) clears all bits in the condition register.

**STATus:QUEStionable:ENABLE <enable>****STATus:QUEStionable:ENABLE?**

Enables bits in the enable register for the **Questionable Data Register** group. The selected bits are then reported to the Status Byte. The query reads the enable register and returns a decimal value that corresponds to the binary-weighted sum of all bits set in the register.

Parameter	Typical return
Numeric. An integer from 0 to 65535.	+512
Enables bit 9 in the enable register. STAT:QUES:ENAB 512	

**STATus:QUEStionable[:EVENT]?**

Returns the sum of the bits in the event register for the **Questionable Data Register** group. This is a read-destructive register and the bits are cleared when you read the register. The query reads the enable register and returns a decimal value that corresponds to the binary-weighted sum of all bits set in the register.



Parameter	Typical return
(none)	+514
Reads the questionable event register (bits 1 and 9 are set): STAT:QUES?	

- Once a bit is set, it remains set until cleared by reading the event register or the **\*CLS** (clear status) command.
- The **\*RST** command has no effect on this register.

## 2 SCPI Programming

### SYSTEM Subsystem

SYSTEM subsystem can be divided into two categories, as below:

**General Commands**

**Remote Interface Configuration Commands**

## General Commands

### Command Summary

SYSTem:ACALibration Subsystem

SYSTem:ALARm?

SYSTem:BEEPer

SYSTem:BEEPer:STATe

SYSTem:CLICk:STATe

SYSTem:CPON

SYSTem:CTYPe?

SYSTem:DATE

SYSTem:ERRor?

SYSTem:HELP?

SYSTem:LOCal

SYSTem:LOCK Subsystem

SYSTem:PERSONa Subsystem

SYSTem:PRESet

SYSTem:RELay Subsystem

SYSTem:REMote

SYSTem:SECurity:COUNT?

SYSTem:SECurity:ENABLE

SYSTem:SECurity:IMMEDIATE

SYSTem:SET

SYSTem:SLOT:LABel

SYSTem:TEMPerature?

SYSTem:TIME

SYSTem:TIME:SCAN?

SYSTem:UPTime?

SYSTem:VERSion?

SYSTem:WMESsage

## SYSTem:ACALibration Subsystem

This subsystem is used to perform autocalibration. Autocalibration compensates for internal drifts caused by time and temperature change. This can help to eliminate the errors to achieve a better performance. Following the autocalibration, the instrument returns to the instrument state that existed before the autocalibration.

### NOTE

Only supported on DAQM907A multifunction module and internal DMM.

### Command Summary

**SYSTem:ACALibration?**

**SYSTem:ACALibration:DATE?**

**SYSTem:ACALibration:INTerval**

**SYSTem:ACALibration:INTerval:MDAY**

**SYSTem:ACALibration:INTerval:TIME**

**SYSTem:ACALibration:INTerval:WDAY**

**SYSTem:ACALibration:TEMPerature?**

**SYSTem:ACALibration:TIME?**

### SYSTem:ACALibration? {<slot> | DMM | ALL}

Returns the autocalibration state in either a specified multifunction module slot, the internal DMM, or both.

Parameter	Typical return
<slot> = {1 2 3}, any slot number with DAQM907A multifunction module installed DMM = Internal DMM ALL = Both internal DMM and slot of DAQM907A multifunction module	+0 or +1

Returns the autocalibration state in slot 1:

SYST:ACAL? 1

Returns the autocalibration state in the internal DMM:

SYST:ACAL? DMM

Returns the autocalibration state in both slot and internal DMM:

SYST:ACAL? ALL

- SYSTem:ACALibration? ALL command is equivalent to **\*CAL?**.
- If there is no any DAQM907A multifunction module installed, instrument will only perform the autocalibration on the internal DMM.

**SYSTem:ACALibration:DATE? {<slot> | DMM}**

Returns the date of the last autocalibration in the format yyyy,mm,dd, in either a specified multifunction module slot, or the internal DMM.

Parameter	Typical return
<slot> = {1 2 3}, slot number with DAQM907A multifunction module installed. DMM = Internal DMM	+2018,+1,+1
Returns the last autocalibration date in slot 1: SYST:ACAL:DATE? 1	
Returns the last autocalibration date in internal DMM: SYST:ACAL:DATE? DMM	

- The date is based on instrument's real time clock. Set the date for the instrument's real-time clock with **SYSTem:DATE**.

**SYSTem:ACALibration:INTerval {OFF | DAILY | WEEKly | MONTHly}**  
**SYSTem:ACALibration:INTerval?**

Disables (Off) or specifies the scheduled autocalibration interval as a daily, weekly, or monthly occurrence.

Parameter	Typical return
{OFF   DAILY   WEEKly   MONTHly} Default: OFF	DAIL, WEEK, or MONT
Schedules autocalibration as a weekly interval: SYST:ACAL:INT WEEK	

**SYSTem:ACALibration:INTerval:MDAY <dayOfMonth>**  
**SYSTem:ACALibration:INTerval:MDAY?**

Schedules the autocalibration to start at a specific day (day 1 to 31) of each month.

Parameter	Typical return
<dayOfMonth> = Number of days in a month from 1 to 31	Any value from 1 to 31
Sets the autocalibration (monthly interval) as first day of each month: SYST:ACAL:INT:MDAY 1	

**SYSTem:ACALibration:INTerval:TIME <hour>, <minute>**  
**SYSTem:ACALibration:INTerval:TIME?**

Schedules the autocalibration to start at a specific time (hour and minute). Time is in 24-hour format.

Parameter	Typical return
<hour> = 0 to 23 <minute> = 0 to 59	+15,+30
Sets the autocalibration (daily interval) to 3:30 PM: SYST:ACAL:INT:TIME 15,30	



**SYSTem:ACALibration:INTerval:WDAY <dayOfWeek>****SYSTem:ACALibration:INTerval:WDAY?**

Schedules the autocalibration to start at a specific day (Sunday to Saturday) of each week.

Parameter	Typical return
<dayOfWeek> = { SUNDay   MONDay   TUESday   WEDNesday   THURsday   FRIDay   SATurday }	SUND, MOND, TUES, WEDN, THUR, FRID, or SAT
Sets the autocalibration (weekly interval) as Sunday: SYST:ACAL:INT:WDAY SUND	

**SYSTem:ACALibration:TEMPerature? {<slot> | DMM}**

Returns the temperature of the last autocalibration in °C.

Parameter	Typical return
<slot> = {1 2 3}, slot number with DAQM907A multifunction module installed. DMM = Internal DMM	+2.42850208E+001
Returns the last autocalibration temperature in slot 1: SYST:ACAL:TEMP? 1	

- You can perform this query regardless of whether the instrument is secured.
- This setting is non-volatile. It will not be changed by power cycling, after a Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet** command).

**SYSTem:ACALibration:TIME? {<slot> | DMM}**

Returns the time of the last autocalibration in the format hh,mm,ss.sss. Time is in 24-hour format.

Parameter	Typical return
<slot> = {1 2 3}, slot number with DAQM907A multifunction module installed. DMM = Internal DMM	20,15,30.000
Returns the last autocalibration time in slot 1: SYST:ACAL:TIME? 1	

- The time is based on instrument's real time clock. Set the time for the instrument's real-time clock with **SYSTem:TIME**.
- Time is in 24-hour format.

**SYSTem:ALARm?****NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

Reads the alarm data from the alarm queue (one alarm event is read and deleted from the queue each time this command is executed). A record of up to 20 alarms can be stored in the instrument's alarm queue.

Parameter	Typical return
(none)	2.41286927E+01 C,2018,02,03,10,10,38.625,101,1,1
Reads one message from the alarm queue: SYST:ALAR?	

The query returns a string in the form shown below (independent of **FORMat:READING** commands):

```
2.41286927E+01 C    Reading with units (24.129 °C)
2018,02,03         Date (February 3, 2018)
10,10,38.625      Time of day (10:10:38.625 AM)
101               Channel number
1                 Alarm limit threshold crossed (0 = No Alarm, 1 = LO, 2 = HI)
1                 Alarm number (1-4)
```

- Each time you start a new scan, the instrument clears all readings (including alarm data) stored in reading memory from the previous measurement. Therefore, the contents of memory are always from the most recent scan.
- Alarm data is retrieved in first-in-first-out (FIFO) order. The first alarm returned is the first alarm that was stored.
- Up to 20 alarms can be logged in the alarm queue. If more than 20 alarms are generated, they will be cleared (only the first 20 alarms are saved).
- Use the **FETCh?** command to retrieve scanned memory readings and alarm data from reading memory without clearing the information.
- The alarm queue is cleared by the **\*CLS** (clear status) command, when power is cycled, and by reading all of the entries. A Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet** command) does not clear the alarm queue.

**SYSTem:BEEPer[:IMMediate]**

Issues a single beep.

Parameter	Typical return
(none)	(none)
Issues a single beep: SYST:BEEP	

- Programmed beeps may be useful for program development and troubleshooting.
- You can issue a beep with this command regardless of the current beeper state (**SYSTem:BEEPer:STATe** command).



### **SYSTem:BEEPer:STATe {OFF | ON}** **SYSTem:BEEPer:STATe?**

Enables (On) or disables (Off) the beep heard during measurements, or when an error is generated from the front panel or remote interface.

Parameter	Typical return
{OFF ON} Default: ON	0 (OFF) or 1 (ON)
Disable beep heard: SYST:BEEP:STATE OFF	

- This setting will not affect the front panel key click (**SYSTem:CLICk:STATe** command).
- A beep is always emitted (even with beeper state OFF) when **SYSTem:BEEPer** is done.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command) or after an Instrument Preset (**SYSTem:PRESet** command).

### **SYSTem:CLICk:STATe {OFF | ON}** **SYSTem:CLICk:STATe?**

Enables (On) or disables (Off) the click heard when knob is turned or keys are pressed.

Parameter	Typical return
{OFF   ON}. Default: ON{OFF ON} Default: ON	0 (OFF) or 1 (ON)
Disable click heard: SYST:CLIC:STATE OFF	

- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command) or after an Instrument Preset (**SYSTem:PRESet** command).

### **SYSTem:CPON {<slot> | ALL}**

Resets the module in the specified slot to its power-on state (CPON means "card power on"). This opens all channels on the module. On the DAQM907A multifunction module, this also configures the digital I/O ports as inputs and sets the DAC outputs to voltage mode (if not locked) and the output level to 0.

Parameter	Typical return
<slot> = {1 2 3} ALL = All three slots	(none)
Resets module in slot 2: SYST:CPON 2	
Resets module in all three slots: SYST:CPON ALL	

Modules used are affected, as below:

## 2 SCPI Programming

Module	Effect
DAQM900A	If any channel is configured for a measurement, this command has no effect. If no channel is configured, this command opens all channels.
DAQM901A	If any channel is configured for a measurement, this command has no effect. If no channel is configured, this command opens all channels.
DAQM902A	If any channel is configured for a measurement, this command has no effect. If no channel is configured, this command opens all channels.
DAQM903A	This command opens all channels.
DAQM904A	This command opens all channels.
DAQM905A	This command closes channels 11 and 21.
DAQM907A	This command resets all channels not involved in scan to the power-on state.
DAQM908A	If any channel is configured for a measurement, this command has no effect. If no channel is configured, this command opens all channels.

- This command does not reset the internal DMM.
- The instrument will produce an error if you are actively scanning and try to execute a `SYSTEM:CPON` for a card that is involved in the scan.

### **SYSTEM:CTYPe? <slot>**

Returns the identity of the plug-in modules in the specified slot.

Parameter	Typical return
<slot> = {1 2 3}	<Company Name>, <Card Model Number>, <Serial Number>, <Firmware Rev>

Returns the identity of the module in slot 1 with DAQM901A installed:

```
SYST:CTYP? 1
```

Typical response: Keysight Technologies,DAQM901A,0,00.76

- The manufacturer name and model number are affected by the settings on the **SYSTEM PERSona Sub-system** commands.
- The <Card Model Number> is either a number from DAQM900A through DAQM908A. The number 0 is returned for the <Serial Number> field. The Firmware Revision has the form RR.RR and indicates the revision of firmware currently in use on the specified module.
- If the specified slot is empty, the command responds with **Keysight Technologies ,0,0,0**.

**SYSTem:DATE <year>, <month>, <day>****SYSTem:DATE?**

Sets the date for the instrument's real-time clock. Use **SYSTem:TIME** to set the time.

Parameter	Typical return
<year> = 2000 to 2099	Three comma-separated values in the form "+yyyy,+mm,+dd".
<month> = 1 to 12	
<day> = 1 to 31	
Sets the instrument date to January 1, 2018:	
SYST:DATE 2018,1,1	
Typical response: +2018,+1,+1	

- The real-time clock is used for Mass Memory (MMEMory) system file time stamps.
- The real-time clock is battery-backed and retains the date and time when power is off.
- When shipped from the factory, the instrument is set to the current time and date for Greenwich Mean Time (GMT).
- The real-time clock does not adjust itself for time zone changes or daylight savings time. Be sure to set the date and time when you first receive your instrument.
- This setting is non-volatile. It will not be changed by power cycling, after a Factory Reset (**\*RST** command) or Instrument Preset (**SYSTem:PRESet** command).

**SYSTem:ERRor?**

Reads and clears one error from the error queue. See **SCPI Error Messages** for the complete SCPI error message list.

Parameter	Typical return
(none)	<error code>,<error string>
Read and clear the first error in the error queue: SYST:ERR?	

- Up to 20 errors can be stored in the instrument's error queue. Each remote interface I/O session (USB, VXI-11, Telnet/sockets) has its own interface-specific error queue. Errors appear in the error queue of the I/O session that caused the error.
- Error retrieval is first-in-first-out (FIFO), and errors are cleared as you read them. The instrument beeps each time an error is generated (unless disabled by **SYSTem:BEEPer:STATe OFF**).
- If more than 20 errors have occurred, the most recent error stored in the queue is replaced with -350,"Error queue overflow". No additional errors are stored until you remove errors from the queue. If no errors have occurred when you read the error queue, the instrument responds with +0,"No error".

## 2 SCPI Programming

- Errors have the following format (the error string may contain up to 255 characters).

*<error code>*,*<error string>*

Where:

*<error code>* = a positive or negative integers

*<error string>* = a quoted ASCII string up to 255 characters

- Error conditions are also summarized in the Status Byte Register. For more information, see **STATus Subsystem**.

### SYSTem:HELP?

Returns a complete list of the instrument's SCPI commands.

Parameter	Typical return
(none)	(see below)
Returns the list of SCPI commands: SYST:HELP?	

- The query returns Definite Length Block Data, which allows any type of data to be transmitted as a series of 8-bit data bytes. The first line is a pound sign (#) followed by one digit representing the number of digits in the decimal integer to follow. This digit is followed by a decimal integer indicating the number of data bytes to follow, followed by the first New Line. For example, "#47947" in the first line means that there are 7947 data bytes to follow. The rest of the block has one command per line, each terminated by a New Line character (ASCII character 10).
- The beginning of a returned list is shown below. Note that the actual contents may vary, depending on the firmware version installed:

```
#48085
:ABORt/nquery/
:CALibration:ADC?/qonly/
:CALibration:ALL?/qonly/
:CALibration:COUNT?/qonly/
```

In this list,

- /nquery/ indicates a command with no query.
- /qonly/ indicates a query with no command form.
- All other commands consist of a command and query.
- The list may include commands or queries that are not described in this document. These are deprecated commands included for compatibility with older instruments.

## SYSTem:LOCal

## SYSTem:REMote

These commands place the instrument in either the local or remote mode.

Parameter	Typical return
(none)	(none)
Places the instrument in local mode: SYST:LOC	
Places the instrument in remote mode: SYST:REM	

- In the LOCal mode, all keys on the front panel are fully functional.
- In the REMote mode, all keys on the front panel are disabled except "Local" ([Save Recall] key). Also, the knob and the arrow keys are enabled.

## 2 SCPI Programming

### SYSTem:LOCK Subsystem

This subsystem is to perform system's I/O locking.

#### Command Summary

**SYSTem:LOCK:NAME?**

**SYSTem:LOCK:OWNer?**

**SYSTem:LOCK:RELease**

**SYSTem:LOCK:REQuest?**

#### SYSTem:LOCK:NAME?

Returns the I/O interface name of the I/O session sending the query. You can use the returned name to determine whether the I/O session owns the interface lock by comparing it to the value returned by **SYSTem:LOCK:OWNer?**.

The query returns USB or LAN<*IP Address*> indicating the I/O interface being used by the querying computer. The IP address is four integers separated by periods, such as 156.140.79.29, and there is no space between the word LAN and the <*IP Address*>

Parameter	Typical return
(none)	(none)

Returns the name of the LAN interface in used:

SYST:LOCK:NAME?

Typical response: "LAN169.254.149.35"

Returns the name of the USB interface in used:

SYST:LOCK:NAME?

Typical response: "USB169.254.149.35"

- Use this command to determine the lock name for the interface that you are using. Then use the SYSTem:LOCK:OWNer? command to determine which interface, if any, has the lock. Once you have executed both of these commands, you can compare the results to determine whether you have the lock.
- The differences between SYSTem:LOCK:NAME? and SYSTem:LOCK:OWNer? queries is that SYSTem:LOCK:OWNer? returns the name of the interface that has the lock, while SYSTem:LOCK:NAME? returns the name of the current interface, regardless of whether it has the lock.

**SYSTem:LOCK:OWNer?**

Returns the name of the I/O interface that currently has a lock. If no interface has a lock, the query returns NONE.

Parameter	Typical return
(none)	(none)

Returns the name of the I/O interface that currently has a lock:

SYST:LOCK:OWN?

Typical response: "USB169.254.149.35"

- If the value returned by this query matches the value returned by **SYSTem:LOCK:NAME?**, then the I/O session sending this query owns the lock.
- When a lock is active, bit 10 in the Standard Operation Register will be set (**STATus:OPERa-tion:CONDition?** command). When there is no active lock on any I/O interface, this bit will be cleared.
- The differences between SYSTem:LOCK:OWNer? and SYSTem:LOCK:NAME? queries is that SYSTem:LOCK:NAME? returns the name of the current interface, regardless of whether it has the lock, and SYSTem:LOCK:OWNer? returns the name of the interface that has the lock.

**SYSTem:LOCK:RELease**

Decrements the lock count by one and releases the instrument lock.

Parameter	Typical return
(none)	(none)

Decreases the lock count by one: SYST:LOCK:REL

The following series of commands illustrates usage of this command with **SYSTem:LOCK:REQuest?**.

Initial State = unlocked, Count = 0

```
<FROM USB> SYST:LOCK:REQ? returns +1 (request successful)
```

State = locked, Count = 1

```
<FROM LAN> SYST:LOCK:REQ? returns +0 because USB has lock
```

State = locked, Count = 1

```
<FROM USB> SYST:LOCK:REQ? returns +1 (request successful)
```

State = locked, Count = 2

```
<FROM USB> SYST:LOCK:REL
```

State = locked, Count = 1

## 2 SCPI Programming

```
<FROM USB> SYST:LOCK:REL
```

State = unlocked, Count = 0

- For each successful lock request, a lock release is required. Two requests require two releases.
- When a lock is active, bit 10 in the Standard Operation Register will be set (**STATus:OPERation:CONDition?** command). When the lock is released, this bit is cleared.

### SYSTem:LOCK:REQuest?

Issues a request to lock the instrument's configuration to a single I/O interface. This allows you to lock the instrument or share the instrument with other computers.

Parameter	Typical return
(none)	+1 (request granted) or +0 (request denied)
Requests a lock of the current I/O interface: SYST:LOCK:REQ?	

- You can refer to the previous example to see the usage of this command with **SYSTem:LOCK:RELease**. For each successful lock request, a lock release is required. Two requests require two releases.
- When a request is granted, only I/O sessions from the interface which was granted the lock will be allowed to change the state of the instrument. From the other I/O interfaces, you can query the state of the instrument but no instrument configuration changes or measurements are allowed.
- Lock requests can be nested and each request will increase the lock count by 1. For every request, you will need a release from the same I/O interface (**SYSTem:LOCK:RELease** command).
- Instrument locks are handled at the I/O interface level (USB or Sockets) and you are responsible for all coordination between threads and/or programs on that interface.
- Locks from socket sessions will be automatically released when a socket disconnect is detected.
- When a lock is granted, bit 10 in the Standard Operation Register will be set (**STATus:OPERation:CONDition?** command).



## SYSTem:PERSONa Subsystem

### Command Summary

**SYSTem:PERSONa[:MANufacturer]**

**SYSTem:PERSONa[:MANufacturer]:DEFault**

**SYSTem:PERSONa:MODEl**

**SYSTem:PERSONa:MODEl:DEFault**

**SYSTem:PERSONa[:MANufacturer] {"<string>"}**

**SYSTem:PERSONa[:MANufacturer]?**

Sets the instrument's manufacturer ID string for backward compatibility.

Parameter	Typical return
<string> = {"Keysight Technologies"   "Agilent Technologies"   "HEWLETT- PACKARD"} {"Keysight Technologies"   "Agilent Technologies"   "HEWLETT- PACKARD"}	"Keysight Technologies", "Agilent Technologies", or "HEWLETT- PACKARD"

Sets the instrument's manufacturer name to Keysight Technologies: SYST:PERS "Keysight Technologies"

- The command will affect \*IDN? that contains "Agilent Technologies", or "HEWLETT-PACKARD" instead of "Keysight Technologies".

**SYSTem:PERSONa[:MANufacturer]:DEFault**

**SYSTem:PERSONa[:MANufacturer]:DEFault?**

Returns the default manufacturer's ID string.

Parameter	Typical return
(none)	"Keysight Technologies"

Returns the default manufacturer's ID string: SYST:PERS:DEF

**SYSTem:PERSONa:MODEl {"DAQ970A" | "34970A" | "34972A"}**

**SYSTem:PERSONa:MODEl?**

Sets the instrument's model number for backward compatibility.

Parameter	Typical return
{"DAQ970A"   "34970A"   "34972A"}	"DAQ970A", "34970A", or "34972A"

Sets the instrument's model number to DAQ970A: SYST:PERS:MOD "DAQ970A"

## 2 SCPI Programming

### **SYSTem:PERSon:MODeL:DEFault** **SYSTem:PERSon:MODeL:DEFault?**

Returns the default instrument's model number.

Parameter	Typical return
(none)	"DAQ970A"

---

Returns the default instrument's model number: SYST:PERS:MOD:DEF

### **SYSTem:PRESet**

Presets the instrument to a known configuration. Readings are cleared, and channels are opened. Channel configurations are unchanged except on DAQM907A multifunction module.

Parameter	Typical return
(none)	(none)

---

Returns the instrument to preset state: SYST:PRES

- See [Instrument Preset State](#) for a complete listing of the instrument's preset state.

## SYSTEM:RELay Subsystem

### Command Summary

SYSTEM:RELay:CYCLes?

SYSTEM:RELay:CYCLes:CLEar

SYSTEM:RELay:CYCLes:FACTory?

### SYSTEM:RELay:CYCLes? (@<ch\_list>)

Reads the cycle count on the specified channels. In addition to the channel relays, you can also query the count on the Analog Bus relays and module relays.

Parameter	Typical return
(none)	+76289,+11055
Returns the cycle count on channels 103 and 113: SYST:REL:CYCL? (@103,113)	

### SYSTEM:RELay:CYCLes:CLEar (@<ch\_list>)

Resets the cycle count on the specified channels.

Parameter	Typical return
(none)	(none)
Resets the cycle count on channels 103 and 113: SYST:REL:CYCL:CLE (@103,113)	

### SYSTEM:RELay:CYCLes:FACTory? (@<ch\_list>)

Reads the factory cycle count on the specified channels.

Parameter	Typical return
(none)	+76289,+11055
Returns the factory cycle count on channels 103 and 113: SYST:REL:CYCL:FACT? (@103,113)	

## 2 SCPI Programming

### SYSTem:SECurity:COUNT?

Queries the instrument to determine the number of times it has been secured.

Parameter	Typical return
(none)	+22

---

Returns the instrument's security count: SYST:SEC:COUN?

- The security count is incremented only when security mode is enabled with **SYSTem:SECurity:ENABLE** command.
- This includes enabling or disabling interfaces, sanitizing memory per the NISPOM standard (**SYSTem:SECurity:IMMEDIATE** command), updating firmware, changing the security code, or overriding the calibration security.
- Be sure to read the initial security count with this command upon receiving your instrument.

### SYSTem:SECurity:ENABLE {OFF | ON} SYSTem:SECurity:ENABLE?

Enables (On) or disables (Off) system security.

Parameter	Typical return
{OFF ON} Default: ON	0 (OFF) or 1 (ON)

---

Disable system security: SYST:SEC:ENAB OFF

- Be sure to read the initial security count with this command upon receiving your instrument.
- **ON**: Security count will be incremented (**SYSTem:SECurity:COUNT?** command), and security must be unlocked from the front panel to make changes on I/O configurations (see **Remote Interface Configuration Commands**).
- **OFF**: Changes on I/O configurations can be done without unlocking the system security.

### SYSTem:SECurity:IMMEDIATE

#### CAUTION

This command is not recommended for use in routine applications due to the possibility of unintended loss of data.

Clears and sanitizes all instrument memory except for the instrument's firmware, MAC address, calibration parameters, and serial number. It then reboots the instrument to the new memory state. This command is typically used to clear all memory before removing the instrument from a secure area.

Parameter	Typical return
(none)	(none)

---

Sanitizes all user-accessible instrument memory: SYST:SEC:IMM

- The command clears and sanitizes all user files on the internal file, but will not clear an attached USB storage device.
- Security mode is a user-preferenced settings. It can be disabled (Off) when user-preferenced settings are set to default from front panel (press [Utility] > Security > Security Off), or by executing this command.
- This command initializes all instrument settings to their Factory Reset (\*RST command) values. All I/O settings, such as the IP address, are returned to their factory settings.

### **SYSTEM:SET <arbitrary\_block\_data > SYSTEM:SET?**

Sets the DAQ970A instrument state as defined by the data returned by SYSTEM:SET? query.

Parameter	Typical return
<arbitrary_block_data> = The block data returned by SYSTEM:SET? query.	#nN<instrument state>  where the first digit after the # indicates the number of following digits. The following digits indicate the length of the data.

### **SYSTEM:SLOT:LABel <slot>, "<string>" SYSTEM:SLOT:LABel? <slot>**

Allows you to add a custom label of up to 10 characters to the module in the specified slot. Characters beyond the tenth character are truncated, and no error message is generated. The query returns the label string.

Parameter	Typical return
<slot> = {1 2 3} <string> = A quoted string of up to 10 characters	Any label string defined.
Adds a custom label "Test" to a module in slot 2: SYST:SLOT:LAB 2, "TEST"	

- This command allows you to differentiate between modules of the same type from within your program.
- Unsecure the instrument with CALibration:SECure:STATe OFF command before you can store the custom label.

### **SYSTEM:TEMPerature?**

Returns the instrument's internal temperature in °C.

## 2 SCPI Programming

Parameter	Typical return
(none)	+3.89430885E+01

---

Return the instrument's internal temperature: SYST:TEMP?

---

- Value returned is not affected by **UNIT:TEMPerature**.

### **SYSTem:TIME <hour>, <minute>, <second>** **SYSTem:TIME?**

Sets the time for the instrument's real-time clock. Use **SYSTem:DATE** to set the date.

Parameter	Typical return
<hour> = 0 to 23 <minute> = 0 to 59 <second> = 0 to 60	Three comma-separated values in the form "hh,mm,sss.ss".

---

Sets the instrument time to 3:30:23.000 PM: SYST:TIME 15,30,23.000

---

- The real-time clock is used for Mass Memory (MMEMory) system file time stamps.
- The real-time clock is battery-backed and retains the date and time when power is off.
- When shipped from the factory, the instrument is set to the current time and date for Greenwich Mean Time (GMT).
- The real-time clock does not adjust itself for time zone changes or daylight savings time. Be sure to set the date and time when you first receive your instrument.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command) or after an Instrument Preset (**SYSTem:PRESet** command).

### **SYSTem:TIME:SCAN?**

Returns the time at the start of the scan.

Parameter	Typical return
(none)	yyyy,mm,dd,hh,mm,ss.sss

---

Returns the time and date at the start of the most recent scan:

SYST:TIME:SCAN?  
Typical response: 2018,01,01,22,03,10.314

---

The string returned has the form yyyy,mm,dd,hh,mm,ss.sss:

- yyyy** is the year
- mm** is the month
- dd** is the day of the month
- hh** is the hour in 24-hour format

**mm** is the minutes  
**ss.sss** is the seconds (with 1 ms resolution)

- You can read the time at any time, even during a scan.
- This command is not affected by the **FORMat:READing:TIME:TYPE** command, which selects the time format for storing scanned data in reading memory (absolute time versus relative time).
- This command is not affected by the **CALCulate:AVERage:CLEar** command, which clears all values from the statistics registers.
- The instrument clears all stored data on all channels when a new scan is started, after a Factory Reset (**\*RST** command), or after an Instrument Preset (**SYSTem:PRESet** command).

### SYSTem:UPTime?

Returns the amount of time that the instrument has been running since the last power-on.

Parameter	Typical return
(none)	+8,+2,+13,+50
Return time that the instrument has been running: SYST:UPT?	

- Typically used to verify that the instrument is warmed up sufficiently before calibration.
- The numbers returned indicate days, hours, minutes, and seconds, respectively.

### SYSTem:VERSion?

Returns version of the SCPI that the instrument complies with. There is no front panel equivalent.

Parameter	Typical return
(none)	YYYY.V, where YYYY is the year and V is the version number.
Returns the SCPI version:	
SYST:VERS?	
Typical response: 1994.0	

### SYSTem:WMESsage "<string>" SYSTem:WMESsage?

Displays a power-on message.

## 2 SCPI Programming

Parameter	Typical return
<p>&lt;string&gt; = A quoted string of up to 40 characters. You can use letters (A-Z), numbers (0-9) and special characters such as @, %, *, and so forth. Default ""</p>	"Keysight DAQ970A Data Acquisition System"
Display a power-on message: SYST:WMES "Keysight DAQ970A Data Acquisition System"	

- Specifying a null string ("" ) disables the power-on message.
- This parameter is set to its default value when the instrument is shipped from the factory and after **SYSTem:SECurity:IMMEDIATE**.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command) or after an Instrument Preset (**SYSTem:PRESet** command).



## Remote Interface Configuration Commands

### Command Summary

**SYSTem:COMMunicate:ENABle**  
**SYSTem:COMMunicate:LAN:CONTRol?**  
**SYSTem:COMMunicate:LAN:DHCP**  
**SYSTem:COMMunicate:LAN:DNS[*{1|2}*]**  
**SYSTem:COMMunicate:LAN:DOMain?**  
**SYSTem:COMMunicate:LAN:GATeway**  
**SYSTem:COMMunicate:LAN:HOSTname**  
**SYSTem:COMMunicate:LAN:IPADdress**  
**SYSTem:COMMunicate:LAN:MAC?**  
**SYSTem:COMMunicate:LAN:SMASK**  
**SYSTem:COMMunicate:LAN:TELNet:PROMpt**  
**SYSTem:COMMunicate:LAN:TELNet:WMESsage**  
**SYSTem:COMMunicate:LAN:UPDate**  
**SYSTem:COMMunicate:LAN:WINS[*{1|2}*]**  
**SYSTem:USB:HOST:ENABle**

**SYSTem:COMMunicate:ENABle {OFF | ON}, <*interface*>**

**SYSTem:COMMunicate:ENABle? <*interface*>**

Enables (On) or disables (Off) the LAN and USB interfaces, and others available remote interfaces on the instrument.

Parameter	Typical return
{OFF ON}	0 (OFF) or 1 (ON)
Default: ON, for all interfaces	
< <i>interface</i> > = {USB   LAN   SOCKets   TELNet   VXI11   WEB   USBMtp   USBHost   HISLip}	
Disable the USB interface: SYST:COMM:ENAB OFF,USB	

- After making changes, you must cycle instrument power for the changes to take effect.
- Enabling USBMtp allows you to transfer files, using media transfer protocol (MTP), from the instrument to a PC via the rear-panel USB interface connector.
- The USBHost parameter refers to the instrument's front panel USB port.
- If you disable the LAN interface, none of the associated LAN services will be started when you power on the instrument.

## 2 SCPI Programming

- **SYSTem:SECurity:IMMediate** enables all interfaces except USBMtp.
- The interface enable settings are stored in non-volatile memory, and does not change when power has been off, after a Factory Reset (**\*RST** command) or after an Instrument Preset (**SYSTem:PRESet** command).

### **SYSTem:COMMunicate:LAN:CONTRol?**

Reads and returns the control connection port number for Socket communications. Connection is used to send and receive commands and queries. If 0 is returned, the interface does not support a Socket Control connection.

Parameter	Typical return
(none)	+5000 (if the interface does not support sockets)

Returns the control connection port number.

SYST:COMM:LAN:CONT?  
Typical response: +5005

- This query is only used when programming over Sockets.
- You can use the Socket Control connection to send a Device Clear to the instrument or to detect pending Service Request (SRQ) events.

### **SYSTem:COMMunicate:LAN:DHCP {OFF | ON}**

#### **SYSTem:COMMunicate:LAN:DHCP?**

Enables (On) or disables (Off) the use of the Dynamic Host Configuration Protocol (DHCP) for the instrument.

ON: The instrument will try to obtain an IP address from a DHCP server. If a DHCP server is found, it will assign a dynamic IP address, Subnet Mask, and Default Gateway to the instrument. If a DHCP server is not found, the instrument uses AutoIP to automatically configure its IP setting in the Automatic Private IP Addressing range (169.254.xxx.xxx).

OFF: The instrument will use the static IP address, Subnet Mask, and Default Gateway during power-on.

#### **NOTE**

If you change this setting, you must execute a **SYSTem:COMMunicate:LAN:UPDate** command to activate the setting.

Parameter	Typical return
{OFF ON} Default: ON	0 (OFF) or 1 (ON)

Disables DHCP:

SYST:COMM:LAN:DHCP OFF  
SYST:COMM:LAN:UPD

- Most site LANs have a DHCP server.
- **SYSTem:SECurity:IMMEDIATE** sets this parameter to its default value.
- If a DHCP LAN address is not assigned by a DHCP server, then an AutoIP address static IP will be assumed after approximately two minutes.
- The DHCP setting is stored in non-volatile memory, and does not change when power has been off, after a Factory Reset (**\*RST**) or after an Instrument Preset (**SYSTem:PRESet**).

### **SYSTem:COMMunicate:LAN:DNS[**{1|2}**] "<address>"** **SYSTem:COMMunicate:LAN:DNS[**{1|2}**]? [**{CURRENT | STATIC}**]**

Assigns static IP addresses of Domain Name System (DNS) servers. A primary and a secondary server address (**{1|2}**) may be assigned. If DHCP is available and enabled, DHCP will auto-assign these server addresses. These auto-assigned server addresses take precedence over the static addresses assigned with this command. Contact your LAN administrator for details.

#### NOTE

If you change this setting, you must execute a **SYSTem:COMMunicate:LAN:UPDate** command to activate the setting.

Parameter	Typical return
<address> = Four-byte dot notation ("nnn.nnn.nnn.nnn"), where "nnn" in each case is a byte value in the range of 0 through 255.	"198.105.232.4"
<b>{CURRENT   STATIC}</b> Default = CURRENT	
Set a static primary DNS address:	
SYST:COMM:LAN:DNS "198.105.232.4"	
SYST:COMM:LAN:UPD	

- **CURRENT** - Returns address currently being used by the instrument.
- **STATIC** - Returns address from non-volatile memory. This address is used if DHCP is disabled or unavailable.
- **SYSTem:SECurity:IMMEDIATE** sets this parameter to its default value.
- The assigned DNS address is used for the DNS server if DHCP is disabled. Otherwise, the DNS server address is auto-assigned by DHCP.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command) or after an Instrument Preset (**SYSTem:PRESet** command).

### **SYSTem:COMMunicate:LAN:DOMain?**

Reads the current network domain name and returns an ASCII string enclosed in double quotes.

## 2 SCPI Programming

Parameter	Typical return
(none)	"example.com"

Returns the domain name being used by the instrument: SYST:COMM:LAM:DOM?

- If Dynamic Domain Name System (DNS) is available on your network and your instrument uses DHCP, the domain name is assigned by the Dynamic DNS service at power-on.
- If a domain name has not been assigned, a null string ( " " ) is returned.

### **SYSTem:COMMunicate:LAN:GATEway "<address>"** **SYSTem:COMMunicate:LAN:GATEway? [{CURRENT|STATIC}]**

Assigns a default gateway for the instrument. The specified IP Address sets the default gateway, which allows the instrument to communicate with systems that are not on the local subnet. Thus, this is the default gateway where packets are sent that are destined for a device not on the local subnet, as determined by the Subnet Mask setting. Contact your LAN administrator for details.

#### NOTE

If you change this setting, you must execute a **SYSTem:COMMunicate:LAN:UPDate** command to activate the setting.

Parameter	Typical return
<address> = Four-byte dot notation ("nnn.nnn.nnn.nnn"), where "nnn" in each case is a byte value in the range of 0 through 255.	"198.105.232.4"
[[CURRENT   STATIC]] Default = CURRENT	

Set a default gateway address:

```
SYST:COMM:LAN:GATE "198.105.232.4"  
SYST:COMM:LAN:UPD
```

- **CURRENT** - Returns address currently being used by the instrument.
- **STATIC** - Returns address from non-volatile memory. This address is used if DHCP is disabled or unavailable.
- **SYSTem:SECurity:IMMEDIATE** sets this parameter to its default value.
- If DHCP is enabled (**SYSTem:COMMunicate:LAN:DHCP ON** command), the specified default gateway is not used. However, if the DHCP server fails to assign a valid IP address, the currently configured default gateway is used.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command) or after an Instrument Preset (**SYSTem:PRESet** command).
- A gateway value of "0.0.0.0" indicates that subnetting is not being used.

## **SYSTem:COMMunicate:LAN:HOSTname "<name>"**

### **SYSTem:COMMunicate:LAN:HOSTname? [{CURRENT|STATIC}]**

Assigns a hostname to the instrument. A hostname is the host portion of the domain name, which is translated into an IP address. If Dynamic Domain Name System (Dynamic DNS) is available on your network and your instrument uses DHCP, the hostname is registered with the Dynamic DNS service at power-on. If DHCP is enabled (**SYSTem:COMMunicate:LAN:DHCP ON**), the DHCP server can change the specified hostname.

#### NOTE

If you change this setting, you must execute a **SYSTem:COMMunicate:LAN:UPDate** command to activate the setting.

Parameter	Typical return
<p>&lt;name&gt; = A string of up to 15 characters. Must start with letter (A-Z) May contain letters, numbers (0-9), or dashes ("-")</p> <p>Default: "K-&lt;instrument model number&gt;-nnnnn", where "nnnnn" is the last five digits of the instrument's serial number.</p>	
<p>[{CURRENT   STATIC}] Default = CURRENT</p>	
<p>Define a hostname:</p>	
<pre>SYST:COMM:LAN:HOST "LAB1-DAQ970A" SYST:COMM:LAN:UPD</pre>	

- **CURRENT** - Returns hostname currently being used by the instrument.
- **STATIC** - Returns desired hostname from non-volatile memory, that may not be the actual name used by the instrument if DHCP is enabled.
- If host name has not been assigned, the query returns a null string ("").
- This parameter is set to its default value when the instrument is shipped from the factory and after **SYSTem:SECurity:IMMEDIATE**.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command) or after an Instrument Preset (**SYSTem:PRESet** command).

## **SYSTem:COMMunicate:LAN:IPADdress "<address>"**

### **SYSTem:COMMunicate:LAN:IPADdress? [{CURRENT|STATIC}]**

Assigns a static Internet Protocol (IP) address for the instrument. If DHCP is enabled (**SYSTem:COMMunicate:LAN:DHCP ON**), the specified static IP address is not used. Contact your LAN administrator for details.

#### NOTE

If you change this setting, you must execute a **SYSTem:COMMunicate:LAN:UPDate** command to activate the setting.

## 2 SCPI Programming

Parameter	Typical return
<code>&lt;address&gt;</code> = Four-byte dot notation ("nnn.nnn.nnn.nnn"), where "nnn" in each case is a byte value in the range 0 through 255.	"198.105.232.4"
[[CURRent   STATic]] Default: CURRent	
Sets a static IP address:	
SYST:COMM:LAN:IPAD "198.105.232.4"	
SYST:COMM:LAN:UPD	

- **CURRent** - Returns address currently being used by the instrument.
- **STATic** - Returns static address from non-volatile memory. This address is used if DHCP is disabled or unavailable.
- **SYSTem:SECurity:IMMediate** sets this parameter to its default value.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST**) or after an Instrument Preset (**SYSTem:PRESet**).

### SYSTem:COMMunicate:LAN:MAC?

Returns the instrument's Media Access Control (MAC) address as an ASCII string of 12 hexadecimal characters (0-9 and A-F) enclosed in quotation marks.

#### NOTE

Your network administrator may need the instrument's MAC address in order to assign a static IP address for this device.

Parameter	Typical return
(none)	"0030D3001041"
Returns the MAC address: SYST:COMM:LAN:MAC?	

- Query reads the MAC address and returns an ASCII string enclosed in double quotes.
- The instrument's MAC address is unique to the instrument. It is set at the factory and cannot be changed.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command), or after an Instrument Preset (**SYSTem:PRESet** command).
- MAC address also known as the link-layer address, the Ethernet (station) address, LANIC ID, or Hardware Address. This is an unchangeable 48-bit address assigned by the manufacturer to each unique Internet device.

### SYSTem:COMMunicate:LAN:SMASk "<mask>" SYSTem:COMMunicate:LAN:SMASk? [[CURRent|STATic]]

Assigns a subnet mask for the instrument to use in determining whether a client IP address is on the same local subnet. When a client IP address is on a different subnet, all packets must be sent to the Default Gateway. Contact your LAN administrator for details.

**NOTE**

If you change this setting, you must execute a **SYSTem:COMMunicate:LAN:UPDate** command to activate the setting.

Parameter	Typical return
<code>&lt;mask&gt;</code> = Four-byte dot notation ("nnn.nnn.nnn.nnn"), where "nnn" in each case is a byte value in the range 0 through 255. Default: "255.255.0.0"	"198.105.232.4"
[[CURRent   STATic]] Default: CURRent	
Sets the subnet mask:	
SYST:COMM:LAN:SMAS "255.255.254.0" SYST:COMM:LAN:UPDate	

- **CURRent** - Returns subnet mask currently being used by the instrument.
- **STATic** - Returns subnet mask from non-volatile memory. This address is used if DHCP is disabled or unavailable.
- **SYSTem:SECurity:IMMediate** sets this parameter to its default value.
- A value of "0.0.0.0" or "255.255.255.255" indicates that subnetting is not being used.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command), or after an Instrument Preset (**SYSTem:PRESet** command).

### **SYSTem:COMMunicate:LAN:TELNet:PROMpt "<string>"** **SYSTem:COMMunicate:LAN:TELNet:PROMpt?**

Sets the command prompt displayed when communicating the instrument with Telnet.

Parameter	Typical return
<code>&lt;string&gt;</code> A string of up to 15 characters	"Command"
Defines the command prompt: SYST:COMM:LAN:TELN:PROM "Command"	

- Query returns the command prompt as ASCII strings enclosed in double quotes.
- Instrument uses LAN port 5024 for SCPI Telnet sessions, and port 5025 for SCPI Socket sessions.
- Telnet port is an alternate way to send SCPI commands to the instrument.

## 2 SCPI Programming

- Telnet session can typically be started as follows from a host computer shell:

```
telnet <IP_address> <port>
```

For example:

```
telnet 169.254.4.10 5024
```

To exit a Telnet session, press <Ctrl-D>.

- **SYSTem:SECurity:IMMEDIATE** sets this parameter to its default value.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command), or after an Instrument Preset (**SYSTem:PRESet** command).

### **SYSTem:COMMunicate:LAN:TELNet:WMESsage "<string>"** **SYSTem:COMMunicate:LAN:TELNet:WMESsage?**

Sets the welcome message displayed when communicating the instrument with Telnet.

Parameter	Typical return
<string> A string of up to 63 characters Default: "Welcome to Keysight's <instrument model number> Data Acquisition System"	"Welcome to the Telnet Session"
Define a welcome message: SYST:COMM:LAN:TELN:WMES "Welcome to the Telnet Session"	

- Query returns the command prompt as ASCII strings enclosed in double quotes.
- Instrument uses LAN port 5024 for SCPI Telnet sessions and port 5025 for SCPI Socket sessions.
- **SYSTem:SECurity:IMMEDIATE** sets this parameter to its default value.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command), or after an Instrument Preset (**SYSTem:PRESet** command).

### **SYSTem:COMMunicate:LAN:UPDate**

Stores any changes made to the LAN settings into non-volatile memory and restarts the LAN driver with the updated settings.

Parameter	Typical return
(none)	(none)



Parameter	Typical return
Configures the instrument to use statically assigned LAN settings (disables DHCP):	
SYST:COMM:LAN:DHCP OFF	
SYST:COMM:LAN:DNS "198.105.232.4"	
SYST:COMM:LAN:DNS2 "198.105.232.5"	
SYST:COMM:LAN:GAT "198.105.232.1"	
SYST:COMM:LAN:HOST "LAB1-DAQ970A"	
SYST:COMM:LAN:IPAD "198.105.232.101"	
SYST:COMM:LAN:WINS "198.105.232.4"	
SYST:COMM:LAN:WINS "198.105.232.5"	
SYST:COMM:LAN:UPD	

Configures the instrument back to use DHCP (enables DHCP):

```
SYST:COMM:LAN:DHCP OFF
SYST:COMM:LAN:UPD
```

- Be very careful when you execute this command, because your instrument may not work on the LAN if you update the instrument with invalid LAN settings.
- If your instrument does not work after you execute this command, perform the LAN Reset through instrument's front panel softkey to restore the settings to reset values and reset the LAN, or use another I/O interface, such as USB, to correct the settings.
- This command must be sent after changing the settings for DHCP, DNS, gateway, hostname, IP address, subnet mask, or WINS.

### **SYSTem:COMMunicate:LAN:WINS[*{1|2}*] "<address>"** **SYSTem:COMMunicate:LAN:WINS[*{1|2}*]? [*{CURRENT | STATic}*]**

Assigns the static IP addresses of the Windows Internet Name System (WINS) servers. A primary and a secondary server address (*{1|2}*) may be assigned. If DHCP is available and enabled, DHCP will auto-assign these server addresses. These auto-assigned server addresses take precedence over the static addresses assigned with this command. Contact your LAN administrator for details.

#### **NOTE**

If you change this setting, you must execute a **SYSTem:COMMunicate:LAN:UPDate** command to activate the setting.

Parameter	Typical return
<address> = Four-byte dot notation ("nnn.nnn.nnn.nnn"), where "nnn" in each case is a byte value in the range 0 through 255.	"198.105.232.4"
[ <i>{CURRENT   STATic}</i> ]	Default: CURRENT

## 2 SCPI Programming

Parameter	Typical return
Set a static primary WINS address:	
<code>SYST:COMM:LAN:WINS "198.105.232.4"</code>	
<code>SYST:COMM:LAN:UPD</code>	

- **CURRent** - Returns address currently being used by the instrument.
- **STATic** - Returns address from non-volatile memory. This address is used if DHCP is disabled or unavailable.
- **SYSTem:SECurity:IMMediate** sets this parameter to its default value.
- The assigned DNS address is used for the DNS server if DHCP is disabled. Otherwise, the DNS server address is auto-assigned by DHCP.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST**) or after an Instrument Preset (**SYSTem:PRESet**).

### **SYSTem:USB:HOST:ENABle {OFF | ON}**

#### **SYSTem:USB:HOST:ENABle?**

Enables (On) or disables (Off) the front panel USB host port. Calibration security must be unsecured (**CALibration: SECure:STATe OFF, <code>** command) before sending this command.

Parameter	Typical return
{OFF ON}	0 (OFF) or 1 (ON)
Default: OFF	
Disables the front panel USB host port:	
<code>CAL:SEC:STAT OFF,MY_CAL_CODE</code>	
<code>SYST:USB:HOST:ENAB OFF</code>	
<code>CAL:SEC:STAT ON</code>	

- If the front panel USB host port is disabled, it cannot be used to store or load measurements, state files, preferences or other files or to perform firmware update.
- The setting is non-volatile, and does not change when power has been off, after a Factory Reset (**\*RST** command), or after an Instrument Preset (**SYSTem:PRESet** command).

## TRIGger Subsystem

This subsystem configures the triggering that controls measurement acquisition.

**NOTE**

Only supported on multiplexer modules (DAQM900A, DAQM901A, DAQM902A, and DAQM908A) and DAQM907A multifunction module.

---

Recommendation: All triggered measurements should be made using an appropriate fixed manual range. That is, turn autorange on ([SENSe:]<function>:RANGe:AUTO ON command) or set a fixed range using the [SENSe:]<function>:RANGe, CONFigure?, or MEASure command.

---

### Command Summary

TRIGger:COUNT

TRIGger:SLOPe

TRIGger:SOURce

TRIGger:TIMer

**TRIGger:COUNT {<count> | MIN | MAX | DEF | INFinity}****TRIGger:COUNT? [{MIN | MAX | DEF}]**

Specifies the number of triggers that are accepted by the instrument before returning to the "idle" trigger state.

Parameter	Typical return
<count> = 1 to 1,000,000 (1x10 <sup>6</sup> ), or continuous (INFinity). Default: 1	+1.00000000E+00 For a continuous trigger (INFinity), the query returns "9.9E37".

Configures two channels for DC voltage measurements, puts the channels in the scan list (the scan list is redefined), and sets the trigger count to 10. For each trigger received, one reading is returned for each channel (20 readings total).

```
CONF:VOLT:DC 10,0.003,(@103,108)
ROUT:SCAN (@103,108)
TRIG:COUN 10
INIT
```

- After setting the trigger count, you must place the instrument in the "wait-for-trigger" state using the **INITiate** or **READ?** command. A trigger will not be accepted from the selected trigger source (**TRIGger:SOURce** command) until the instrument is in the "wait-for-trigger" state.
  - a. For the **BUS** source, the trigger count sets the number of **\*TRG** commands that will be accepted before returning to the "idle" trigger state.
  - b. For the **EXTernal** source, the trigger count sets the number of external pulses that will be accepted before returning to the "idle" trigger state.
  - c. For the **ALARm<n>** source, the trigger count sets the number of alarms that will be accepted before returning to the "idle" trigger state.
  - d. For the **TIMer** source, the trigger count sets the number of times the instrument will sweep through the scan list and therefore determines the overall duration of the scan.
- You can store at least 100,000 readings in reading memory and all readings are automatically time stamped. If memory overflows, the new readings will overwrite the first (oldest) readings stored; the most recent readings are always preserved.
- To set the trigger-to-trigger interval (in seconds) for measurements on the channels in the present scan list, use the **TRIGger:TIMer** command.
- The **CONFigure** and **MEASure?** commands automatically set the trigger count to 1.
- The instrument sets the trigger count to 1 after a Factory Reset (**\*RST** command).

**TRIGger:SLOPe {POSitive | NEGative}****TRIGger:SLOPe?**

Specifies polarity of trigger signal on rear-panel Ext Trig/Alarms connector for any externally-triggered mode.

Parameter	Typical return
{POSitive   NEGative} Default: NEG	POS or NEG
Use rising edge (POS) of the trigger signal: TRIG:SLOP POS	

- A Factory Reset (**\*RST** command) resets the slope to the default positive rising edge.

## TRIGger:SOURce {IMMEDIATE | EXTERNAL | BUS | TIMER | ALARm[{1|2|3|4}]}

### TRIGger:SOURce?

Selects the trigger source to start a sweep. A sweep is one pass through the scan list.

Parameter	Typical return
{IMMEDIATE   EXTERNAL   BUS   TIMER   ALARm[{1 2 3 4}]}	"IMM", "EXT", "BUS", "TIM", "ALAR1", "ALAR2", "ALAR3", or "ALAR4".
IMMEDIATE = Continuous scan trigger	
EXTERNAL = An external TTL-compatible pulse trigger	
BUS = Software trigger	
TIMER = Internally paced timer trigger	
ALARm = Trigger on alarm 1,2,3, and 4	

Default: IMMEDIATE

Selects the external trigger source. In this configuration, the instrument sweeps through the scan list once each time a low-true TTL-compatible pulse is received on the rear-panel Ext Trig/Alarms connector.

TRIG:SOUR EXT

INIT

Typical response: EXT

Selects the bus (software) trigger source. Note that the **\*TRG** command will not be accepted unless the instrument is in the "wait-for-trigger" state.

TRIG:SOUR BUS

INIT

\*TRG

Typical response: BUS

- For the IMMEDIATE (continuous) source, the trigger signal is always present. When you place the instrument in the "wait-for-trigger" state, the trigger is issued immediately.
- The **READ?** and **MEASure** commands and queries cannot be used to take readings when the selected trigger source is BUS. This is called a trigger deadlock condition.
- For the BUS (software) source, the instrument is triggered by the **\*TRG** command received over the remote interface. The **\*TRG** command will not be accepted unless the instrument is in the "wait-for-trigger" state (**INITiate** command). If the instrument receives an external trigger before the next "waiting for trigger" state, it will buffer one **\*TRG** command and then ignore any additional triggers received (no error is generated).

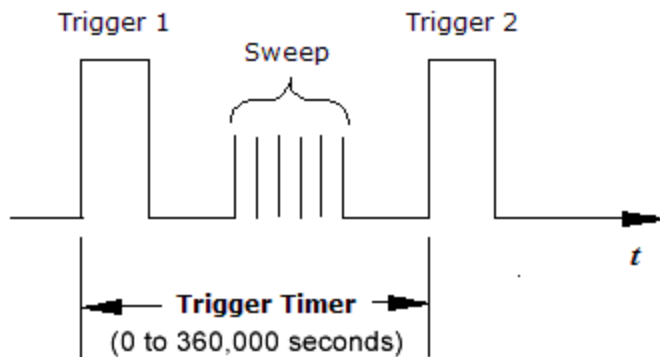
## 2 SCPI Programming

- For the EXTERNAL source, the instrument will accept a hardware trigger applied to the rear-panel Ext Trig/Alarms connector. The instrument takes one sweep through the scan list each time a low-true TTL-compatible pulse is received. If the instrument receives an external trigger but is not in the "wait-for-trigger" state, it will buffer one trigger and then ignore any additional triggers received (no error is generated). Also, if the trigger source is BUS, you can use the [Scan] key as a trigger.
- For the ALARm<n> source, the instrument is triggered each time a reading crosses an alarm limit on a channel. See the **OUTPut:ALARm<n>:SOURce** command for more information. With this source, you can use the Monitor mode (see **ROUTE:MONitor:STATe** command) to continuously take readings on a selected channel and wait for an alarm on that channel.
- For the TIMER source, you can control the trigger-to-trigger interval (in seconds) for measurements on the channels in the present scan list. Use the **TRIGger:TIMer** command to set the wait period.
- After selecting the trigger source, you must place the instrument in the "wait-for-trigger" state using the **INITiate** or **READ?** command. A trigger will not be accepted from the selected trigger source until the instrument is in the "wait-for-trigger" state.
- Although the **TRIGger:SOURce** command shares some of the same signals as the **ROUTE:CHANnel:ADVance:SOURce** command (used for external scanning), they cannot be set to the same source (except IMMEDIATE). If you attempt to select the same source, an error is generated and the **TRIGger:SOURce** is reset to IMMEDIATE.
- The **CONFigure** and **MEASure?** commands automatically set the trigger source to IMMEDIATE.
- The instrument selects the immediate trigger source after a Factory Reset (**\*RST** command). An Instrument Preset (**SYSTem:PRESet** command) or Card Reset (**SYSTem:CPON** command) does not change the setting.

**TRIGger:TIMer** {<seconds>|MIN|MAX|DEF}

**TRIGger:TIMer?** [{MIN|MAX|DEF}]

Sets the trigger-to-trigger interval (in seconds) for measurements on the channels in the present scan list. This command defines the time from the start of one trigger to the start of the next trigger, up to the specified trigger count (**TRIGger:COUNt** command).



Parameter	Typical return
<code>&lt;seconds&gt; =</code> A number from 0 seconds to 360,000 (default: 10) with 1/32,768 Hz resolution (~30.5 $\mu$ s)	+1.00000000E+01
Sets the trigger interval to 30 milliseconds.	
TRIG:SOUR TIMER	
TRIG:TIM 30E-03	

- The scan interval applies to the TIMER trigger source as set by the **TRIGger:SOURce** command.
- If the scan interval is less than the time required to measure all channels in the scan list, the instrument will scan continuously, as fast as possible (no error is generated).
- The **CONFigure** and **MEASure?** commands automatically set the trigger interval to 1 second and the trigger count to 1 sweep.
- The instrument sets the scan interval to immediate (0 seconds) after a Factory Reset (**\*RST** command).

# 3 SCPI Error Messages

## SCPI Error Messages

Command Errors (-100...)

Execution Errors (-200...)

Device-specific Errors (-300...)

Query Errors (-400...)

Network Errors (+100...)

Instrument Errors (+200...)

Miscellaneous Errors (+300..., +400..., and +500...)

Self-test Errors (+600...)

Calibration Errors (+700...)

Miscellaneous Errors (+800...)

This chapter describes the SCPI error codes and error messages returned from the DAQ970A.



## SCPI Error Messages

The instrument returns error messages in accordance with the SCPI standard.

- Up to 20 errors can be saved in the instrument's error queue. Each remote interface I/O session (USB, VXI-11, Telnet/Sockets) has its own interface-specific error queue. Errors appear in the error queue of the I/O session that caused the error. For example, if an error was generated by a command sent over USB, send **SYSTem:ERRor?** from USB interface to read the error queue. Errors generated by instrument hardware are broadcast to all I/O sessions.
- The instrument beeps each time an error is generated (unless disabled by **SYSTem:BEEPer:STATe OFF**). The front panel error annunciator (ERR) turns on when one or more errors are in the error queue.
- A special global error queue holds all power-on and hardware-related errors (for example, over temperature).
- Error retrieval is in first-in-first-out (FIFO) order, and cleared as you read the error queue. When you have read all of the interface-specific errors, the errors in the global error queue are retrieved. When you have read all errors from the interface-specific and global error queues, the error annunciator (ERR) turns off.
- If more than 20 errors have occurred, the most recent error saved in the queue is replaced with "- 350 Queue overflow". No additional errors are saved until you remove errors from the queue. If no errors have occurred when you read the error queue, the instrument responds with "+0 No error".
- The front panel reports errors from all I/O sessions and the global error queue. To read the error queue from the front panel, press **[View] > Errors**.
- Error conditions are also summarized in the **Status Byte Register**. For more information, see **STATUS Subsystem**.
- The interface-specific error queues are cleared by the **\*CLS** (Clear Status) command and when power is cycled. The error queue is not cleared by a Factory Reset (**\*RST** command) or an Instrument Preset (**SYSTem:PRESet** command).
- **Front panel:**  
If the error annunciator (ERR) turns on, there are errors in the error queue. The remote annunciator (RMT) is likely on as well. Press the "Local" key to return to local operation mode (the remote annunciator (RMT) turns off). Then press **[View] > Errors** to view the error queue (up to 20 errors). Errors are cleared as you read them and error annunciator (ERR) will be disabled.
- **Remote interface:**  
**SYSTem:ERRor?** Read and clear one error from the error queue. Errors have the following format (the error string may contain up to 80 characters):

"-113 Undefined header"

### 3 SCPI Error Messages

#### Command Errors (-100...)

Error code	Error message
-100	Command error
-101	Invalid character
-102	Syntax error
-103	Invalid separator
-104	Data type error
-105	GET not allowed
-108	Parameter not allowed
-109	Missing parameter
-110	Command header error
-111	Header separator error
-112	Program mnemonic too long
-113	Undefined header
-114	Header suffix out of range
-120	Numeric data error
-121	Invalid character in number
-123	Numeric overflow
-123	Exponent too large
-124	Too many digits
-128	Numeric data not allowed
-130	Suffix error"
-131	Invalid suffix
-134	Suffix too long
-138	Suffix not allowed
-140	Character data error
-141	Invalid character data
-144	Character data too long
-148	Character data not allowed
-150	String data error
-151	Invalid string data
-158	String data not allowed
-160	Block data error
-161	Invalid block data
-168	Block data not allowed
-170	Expression error
-171	Invalid expression
-178	Expression data not allowed

## Execution Errors (-200...)

Error code	Error message
-200	Execution error
-201	Invalid while in local
-203	Secure option: Instrument security is unlocked
-203	Command protected; License required
-203	Command protected"
-210	Trigger error
-211	Trigger ignored
-212	Arm ignored
-213	Init ignored
-213	INIT ignored
-214	Trigger deadlock
-215	Arm deadlock
-220	Parameter error
-221	Settings conflict; trigger source is BUS
-221	Settings conflict; trig source changed to IMM
-221	Settings conflict; scaling not allowed in current measurement function; CALC:SCAL:STAT OFF set
-221	Settings conflict; offset compensation not allowed with low power ohms; low power disabled
-221	Settings conflict; lower limit > upper limit
-221	Settings conflict; internal trigger not allowed in current measurement function; TRIG:SOUR IMM selected
-221	Settings conflict; channel removed from scan list
-221	Settings conflict; chan adv source changed to IMM
-221	Settings conflict; cannot delete state selected and enabled for automatic power-on recall
-221	Settings conflict; CALC:SCAL:REF 0.0 not compatible with CALC:SCAL:FUNC PCT; CALC:SCAL:STATE OFF set
-221	Settings conflict: state recall failed due to SOURce:MODE:LOCK conflict
-221	Settings conflict: one or more dependent measurement channels not in scan list; computed channel removed
-221	Settings conflict: module type does not match state
-221	Settings conflict: channel numbers for computed channel arguments must be lower than the computed channel number
-221	Settings conflict: cannot change DAC output mode when locked
-221	Settings conflict: DMM enabled
-221	Settings conflict: DMM enable changed
-221	Settings conflict: DMM disabled
-221	Settings conflict

### 3 SCPI Error Messages

Error code	Error message
-222	Data out of range; value clipped to upper limit
-222	Data out of range; value clipped to lower limit
-222	Data out of range
-223	Too much data
-224	Illegal parameter value
-225	Out of memory; measurement data overrun
-225	Out of memory
-226	Lists not same length
-230	Data corrupt or stale
-231	Data questionable; requested sample timing not met
-231	Data questionable
-232	Invalid format
-232	Commas are not allowed
-233	Invalid version
-240	Hardware error; not able to communicate with DMM
-240	Hardware error; main processor initialization failed
-240	Hardware error; GPIB interface failed
-240	Hardware error; DMM hardware initialization failed
-240	Hardware error; DMM FPGA FIFO overflow
-240	Hardware error
-241	Hardware missing
-250	Mass storage error; internal file system could not be opened
-250	Mass storage error; USB file system could not be opened
-250	Mass storage error: file read/write error
-250	Mass storage error
-251	Missing mass storage
-252	Missing media
-253	Corrupt media; internal file system scan failed
-253	Corrupt media; internal file system format failed
-253	Corrupt media; file system corruption detected; reformat needed
-253	Corrupt media; USB file system scan failed
-253	Corrupt media
-254	Media full
-255	Directory full
-256	File or folder name not found
-256	File name not found

Error code	Error message
-257	File name error; unknown file extension
-257	File name error; relative path not allowed
-257	File name error; path too long
-257	File name error; path name missing
-257	File name error; path is a folder name
-257	File name error; not a folder name
-257	File name error; invalid character in name
-257	File name error; folder not empty
-257	File name error; folder is default folder
-257	File name error; file too large
-257	File name error; file or folder already exists
-257	File name error; drive name missing or not recognized
-257	File name error; access denied
-257	File name error
-258	Media protected
-260	Expression error
-261	Math error in expression
-290	Memory use error
-291	Out of memory
-292	Referenced name does not exist

### Device-Specific Errors (-300...)

Error code	Error message
-300	Device specific error
-310	System error; software initialization failed
-310	System error; out of memory
-310	System error; internal software error
-310	System error: slave processor received unexpected signal
-310	System error: slave processor aborted due to error
-310	System error
-311	Memory error
-312	PUD memory lost
-312	PUD memory error
-313	Calibration memory lost; due to firmware revision change
-313	Calibration memory lost
-314	Save/recall memory lost; memory corruption detected
-314	Save/recall memory lost; due to firmware revision change

### 3 SCPI Error Messages

Error code	Error message
-314	Save/recall memory lost
-315	Configuration memory lost; memory corruption detected
-315	Configuration memory lost; due to firmware revision change
-315	Configuration memory lost
-320	Storage fault
-321	Out of memory
-330	Self-test failed
-340	Calibration failed
-350	Queue overflow
-350	Error queue overflow
-360	Communication error
-363	Input buffer overrun

#### Query Errors (-400...)

Error code	Error message
-400	Query error
-410	Query INTERRUPTED
-420	Query UNTERMINATED
-430	Query DEADLOCKED
-440	Query UNTERMINATED after undefine response

#### Network Errors (+100...)

Error code	Error message
100	Network Error
110	LXI mDNS Error
111	Channel list: slot number out of range
112	Channel list: channel number out of range
113	Channel list: empty scan list

#### Instrument Errors (+200...)

Error code	Error message
201	Memory lost: stored state
202	Memory lost: power-on state
203	Memory lost: stored measurements
204	Memory lost: time and date
251	Unsupported temperature transducer type

Error code	Error message
261	Not able to execute while scan initiated
262	Not able to abort scan
263	Not able to execute while instrument is measuring
264	Not a scannable channel
281	Not able to perform on more than one channel
291	Not able to recall state: it is empty
292	State file size error
293	State file corrupt
294	Preference file size error
295	Preference file corrupt

### Miscellaneous Errors (+300..., +400..., and +500...)

Error code	Error message
301	Module currently committed to scan
302	No module was detected in this slot
303	Module is not able to perform requested operation
304	Does not exist
305	Not able to perform requested operation
306	Part of a 4-wire pair
307	Incorrectly configured ref channel
308	Channel not able to perform requested operation
309	Incorrectly formatted channel list
310	Operation refused because channel is locked open
311	No channel in range able to perform requested operation
312	Channel currently committed to scan
320	DMM communication error: boot message queue overflowed
320	DMM communication error: command returned error status
320	DMM communication error: communication restart failed
320	DMM communication error: communication restart succeeded
320	DMM communication error: data packet error detected
320	DMM communication error: read error detected
320	DMM communication error: write error detected
330	Data logging halted due to slow USB stick write speed
401	Temperature warning: unit overheating
402	Temperature error: unit overheated; DMM power turned off to prevent damage
403	Power error: DMM power lost
404	Real Time Clock battery is low, settings may be lost

### 3 SCPI Error Messages

Error code	Error message
514	Not allowed
514	Not allowed; Instrument locked by another I/O session
521	Communications: input buffer overflow
522	Communications: output buffer overflow
532	Not able to achieve requested resolution
540	Cannot use overload as math reference or offset
541	Cannot use zero as math reference for PCT scaling function
542	Measured dB reference too small
550	Not able to execute command in local mode

### Self-test Errors (+600...)

Error code	Error message
611	Self-test failed; Real Time Clock reset, check battery
612	Self-test failed; not able to communicate with keyboard processor
613	Self-test failed; not able to communicate with power processor
614	Self-test failed; not able to sense line frequency
615	Self-test failed; not able to communicate with DMM
616	Self-test failed; DMM calibration memory reading error
617	Self-test failed; DMM FPGA unconfigured
618	Self-test failed; DMM FPGA bus error
619	Self-test failed; DMM FPGA clock
620	Self-test failed; DMM shift register
621	Self-test failed; DMM overload sense stuck on
622	Self-test failed; DMM ADC generic error
623	Self-test failed; DMM ADC integrator saturated
624	Self-test failed; DMM Coarse ADC error
625	Self-test failed; DMM ADC offset
626	Self-test failed; DMM ADC noise
627	Self-test failed; DMM Fine ADC generic error
628	Self-test failed; DMM Fine ADC off-scale low
629	Self-test failed; DMM Fine ADC off-scale high
630	Self-test failed; DMM Fine ADC range
631	Self-test failed; DMM Fine ADC not monotonic
632	Self-test failed; DMM Fine ADC slope
633	Self-test failed; DMM Fine ADC linearity
634	Self-test failed; DMM low DC zero



Error code	Error message
635	Self-test failed; DMM high DC zero
636	Self-test failed; DMM +7V reference
637	Self-test failed; DMM -10V reference
638	Self-test failed; DMM x1 gain, zero input
639	Self-test failed; DMM x10 gain, zero input
640	Self-test failed; DMM x100 gain, zero input
641	Self-test failed; DMM precharge
642	Self-test failed; DMM x1 gain, non-zero input
643	Self-test failed; DMM x10 gain, non-zero input
644	Self-test failed; DMM x100 gain, non-zero input
645	Self-test failed; DMM 100uA current source
646	Self-test failed; DMM 10uA current source
648	Self-test failed; DMM AC offset
649	Self-test failed; DMM frequency input
650	Self-test failed; DMM input switch
651	Self-test failed; DMM autocal 10 V range full scale
652	Self-test failed; DMM autocal 10 V range tenth scale
653	Self-test failed; DMM autocal 1 V range full scale
654	Self-test failed; DMM autocal 1 V range tenth scale
655	Self-test failed; DMM autocal 100 mV range full scale
656	Self-test failed; DMM autocal 100 V range reference
657	Self-test failed; DMM autocal 10 KOhm range full scale
658	Self-test failed; DMM autocal 10 KOhm range tenth scale
659	Self-test failed; DMM autocal 1 KOhm range full scale
660	Self-test failed; DMM autocal 100 KOhm range tenth scale
661	Self-test failed; DMM autocal 1 MOhm range half scale
662	Self-test failed; DMM autocal 100 KOhm to 1 MOhm transfer
663	Self-test failed; DMM autocal 1 MOhm to 10 MOhm transfer
664	Self-test failed; DMM autocal 10 MOhm internal resistor
665	Self-test aborted; high ac voltage present on DMM input
666	Self-test aborted; high dc voltage present on DMM input
667	Self-test failed; main processor temperature too high
668	Self-test failed; Real Time Clock battery is low, settings may be lost
669	Self-test failed; fan control temperature exceeds operating limits
670	Self-test failed; DMM power supply
687	Self-test failed: nonvolatile SRAM

#### Module related self-test errors

### 3 SCPI Error Messages

Error code	Error statement
671	Self-test failed; communication with module slot #
672	Self-test failed; service request of module slot #
673	Self-test failed; GPO signal of module slot # Self-test failed; GP1 signal of module slot #
674	Self-test failed; temperature sensor of module slot # Self-test failed; communication with temperature sensor of module slot #
675	Self-test failed; DAC autocal output voltage offset of module slot #, channel #
676	Self-test failed; DAC autocal output voltage positive gain of module slot #, channel #
677	Self-test failed; DAC autocal output voltage negative gain of module slot #, channel #
678	Self-test failed; DAC autocal output current offset of module slot #, channel #
679	Self-test failed; DAC autocal output current positive gain of module slot #, channel #
680	Self-test failed; DAC autocal output current negative gain of module slot #, channel #
681	Self-test failed; DAC autocal sense voltage offset of module slot #, channel #
682	Self-test failed; DAC autocal sense voltage gain of module slot #, channel #
683	Self-test failed; DAC autocal sense current offset of module slot #, channel #
684	Self-test failed; DAC autocal sense current gain of module slot #, channel #
685	Self-test failed; nonvolatile RAM checksum of NvRelayFactory of module in slot # Self-test failed; nonvolatile RAM checksum of NvRelayOffset of module in slot # Self-test failed; fail to get nonvolatile RAM checksum of module in slot #
686	Self-test failed; fail to get firmware image checksum of module in slot #

## Calibration Errors (+700...)

Error code	Error message
701	Calibration error; security defeated
702	Calibration error; calibration memory is secured
703	Calibration error; secure code provided was invalid
704	Calibration error: secure code too long
705	Calibration error; calibration aborted
706	Calibration error: provided value out of range
707	Calibration error: computed correction factor out of range
708	Calibration error: signal measurement out of range
708	Calibration error; signal frequency out of range
709	Calibration error: no calibration for this function/range
710	Calibration error: full scale correction out of range
711	Calibration error: calibration string too long
712	Calibration failed
713	Calibration error; ADC calibration failed; ADC configuration 'ACI' did not converge
713	Calibration error; ADC calibration failed; ADC configuration 'ACV' did not converge
713	Calibration error; ADC calibration failed; ADC configuration 'DCV' did not converge
713	Calibration error; ADC calibration failed; DC offset for setup 'ACI'
713	Calibration error; ADC calibration failed; DC offset for setup 'ACV'
713	Calibration error; ADC calibration failed; DC offset for setup 'DCV'
713	Calibration error; ADC calibration failed; LUT gain for setup 'ACI'
713	Calibration error; ADC calibration failed; LUT gain for setup 'ACV'
713	Calibration error; ADC calibration failed; LUT gain for setup 'DCV'
713	Calibration error; ADC calibration failed; LUT goal incompatible with ACV
713	Calibration error; ADC calibration failed; PI offset for setup 'ACI'
713	Calibration error; ADC calibration failed; PI offset for setup 'ACV'
713	Calibration error; ADC calibration failed; PI offset for setup 'DCV'
713	Calibration error; ADC calibration failed; feedbackLutGainTune unsupported LUT goal
713	Calibration error; ADC calibration failed; feedbackLutTune search did not converge
713	Calibration error; ADC calibration failed; feedbackPiCancel did not converge for setup 'ACI'
713	Calibration error; ADC calibration failed; feedbackPiCancel did not converge for setup 'ACV'
713	Calibration error; ADC calibration failed; feedbackPiCancel did not converge for setup 'DCV'
713	Calibration error; ADC calibration failed; fine merge for setup 'ACI'
713	Calibration error; ADC calibration failed; fine merge for setup 'ACV'
713	Calibration error; ADC calibration failed; fine merge for setup 'DCV'
713	Calibration error; ADC calibration failed; fine offset for setup 'ACI'

### 3 SCPI Error Messages

Error code	Error message
713	Calibration error; ADC calibration failed; fine offset for setup 'ACV'
713	Calibration error; ADC calibration failed; fine offset for setup 'DCV'
713	Calibration error; ADC calibration failed; fineDcCancel found non-monotonic value in setup 'ACI'
713	Calibration error; ADC calibration failed; fineDcCancel found non-monotonic value in setup 'ACV'
713	Calibration error; ADC calibration failed; fineDcCancel found non-monotonic value in setup 'DCV'
713	Calibration error; DCV 10M input impedance gain adjustment out of range
715	Calibration error; must perform +100mV DCV calibration before -100mV
715	Calibration error; must perform +100uA DCI calibration before -100uA
715	Calibration error; must perform +10V DCV calibration before -10V
715	Calibration error; must perform 10MOhm calibration before 100MOhm
720	Calibration error; DCV offset out of range
721	Calibration error; DCI offset out of range
722	Calibration error; RES offset out of range
723	Calibration error; FRES offset out of range
724	Calibration error; extended resistance self cal failed
725	Calibration error; 1000V DC correction out of range
726	Calibration error; ACV offset out of range
727	Calibration error; ACI offset out of range
730	Calibration error; precharge DAC convergence failed
731	Calibration error; A/D turnover correction out of range
732	Calibration error; AC flatness calibration failed
733	Calibration error; AC low frequency correction out of range
734	Calibration error; AC flatness calibration restarted by function/range change
735	Calibration error; 1 kHz AC flatness frequency point must be last frequency point in sequence
736	Calibration error; DCI 100uA range self-cal failed
740	Calibration data lost: secure state
740	Calibration information lost; count, security state, security code, string
741	Calibration data lost: string data
742	Calibration data lost: corrections
746	System information write failure
747	System information read failure
748	Calibration memory write failure
749	Calibration memory read failure
750	Autocalibration corrections lost; due to firmware revision change
750	Autocalibration corrections lost
751	Autocalibration memory write failure

Error code	Error message
752	Autocalibration memory read failure
753	Autocalibration measurement out of range
754	Module autocalibration needed due to mainframe change
760	Operation aborted; high voltage present on input terminals

### Miscellaneous Errors (+800...)

Error code	Error message
800	Nonvolatile memory write failure
810	State has not been recalled
820	Model and serial numbers not restored
821	Controller and measurement board model numbers do not match
822	Controller and measurement board serial numbers do not match
823	Incorrect firmware loaded for this model number

# 4 Plug-in Modules Reference Information

[DAQM900A 20-Channel FET Multiplexer Module](#)

[DAQM901A 20-Channel Armature Multiplexer Module](#)

[DAQM902A 16-Channel Reed Multiplexer Module](#)

[DAQM903A 20-Channel Actuator/General-Purpose Switch Module](#)

[DAQM904A 4×8 Two-Wire Matrix Switch Module](#)

[DAQM905A Dual 1:4 RF Multiplexer \(50 Ω\) Module](#)

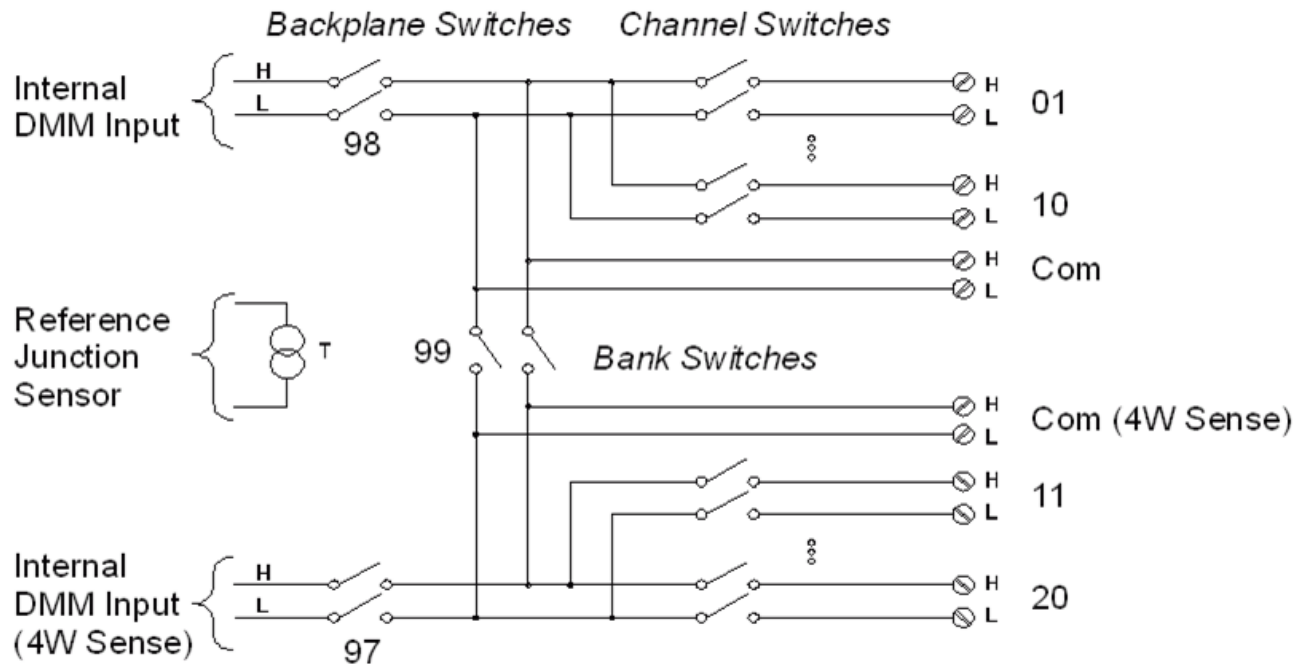
[DAQM907A Multifunction Module](#)

[DAQM908A 40-Channel Single-Ended Multiplexer Module](#)

This chapter describes the simplified schematic diagrams and SCPI commands used on each plug-in modules. Refer to *DAQ970A User's Guide* for further details on each plug-in modules.

## DAQM900A 20-Channel FET Multiplexer

Simplified schematic diagram



SCPI commands used

CALCulate:AVERage:ALL?

CALCulate:AVERage:AVERage?

CALCulate:AVERage:MAXimum?

CALCulate:AVERage:MINimum?

CALCulate:AVERage:PTPeak?

CALCulate:AVERage:SDEVIation?

CALCulate:AVERage:CLEar

CALCulate:AVERage:COUNT?

CALCulate:AVERage:MAXimum:TIME?

CALCulate:AVERage:MINimum:TIME?

CALCulate:SCALE:DB:REFerence

CALCulate:SCALE:DBM:REFerence

CALCulate:SCALE:FUNCTion

CALCulate:SCALE:GAIN

CALCulate:SCALE:OFFSet

CALCulate:SCALE:OFFSet:NULL

#### 4 Plug-in Modules Reference Information

CALCulate:SCALE:REfERENCE  
CALCulate:SCALE:REfERENCE:AUTO  
CALCulate:SCALE[:STATe]  
CALCulate:SCALE:UNIT  
CALCulate:SCALE:UNIT:STATe  
CALCulate:LIMit:LOWer  
CALCulate:LIMit:UPPer  
CALCulate:LIMit:LOWer:STATe  
CALCulate:LIMit:UPPer:STATe  
CONFigure?  
CONFigure:{FREQuency|PERiod}  
CONFigure:{RESistance|FRESistance}  
CONFigure:STRain:{FULL|HALF}:BENDing  
CONFigure:STRain:{FULL|HALF}:POISSon  
CONFigure:STRain:FULL:BENDing:POISSon  
CONFigure:STRain:QUARter  
CONFigure:TEMPerature  
CONFigure[:VOLTage]:{AC|DC}  
\*CAL?  
MEASure:{FREQuency|PERiod}?  
MEASure:{RESistance|FRESistance}?  
MEASure:STRain:{FULL|HALF}:BENDing?  
MEASure:STRain:{FULL|HALF}:POISSon?  
MEASure:STRain:FULL:BENDing:POISSon?  
MEASure:STRain:QUARter?  
MEASure:TEMPerature?  
MEASure[:VOLTage]:DC  
[SENSe:]{FREQuency|PERiod}:APERture  
[SENSe:]{FREQuency|PERiod}:RANGe:LOWer  
[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe:AUTO  
[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe  
[SENSe:]{RESistance|FRESistance}:APERture  
[SENSe:]{RESistance|FRESistance}:APERture:ENABLE



[SENSe:]{RESistance|FRESistance}:NPLCycles  
 [SENSe:]{RESistance|FRESistance}:OCOMpensated  
 [SENSe:]{RESistance|FRESistance}:POWER:LIMit[::STATe]  
 [SENSe:]{RESistance|FRESistance}:RANGe:AUTO  
 [SENSe:]{RESistance|FRESistance}:RANGe  
 [SENSe:]RESistance:ZERO:AUTO  
 [SENSe:]STRain:APERture  
 [SENSe:]STRain:APERture:ENABLE  
 [SENSe:]STRain:EXCitation  
 [SENSe:]STRain:EXCitation:TYPE  
 [SENSe:]STRain:GFACtor  
 [SENSe:]STRain:NPLCycles  
 [SENSe:]STRain:OCOMpensated  
 [SENSe:]STRain:POISson  
 [SENSe:]STRain:RESistance  
 [SENSe:]STRain:UNSTrained  
 [SENSe:]STRain:UNSTrained:IMMEDIATE  
 [SENSe:]STRain:VOLTagE:RANGe:AUTO  
 [SENSe:]STRain:VOLTagE:RANGe  
 [SENSe:]STRain:ZERO:AUTO  
 [SENSe:]TEMPerature:APERture  
 [SENSe:]TEMPerature:APERture:ENABLE  
 [SENSe:]TEMPerature:NPLCycles  
 [SENSe:]TEMPerature:RJUNction?  
 [SENSe:]TEMPerature:TRANSDUCER:{FRTD|RTD}:OCOMpensated  
 [SENSe:]TEMPerature:TRANSDUCER:{FRTD|RTD}:POWER:LIMit[::STATe]  
 [SENSe:]TEMPerature:TRANSDUCER:{FRTD|RTD}:REFerence  
 [SENSe:]TEMPerature:TRANSDUCER:{FRTD|RTD}:RESistance[::REFerence]  
 [SENSe:]TEMPerature:TRANSDUCER:{FThermistor|Thermistor}:POWER:LIMit[::STATe]  
 [SENSe:]TEMPerature:TRANSDUCER:{FThermistor|Thermistor}:REFerence  
 [SENSe:]TEMPerature:TRANSDUCER:{FThermistor|Thermistor}:TYPE  
 [SENSe:]TEMPerature:TRANSDUCER:TCouple:CHECK  
 [SENSe:]TEMPerature:TRANSDUCER:TCouple:RJUNction

#### 4 Plug-in Modules Reference Information

[SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction:TYPE

[SENSe:]TEMPerature:TRANsducer:TCouple:TYPE

[SENSe:]TEMPerature:TRANsducer:TYPE

[SENSe:]TEMPerature:ZERO:AUTO

[SENSe:]VOLTage:AC:BANDwidth

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

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

[SENSe:]VOLTage[:DC]:APERture

[SENSe:]VOLTage[:DC]:APERture:ENABLE

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

[SENSe:]VOLTage[:DC]:NPLCycles

[SENSe:]VOLTage[:DC]:REFerence

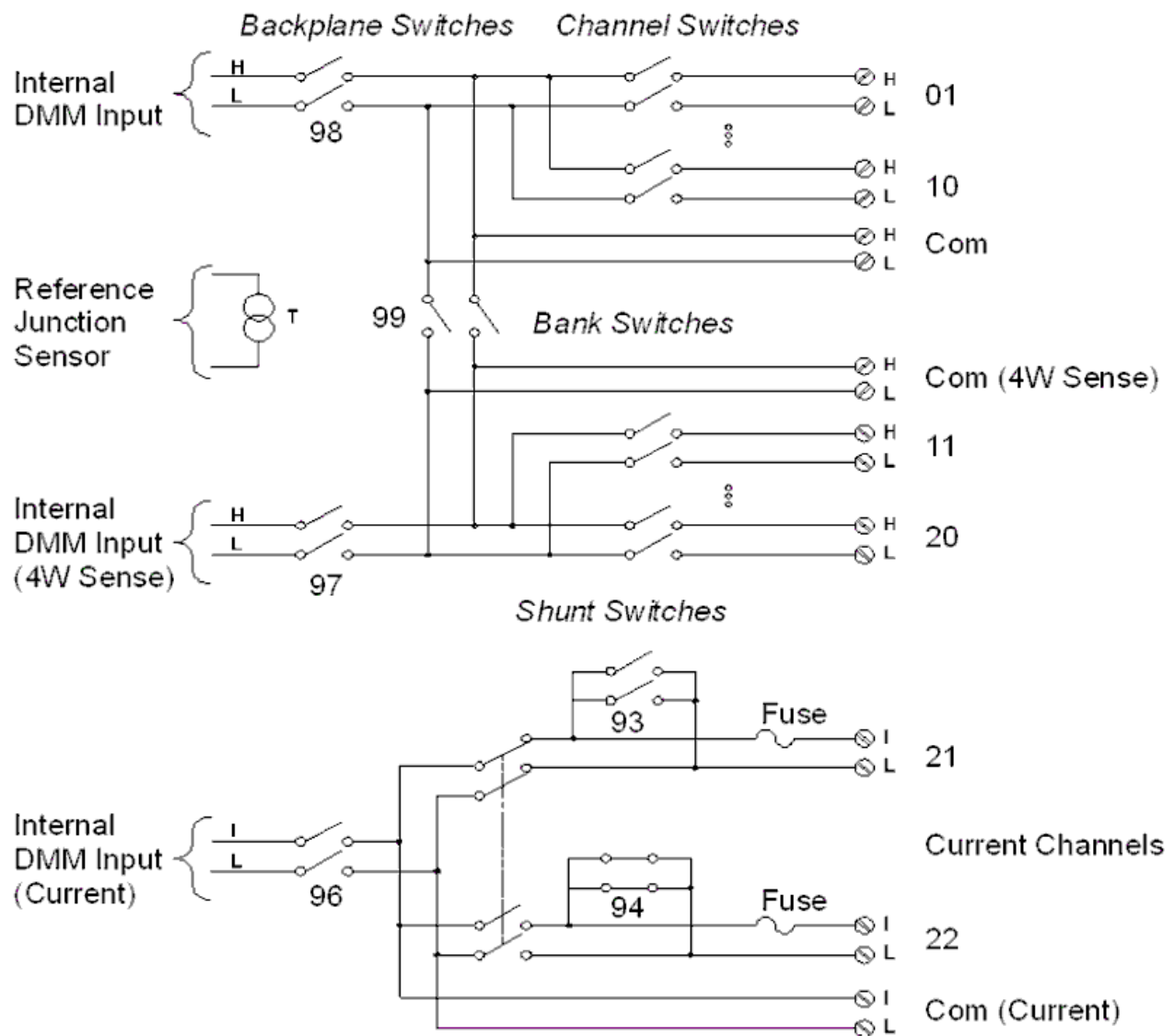
[SENSe:]VOLTage[:DC]:ZERO:AUTO

SYSTem:ALARm?

## DAQM901A 20-Channel Armature Multiplexer

Simplified schematic diagram

Additional 2 channels (channel 21 and 22) for AC and DC current measurements.



SCPI commands used

CALCulate:AVERage:ALL?

CALCulate:AVERage:AVERage?

CALCulate:AVERage:MAXimum?

CALCulate:AVERage:MINimum?

CALCulate:AVERage:PTPeak?

CALCulate:AVERage:SDEVIation?

CALCulate:AVERage:CLEar

CALCulate:AVERage:COUNT?

#### 4 Plug-in Modules Reference Information

CALCulate:AVERage:MAXimum:TIME?  
CALCulate:AVERage:MINimum:TIME?  
CALCulate:SCALE:DB:REFerence  
CALCulate:SCALE:DBM:REFerence  
CALCulate:SCALE:FUNcTION  
CALCulate:SCALE:GAIN  
CALCulate:SCALE:OFFSet  
CALCulate:SCALE:OFFSet:NULL  
CALCulate:SCALE:REFerence  
CALCulate:SCALE:REFerence:AUTO  
CALCulate:SCALE[:STATe]  
CALCulate:SCALE:UNIT  
CALCulate:SCALE:UNIT:STATe  
CALCulate:LIMit:LOWer  
CALCulate:LIMit:UPPer  
CALCulate:LIMit:LOWer:STATe  
CALCulate:LIMit:UPPer:STATe  
CONFigure?  
CONFigure:CAPacitance  
CONFigure:CURREnt:{AC|DC}  
CONFigure:DIODE  
CONFigure:{FREQuency|PERiod}  
CONFigure:{RESistance|FRESistance}  
CONFigure:STRain:{DIRect|FDIRect}  
CONFigure:STRain:{FULL|HALF}:BENDing  
CONFigure:STRain:{FULL|HALF}:POISSon  
CONFigure:STRain:FULL:BENDing:POISSon  
CONFigure:STRain:QUARter  
CONFigure:TEMPerature  
CONFigure[:VOLTage]:{AC|DC}  
\*CAL?  
MEASure:CAPacitance?  
MEASure:CURREnt:{AC|DC}?

MEASure:DIODE?  
 MEASure:{FREQuency|PERiod}?  
 MEASure:{RESistance|FRESistance}?  
 MEASure:STRain:{DIRect|FDIRect}?  
 MEASure:STRain:{FULL|HALF}:BENDing?  
 MEASure:STRain:{FULL|HALF}:POISSon?  
 MEASure:STRain:FULL:BENDing:POISSon?  
 MEASure:STRain:QUARter?  
 MEASure:TEMPerature?  
 MEASure[:VOLTage]:DC  
 [SENSe:]CAPacitance:RANGe:AUTO  
 [SENSe:]CAPacitance:RANGe  
 [SENSe:]CURRent:AC:BANDwidth  
 [SENSe:]CURRent:{AC|DC}:RANGe:AUTO  
 [SENSe:]CURRent:{AC|DC}:RANGe  
 [SENSe:]CURRent[:DC]:APERture  
 [SENSe:]CURRent[:DC]:APERture:ENABLE  
 [SENSe:]CURRent[:DC]:NPLCycles  
 [SENSe:]CURRent[:DC]:ZERO:AUTO  
 [SENSe:]{FREQuency|PERiod}:APERture  
 [SENSe:]{FREQuency|PERiod}:RANGe:LOWer  
 [SENSe:]{FREQuency|PERiod}:VOLTage:RANGe:AUTO  
 [SENSe:]{FREQuency|PERiod}:VOLTage:RANGe  
 [SENSe:]{RESistance|FRESistance}:APERture  
 [SENSe:]{RESistance|FRESistance}:APERture:ENABLE  
 [SENSe:]{RESistance|FRESistance}:NPLCycles  
 [SENSe:]{RESistance|FRESistance}:OCOMPensated  
 [SENSe:]{RESistance|FRESistance}:POWER:LIMit[:STATe]  
 [SENSe:]{RESistance|FRESistance}:RANGe:AUTO  
 [SENSe:]{RESistance|FRESistance}:RANGe  
 [SENSe:]RESistance:ZERO:AUTO  
 [SENSe:]STRain:APERture  
 [SENSe:]STRain:APERture:ENABLE

#### 4 Plug-in Modules Reference Information

[SENSe:]STRain:EXCitation  
[SENSe:]STRain:EXCitation:TYPE  
[SENSe:]STRain:GFACTOR  
[SENSe:]STRain:NPLCycles  
[SENSe:]STRain:OCOMPensated  
[SENSe:]STRain:POISSon  
[SENSe:]STRain:RESistance  
[SENSe:]STRain:UNSTrained  
[SENSe:]STRain:UNSTrained:IMMEDIATE  
[SENSe:]STRain:VOLTagE:RANGe:AUTO  
[SENSe:]STRain:VOLTagE:RANGe  
[SENSe:]STRain:ZERO:AUTO  
[SENSe:]TEMPerature:APERture  
[SENSe:]TEMPerature:APERture:ENABLE  
[SENSe:]TEMPerature:NPLCycles  
[SENSe:]TEMPerature:RJUNction?  
[SENSe:]TEMPerature:TRANSDUCER:{FRTD|RTD}:OCOMPensated  
[SENSe:]TEMPerature:TRANSDUCER:{FRTD|RTD}:POWER:LIMIT[:STATE]  
[SENSe:]TEMPerature:TRANSDUCER:{FRTD|RTD}:REFERENCE  
[SENSe:]TEMPerature:TRANSDUCER:{FRTD|RTD}:RESistance[:REFERENCE]  
[SENSe:]TEMPerature:TRANSDUCER:{FTHERMISTOR|THERMISTOR}:POWER:LIMIT[:STATE]  
[SENSe:]TEMPerature:TRANSDUCER:{FTHERMISTOR|THERMISTOR}:REFERENCE  
[SENSe:]TEMPerature:TRANSDUCER:{FTHERMISTOR|THERMISTOR}:TYPE  
[SENSe:]TEMPerature:TRANSDUCER:TCouple:CHECK  
[SENSe:]TEMPerature:TRANSDUCER:TCouple:RJUNction  
[SENSe:]TEMPerature:TRANSDUCER:TCouple:RJUNction:TYPE  
[SENSe:]TEMPerature:TRANSDUCER:TCouple:TYPE  
[SENSe:]TEMPerature:TRANSDUCER:TYPE  
[SENSe:]TEMPerature:ZERO:AUTO  
[SENSe:]VOLTagE:AC:BANDwidth  
[SENSe:]VOLTagE:{AC|DC}:RANGe:AUTO  
[SENSe:]VOLTagE:{AC|DC}:RANGe  
[SENSe:]VOLTagE[:DC]:APERture

[SENSe:]VOLTage[:DC]:APERTure:ENABle

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

[SENSe:]VOLTage[:DC]:NPLCycles

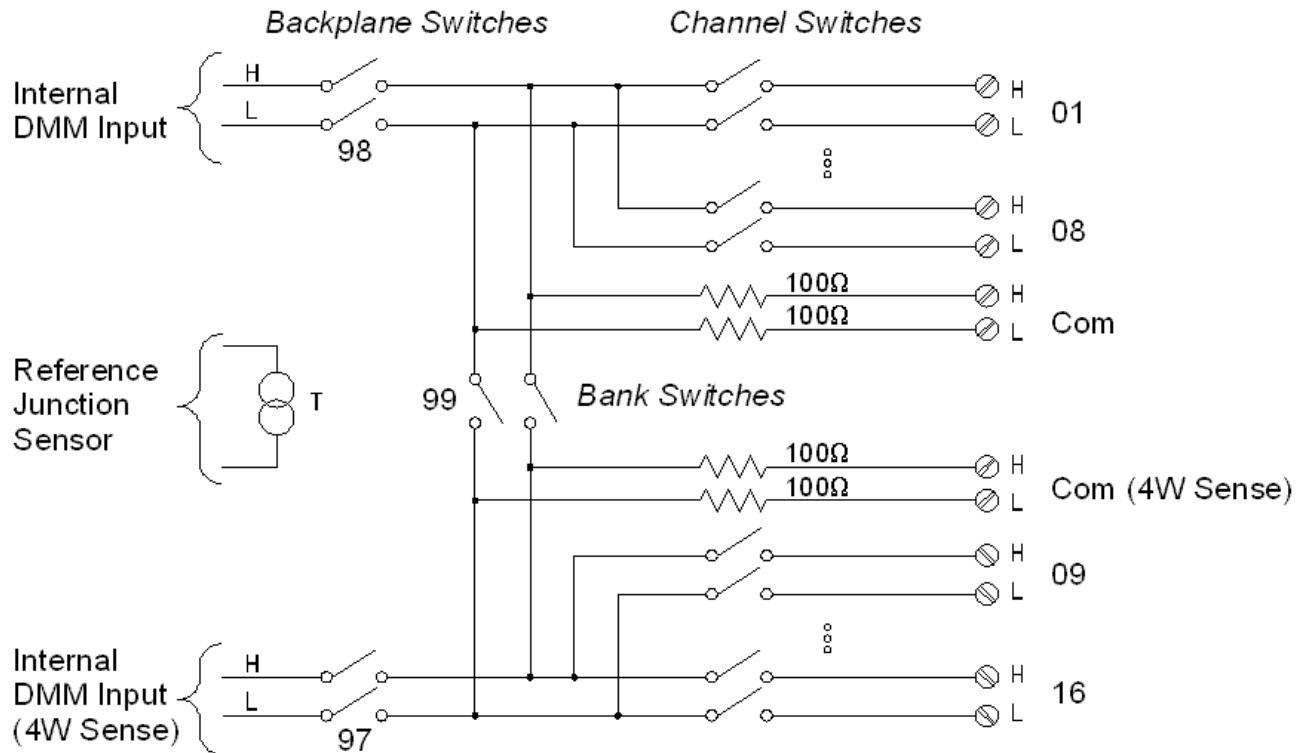
[SENSe:]VOLTage[:DC]:REFerence

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

SYSTem:ALARm?

## DAQM902A 16-Channel Reed Multiplexer

Simplified schematic diagram



SCPI commands used

CALCulate:AVERage:ALL?

CALCulate:AVERage:AVERage?

CALCulate:AVERage:MAXimum?

CALCulate:AVERage:MINimum?

CALCulate:AVERage:PTPeak?

CALCulate:AVERage:SDEViation?

CALCulate:AVERage:CLEar

CALCulate:AVERage:COUNT?

CALCulate:AVERage:MAXimum:TIME?

CALCulate:AVERage:MINimum:TIME?

CALCulate:SCALE:DB:REFerence

CALCulate:SCALE:DBM:REFerence

CALCulate:SCALE:FUNCTion

CALCulate:SCALE:GAIN

CALCulate:SCALE:OFFSet



CALCulate:SCALE:OFFSET:NULL  
 CALCulate:SCALE:REFERENCE  
 CALCulate:SCALE:REFERENCE:AUTO  
 CALCulate:SCALE[:STATE]  
 CALCulate:SCALE:UNIT  
 CALCulate:SCALE:UNIT:STATE  
 CALCulate:LIMIT:LOWER  
 CALCulate:LIMIT:UPPER  
 CALCulate:LIMIT:LOWER:STATE  
 CALCulate:LIMIT:UPPER:STATE  
 CONFIGure?  
 CONFIGure:CAPacitance  
 CONFIGure:DIODE  
 CONFIGure:{FREQuency|PERiod}  
 CONFIGure:{RESistance|RESistance}  
 CONFIGure:STRAIN:{DIRECT|FDIRECT}  
 CONFIGure:STRAIN:{FULL|HALF}:BENDING  
 CONFIGure:STRAIN:{FULL|HALF}:POISSon  
 CONFIGure:STRAIN:FULL:BENDING:POISSon  
 CONFIGure:STRAIN:QUARter  
 CONFIGure:TEMPerature  
 CONFIGure[:VOLTage]:{AC|DC}  
 \*CAL?  
 MEASure:CAPacitance?  
 MEASure:DIODE?  
 MEASure:{FREQuency|PERiod}?  
 MEASure:{RESistance|RESistance}?  
 MEASure:STRAIN:{DIRECT|FDIRECT}?  
 MEASure:STRAIN:{FULL|HALF}:BENDING?  
 MEASure:STRAIN:{FULL|HALF}:POISSon?  
 MEASure:STRAIN:FULL:BENDING:POISSon?  
 MEASure:STRAIN:QUARter?  
 MEASure:TEMPerature?

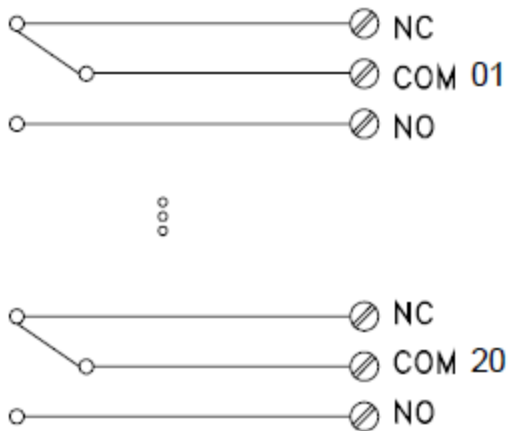
#### 4 Plug-in Modules Reference Information

MEASure[:VOLTage]:DC  
[SENSe:]CAPacitance:RANGe:AUTO  
[SENSe:]CAPacitance:RANGe  
[SENSe:]{FREQuency|PERiod}:APERture  
[SENSe:]{FREQuency|PERiod}:RANGe:LOWer  
[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe:AUTO  
[SENSe:]{FREQuency|PERiod}:VOLTage:RANGe  
[SENSe:]{RESistance|FRESistance}:APERture  
[SENSe:]{RESistance|FRESistance}:APERture:ENABle  
[SENSe:]{RESistance|FRESistance}:NPLCycles  
[SENSe:]{RESistance|FRESistance}:OCOMPensated  
[SENSe:]{RESistance|FRESistance}:POWer:LIMit[:STATe]  
[SENSe:]{RESistance|FRESistance}:RANGe:AUTO  
[SENSe:]{RESistance|FRESistance}:RANGe  
[SENSe:]RESistance:ZERO:AUTO  
[SENSe:]STRain:APERture  
[SENSe:]STRain:APERture:ENABle  
[SENSe:]STRain:EXCitation  
[SENSe:]STRain:EXCitation:TYPE  
[SENSe:]STRain:GFACtor  
[SENSe:]STRain:NPLCycles  
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[SENSe:]STRain:POISSon  
[SENSe:]STRain:RESistance  
[SENSe:]STRain:UNSTrained  
[SENSe:]STRain:UNSTrained:IMMEDIATE  
[SENSe:]STRain:VOLTage:RANGe:AUTO  
[SENSe:]STRain:VOLTage:RANGe  
[SENSe:]STRain:ZERO:AUTO  
[SENSe:]TEMPerature:APERture  
[SENSe:]TEMPerature:APERture:ENABle  
[SENSe:]TEMPerature:NPLCycles  
[SENSe:]TEMPerature:RJUNction?

[SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:OCOMPensated  
 [SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:POWer:LIMit[:STATe]  
 [SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:REFerence  
 [SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:RESistance[:REFerence]  
 [SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:POWer:LIMit[:STATe]  
 [SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:REFerence  
 [SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:TYPE  
 [SENSe:]TEMPerature:TRANsducer:TCouple:CHECK  
 [SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction  
 [SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction:TYPE  
 [SENSe:]TEMPerature:TRANsducer:TCouple:TYPE  
 [SENSe:]TEMPerature:TRANsducer:TYPE  
 [SENSe:]TEMPerature:ZERO:AUTO  
 [SENSe:]VOLTage:AC:BANDwidth  
 [SENSe:]VOLTage:{AC|DC}:RANGe:AUTO  
 [SENSe:]VOLTage:{AC|DC}:RANGe  
 [SENSe:]VOLTage[:DC]:APERture  
 [SENSe:]VOLTage[:DC]:APERture:ENABLE  
 [SENSe:]VOLTage[:DC]:IMPedance:AUTO  
 [SENSe:]VOLTage[:DC]:NPLCycles  
 [SENSe:]VOLTage[:DC]:REFerence  
 [SENSe:]VOLTage[:DC]:ZERO:AUTO  
 SYSTem:ALARm?

## DAQM903A 20-Channel Actuator/General Purpose Switch

Simplified schematic diagram



SCPI commands used

`ROUTe:CHANnel:LABel`

`ROUTe:CHANnel:LABel:CLEar:MODule`

`ROUTe:CLOSe`

`ROUTe:CLOSe:EXCLusive`

`ROUTe:DONE?`

`ROUTe:OPEN`

`SYSTem:CPON`

`SYSTem:CTYPe?`

`SYSTem:RELAy:CYCLes?`

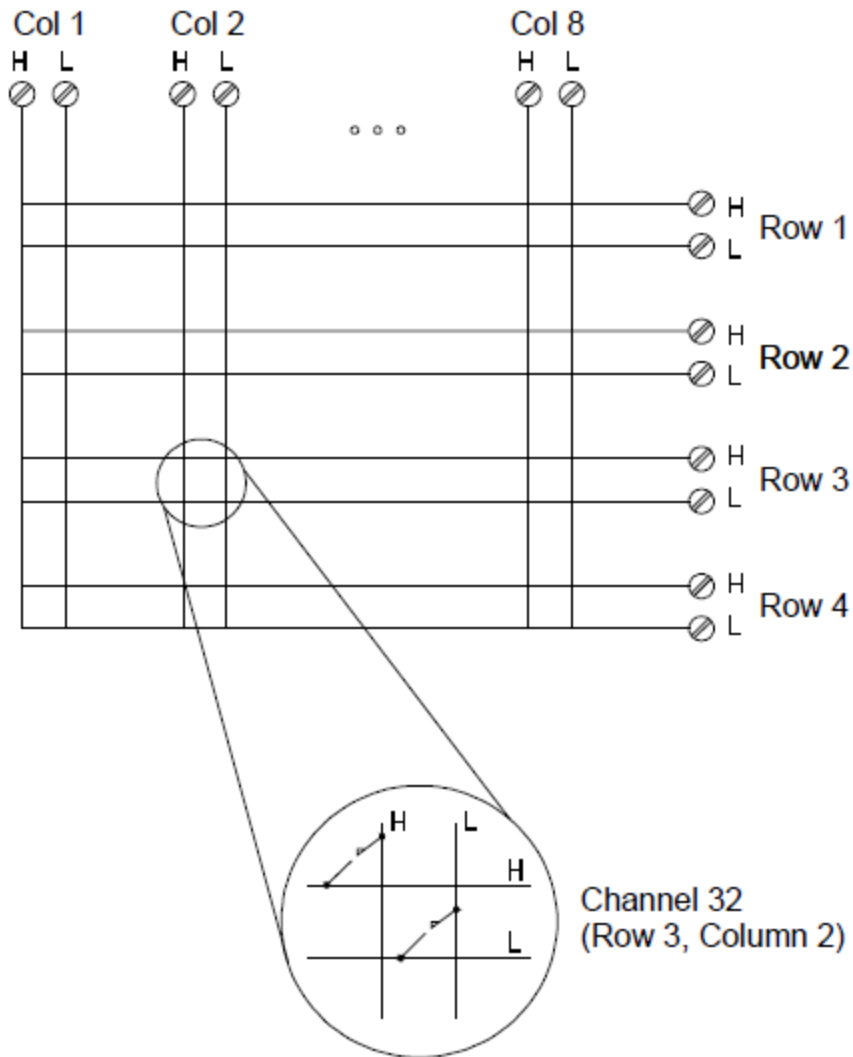
`SYSTem:RELAy:CYCLes:CLEar`

`SYSTem:RELAy:CYCLes:FACTory?`

`SYSTem:SLOT:LABel`

## DAQM904A 4×8 Two-Wire Matrix Switch

Simplified schematic diagram



SCPI commands used

`ROUTe:CHANnel:LABel`

`ROUTe:CHANnel:LABel:CLEar:MODule`

`ROUTe:CLOSe`

`ROUTe:CLOSe:EXCLusive`

`ROUTe:DONE?`

`ROUTe:OPEN`

`SYSTem:CPON`

`SYSTem:CTYPe?`

`SYSTem:RELAy:CYCLes?`

#### 4 Plug-in Modules Reference Information

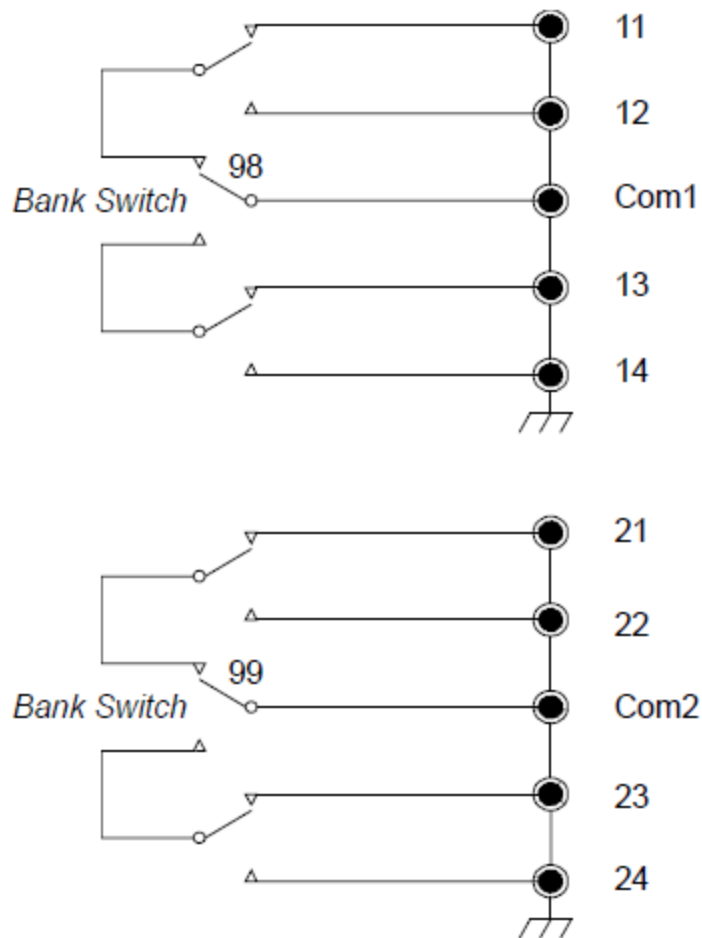
SYSTem:RELAy:CYCLes:CLEar

SYSTem:RELAy:CYCLes:FACTory?

SYSTem:SLOT:LABel

## DAQM905A Dual 1:4 RF Multiplexer (50 $\Omega$ ) Module

Simplified schematic diagram



SCPI commands used

`ROUTe:CHANnel:LABel`

`ROUTe:CHANnel:LABel:CLEar:MODule`

`ROUTe:CLOSe`

`ROUTe:CLOSe:EXCLusive`

`ROUTe:DONE?`

`SYSTem:CPON`

`SYSTem:CTYPe?`

`SYSTem:RELAy:CYCLes?`

`SYSTem:RELAy:CYCLes:CLEar`

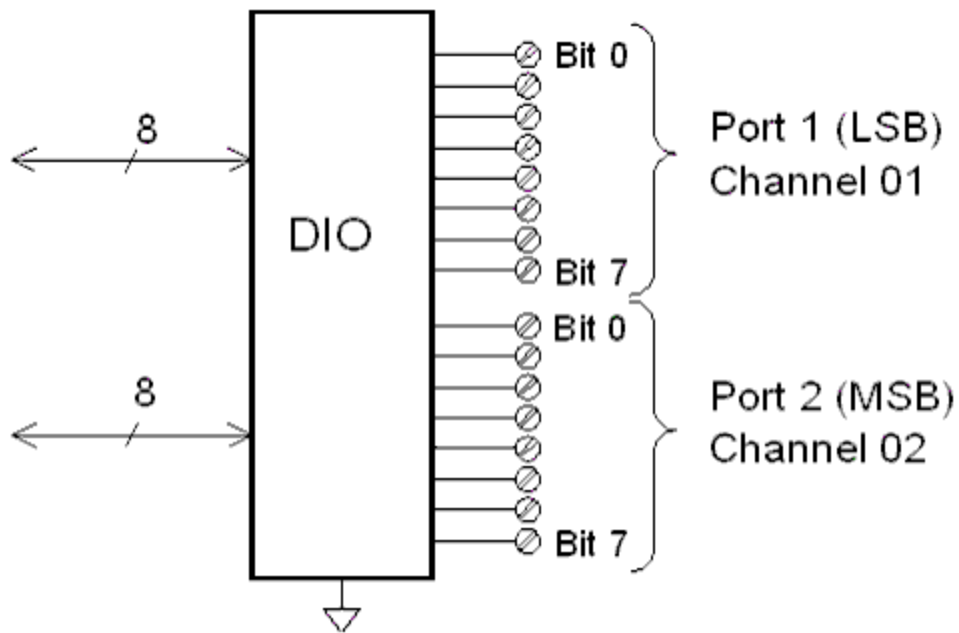
`SYSTem:RELAy:CYCLes:FACTory?`

`SYSTem:SLOT:LABel`

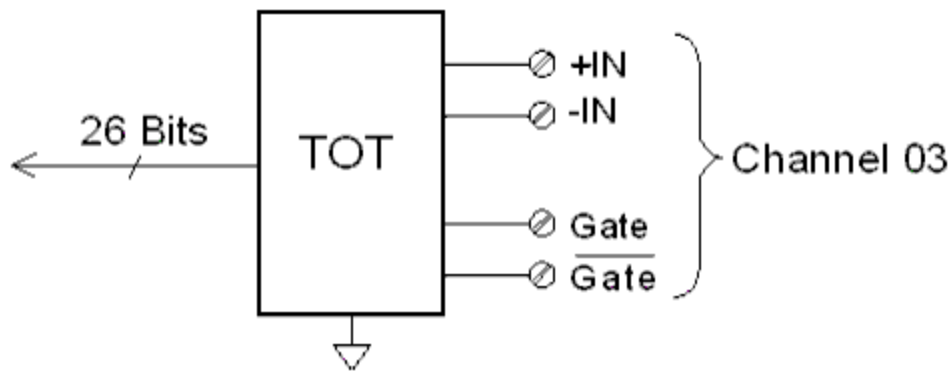
## DAQM907A Multifunction Module

Simplified schematic diagram

Digital Input/Output (channels 01 and 02):

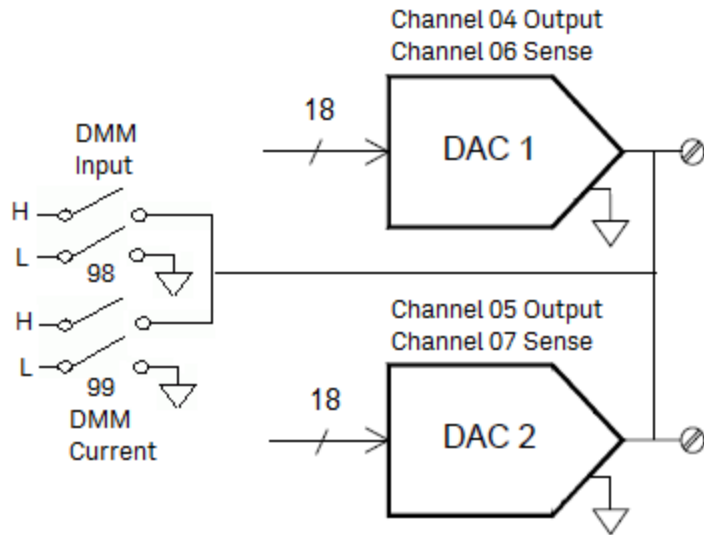


Totalizer channel (channel 03):





DAC output and sense channels (channels 04 through 07):



SCPI commands used

`CALCulate:AVERage:ALL?`

`CALCulate:AVERage:AVERage?`

`CALCulate:AVERage:MAXimum?`

`CALCulate:AVERage:MINimum?`

`CALCulate:AVERage:PTPeak?`

`CALCulate:AVERage:SDEVIation?`

`CALCulate:AVERage:CLEar`

`CALCulate:AVERage:COUNt?`

`CALCulate:AVERage:MAXimum:TIME?`

`CALCulate:AVERage:MINimum:TIME?`

`CALCulate:SCALE:DB:REFerence`

`CALCulate:SCALE:DBM:REFerence`

`CALCulate:SCALE:FUNCTion`

`CALCulate:SCALE:GAIN`

`CALCulate:SCALE:OFFSet`

`CALCulate:SCALE:OFFSet:NULL`

`CALCulate:SCALE:REFerence`

`CALCulate:SCALE:REFerence:AUTO`

`CALCulate:SCALE[:STATe]`

`CALCulate:SCALE:UNIT`

#### 4 Plug-in Modules Reference Information

CALCulate:SCALe:UNIT:STATe

CALCulate:COMPare:DATA

CALCulate:COMPare:MASK

CALCulate:COMPare:STATe

CALCulate:COMPare:TYPE

CALCulate:LIMit:LOWer

CALCulate:LIMit:UPPer

CALCulate:LIMit:LOWer:STATe

CALCulate:LIMit:UPPer:STATe

CONFigure:DAC:{OUTPut|SENSe}

CONFigure:DIgital[:BYTE]

CONFigure:TOTalize

\*CAL?

MEASure:DAC:{OUTPut|SENSe}?

MEASure:DIgital[:BYTE]?

MEASure:TOTalize?

MEASure[:VOLTage]:AC

[SENSe:]TOTalize:CLEar:IMMEDIATE

[SENSe:]TOTalize:DATA?

[SENSe:]TOTalize:SLOPe

[SENSe:]TOTalize:STARt

[SENSe:]TOTalize:STOP

[SENSe:]TOTalize:TYPE

[SENSe:]DIgital

SYSTem:ACALibration?

SYSTem:ACALibration:DATE?

SYSTem:ACALibration:INTerval

SYSTem:ACALibration:INTerval:MDAY

SYSTem:ACALibration:INTerval:TIME

SYSTem:ACALibration:INTerval:WDAY

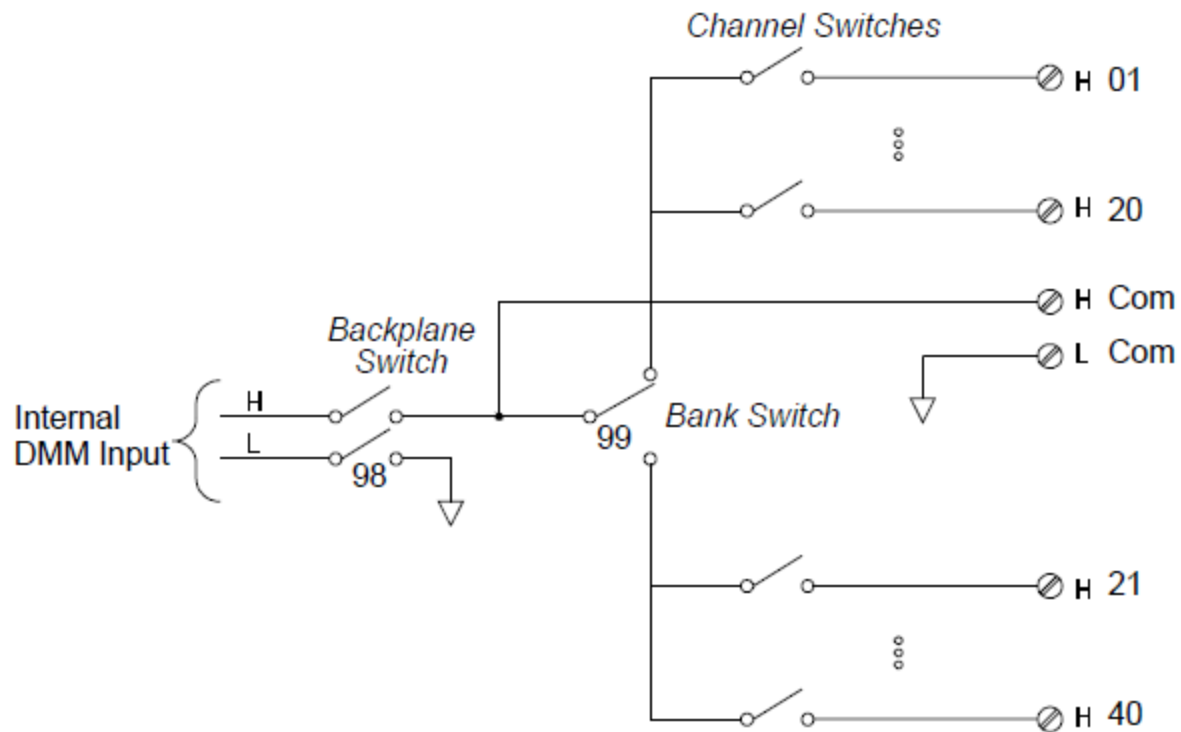
SYSTem:ACALibration:TEMPerature?

SYSTem:ACALibration:TIME?

SYSTem:ALARm?

## DAQM908A 40-Channel Single-Ended Multiplexer

Simplified schematic diagram



SCPI commands used

CALCulate:AVERage:ALL?

CALCulate:AVERage:AVERage?

CALCulate:AVERage:MAXimum?

CALCulate:AVERage:MINimum?

CALCulate:AVERage:PTPeak?

CALCulate:AVERage:SDEVIation?

CALCulate:AVERage:CLEar

CALCulate:AVERage:COUNT?

CALCulate:AVERage:MAXimum:TIME?

CALCulate:AVERage:MINimum:TIME?

CALCulate:SCALE:DB:REFerence

CALCulate:SCALE:DBM:REFerence

CALCulate:SCALE:FUNCTion

CALCulate:SCALE:GAIN

CALCulate:SCALE:OFFSet

#### 4 Plug-in Modules Reference Information

CALCulate:SCALE:OFFSet:NULL  
CALCulate:SCALE:REference  
CALCulate:SCALE:REference:AUTO  
CALCulate:SCALE[:STATe]  
CALCulate:SCALE:UNIT  
CALCulate:SCALE:UNIT:STATe  
CALCulate:LIMit:LOWer  
CALCulate:LIMit:UPPer  
CALCulate:LIMit:LOWer:STATe  
CALCulate:LIMit:UPPer:STATe  
CONFigure?  
CONFigure:CAPacitance  
CONFigure:DIODE  
CONFigure:{FREQuency|PERiod}  
CONFigure:RESistance  
CONFigure:STRain:DIRect  
CONFigure:STRain:{FULL|HALF}:BENDing  
CONFigure:STRain:{FULL|HALF}:POISson  
CONFigure:STRain:FULL:BENDing:POISson  
CONFigure:STRain:QUARter  
CONFigure:TEMPerature  
CONFigure[:VOLTage]:{AC|DC}  
\*CAL?  
MEASure:CAPacitance?  
MEASure:DIODE?  
MEASure:{FREQuency|PERiod}?  
MEASure:RESistance  
MEASure:STRain:DIRect  
MEASure:STRain:{FULL|HALF}:BENDing?  
MEASure:STRain:{FULL|HALF}:POISson?  
MEASure:STRain:FULL:BENDing:POISson?  
MEASure:STRain:QUARter?  
MEASure:TEMPerature?

MEASure[:VOLTage]:DC  
 [SENSe:]CAPacitance:RANGe:AUTO  
 [SENSe:]CAPacitance:RANGe  
 [SENSe:]{FREQuency|PERiod}:APERTure  
 [SENSe:]{FREQuency|PERiod}:RANGe:LOWer  
 [SENSe:]{FREQuency|PERiod}:VOLTage:RANGe:AUTO  
 [SENSe:]{FREQuency|PERiod}:VOLTage:RANGe  
 [SENSe:]RESistance:APERTure  
 [SENSe:]RESistance:APERTure:ENABLE  
 [SENSe:]RESistance:NPLCycles  
 [SENSe:]RESistance:OCOMPensated  
 [SENSe:]RESistance:POWER:LIMit[:STATe]  
 [SENSe:]RESistance:RANGe:AUTO  
 [SENSe:]RESistance:RANGe  
 [SENSe:]RESistance:ZERO:AUTO  
 [SENSe:]STRain:APERTure  
 [SENSe:]STRain:APERTure:ENABLE  
 [SENSe:]STRain:EXCitation  
 [SENSe:]STRain:EXCitation:TYPE  
 [SENSe:]STRain:GFACtor  
 [SENSe:]STRain:NPLCycles  
 [SENSe:]STRain:OCOMPensated  
 [SENSe:]STRain:POISSon  
 [SENSe:]STRain:RESistance  
 [SENSe:]STRain:UNSTrained  
 [SENSe:]STRain:UNSTrained:IMMEDIATE  
 [SENSe:]STRain:VOLTage:RANGe:AUTO  
 [SENSe:]STRain:VOLTage:RANGe  
 [SENSe:]STRain:ZERO:AUTO  
 [SENSe:]TEMPerature:APERTure  
 [SENSe:]TEMPerature:APERTure:ENABLE  
 [SENSe:]TEMPerature:NPLCycles  
 [SENSe:]TEMPerature:RJUNction?

#### 4 Plug-in Modules Reference Information

[SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:OCOMpensated  
[SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:POWER:LIMit[:STATe]  
[SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:REFerence  
[SENSe:]TEMPerature:TRANsducer:{FRTD|RTD}:RESistance[:REFerence]  
[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:POWER:LIMit[:STATe]  
[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:REFerence  
[SENSe:]TEMPerature:TRANsducer:{FTHermistor|THERmistor}:TYPE  
[SENSe:]TEMPerature:TRANsducer:TCouple:CHECK  
[SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction  
[SENSe:]TEMPerature:TRANsducer:TCouple:RJUNction:TYPE  
[SENSe:]TEMPerature:TRANsducer:TCouple:TYPE  
[SENSe:]TEMPerature:TRANsducer:TYPE  
[SENSe:]TEMPerature:ZERO:AUTO  
[SENSe:]VOLTage:AC:BANDwidth  
[SENSe:]VOLTage:{AC|DC}:RANGe:AUTO  
[SENSe:]VOLTage:{AC|DC}:RANGe  
[SENSe:]VOLTage[:DC]:APERture  
[SENSe:]VOLTage[:DC]:APERture:ENABLE  
[SENSe:]VOLTage[:DC]:IMPedance:AUTO  
[SENSe:]VOLTage[:DC]:NPLCycles  
[SENSe:]VOLTage[:DC]:REFerence  
[SENSe:]VOLTage[:DC]:ZERO:AUTO  
SYSTEM:ALARm?

This information is subject to change  
without notice.

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