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A MEASUREMENT COMPUTING COMPANY

UM-23650-L

SCPI Programmer's Manual for LXI Measurement Instruments

(for TEMPpoint, VOLTpoint, and MEASURpoint Instruments)

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About this Manual

This manual describes how to use (Standard Commands for Programmable Instruments (SCPI) to communicate with TEMPpoint, VOLTpoint, and MEASURpoint LXI (LAN eXtensions for Instrumentation) instruments.

Intended Audience

This document is intended for instrument programmers who are responsible for writing SCPI-based programs for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.

What You Should Learn from this Manual

This manual provides detailed information about the SCPI commands that are available for communicating with TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments. This manual is organized as follows:

- Chapter 1, "Syntax Conventions," describes the syntax conventions used.
- Chapter 2, "Using SCPI Commands with LXI Measurement Instruments," provides an introduction to SCPI commands.
- Chapter 3, "Common SCPI Commands," describes the common SCPI commands that are available for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments. The command syntax, functional description, examples, and so on, are provided.
- Chapter 4, "SCPI Subsystem Commands," describes the device-specific SCPI commands that available for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments. The command syntax, functional description, examples, and so on, are provided.
- Chapter 5, "Programming Flowcharts," provides flow diagrams that show how to use the SCPI commands together to write a program that communicates with TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
- Appendix A, "Errors," lists the errors that can be returned and describes how to troubleshoot frequently occurring errors.
- Appendix B, "Registers," describes the registers that are used by SCPI commands.
- Appendix C, "Structures," describes the data structures that are used by SCPI commands.
- Appendix D, "Examples," describes example applications that illustrate how to use SCPI commands to program TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
- Appendix E, "Using HyperTerminal to Send and Receive SCPI Commands," describes how to use HyperTerminal to send and receive SCPI commands.
- An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

- Notes provide useful information or information that requires special emphasis, cautions provide information to help you avoid losing data or damaging your equipment, and warnings provide information to help you avoid catastrophic damage to yourself or your equipment.
- Items that you select or type are shown in **bold**.

Related Documents

Refer to the following documents for more information:

- *User's Manual for Standard TEMPpoint, VOLTpoint, and MEASURpoint LXI Instruments* (UM-23652). This manual describes the operation of the DT8871, DT8871U, DT8872, DT8873, and DT8874 LXI instruments.
- Standard Commands for Programmable Instruments (SCPI), Volume 1-4, Version 1999.0 May 1999, SCPI Consortium, 2515 Camino del Rio South, Suite 340, San Diego, CA 92108.
- IEEE Std 488.2-1992**,** The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017-2394, USA (ISBN 1-55937-238-9)

Where to Get Help

Should you run into problems installing or using SCPI commands to communicate with TEMPpoint, VOLTpoint, and/or MEASURpoint instruments, the Data Translation Technical Support Department is available to provide technical assistance. Refer to Chapter 6 for more information. If you are outside the United States or Canada, call your local distributor, whose number is listed on our web site (www.mccdaq.com).

Syntax Conventions

Introduction

SCPI (Standard Commands for Programmable Instruments) is a universal programming language for electronic test and measurement instruments, based on the IEEE 488.1 and IEEE 488.2 standards. TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments comply with the SCPI language and implement the IEEE-488.2 STD status structure.

You can issue these commands over VISA or sockets using TCP port 5025. Refer to Appendix E starting on page 179 for information on using HyperTerminal to send and receive SCPI commands over TCP port 5025.

Types of SCPI Messages

To program a TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument, you create program messages. A program message consists of one or more properly formatted SCPI commands sent from the controller to the instrument. The program message, which may be sent at any time, requests that the instrument perform some action or send back data or status information; these requests are also called queries.

When queried, the instrument sends a response message back to the controller. The response message consists of data in a specific SCPI format.

Refer to page 19 for more information on the syntax of program messages and to page 22 for more information on the syntax of response messages.

The following documents provide more information about SCPI programming:

- Standard Commands for Programmable Instruments (SCPI), Volume 1-4, Version 1999.0 May 1999, SCPI Consortium, 2515 Camino del Rio South, Suite 340, San Diego, CA 92108.
- IEEE Std 488.2-1992**,** The Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, NY 10017-2394, USA (ISBN 1-55937-238-9)

Types of SCPI Commands

Two types of SCPI commands are available: common commands, described below, and device-specific subsystem commands, described on page 14. TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments respond to all of the required IEEE-488.2 common commands and support subsystem commands for measuring data and performing other device-specific functions.

Common SCPI Commands

Common SCPI commands, defined by IEEE488.2, control and manage generic system functions such as reset, self-test, configuration storage, and device identification. Table 1 summarizes the common SCPI commands that are available for programming TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments. Refer to Chapter 3 starting on page 55 for a detailed description of these commands.

Table 1: Common SCPI Commands for Programming TEMPpoint, VOLTpoint, and MEASURpoint LXI Instruments

Type	Mnemonic	Description
Clear Status	*CLS	Clears all event registers summarized in the Status Byte (STB) register, described on page 170.
Event Status Enable Register	*ESE	Enables specified bits in the Standard Event Status Enable register, described on page 171.
Event Status Enable Register Query	*ESE?	Returns the current value of the Standard Event Status Enable register, described on page 171.
Event Status Register Query	*ESR?	Returns the current value of the Standard Event Status register, described on page 173, and then clears the register.
Identification Query	*IDN?	Returns the unique identity of the instrument.
Operation Complete	*OPC	The Operation Complete bit (bit 0) of the Standard Event Status register, described on page 171, is always enabled. Therefore, this command has no effect when used with TEMPpoint, VOLTpoint, or MEASURpoint LXI instruments.
Operation Complete Query	*OPC?	The Operation Complete bit (bit 0) of the Standard Event Status register, described on page 171, is always enabled. Therefore, this command always places the ASCII character 1 into the device's Output Queue.
Reset	*RST	Clears the Standard Event Status register, message queue, error queue, and Status Byte register, and stop any scans that are in progress.
Self-Test Query	*TST?	Always returns 0 for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
Service Request Enable	*SRE	The Service Request Enable register is not used on these instruments. Therefore, this command has no effect when used with TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
Service Request Enable Query	*SRE?	The Service Request Enable register is not used on these instruments. Therefore, this command has no effect when used with TEMPpoint, VOLTpoint, and MEASURpoint instruments.
Status Byte Query	*STB?	Returns the current value of the Status Byte register, described on page 170.
Wait	*WAI	Has no effect on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.

SCPI Subsystem Commands

SCPI subsystem commands are either measurement-related or other device-specific commands for programming TEMPpoint, VOLTpoint, or MEASURpoint LXI instruments.

The following SCPI subsystem commands are available on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments:

- **STATus** – The STATus subsystem includes commands that are related to the operational status of the instrument. This subsystem is mandatory for SCPI-compliant devices.
- **SYSTem** – The SYSTem subsystem includes commands for returning the number of analog input channels, digital input lines, and digital output lines supported by the instrument, returning the minimum and maximum scan rate supported by the instrument, calibrating instruments, querying the status of scan records on the instrument, querying the errors returned by the instruments, and configuring and querying global system settings, including the time, date, time zone, and network address of the instrument.
- **MEASure** – The MEASure subsystem includes commands that configure specified analog input channels on the instrument for temperature, voltage, or resistance, and then return the measurement values from these channels.
- **CONFigure** – The CONFigure subsystem includes commands for setting the filter type, configuring analog input channels for voltage, resistance, or temperature measurements, enabling the channels to be scanned, and querying the configuration of the analog input channels.
- **INITiate** – The INITiate subsystem includes a command that starts a timed scan operation using the configured scan frequency, channel configuration, and channel scan list.
- **ABORt** – The ABORt subsystem includes a command that stops a scan if it is in progress.
- **FETCh** – The FETCh subsystem includes a query that returns scan records from the circular buffer on the instrument. A scan record contains time stamped values that correspond to a list of specific analog input channels that were configured for a specific type of measurement and scanned at a specific frequency.
- **INPut** – The INPut subsystem includes a query that returns the state of the digital input port.
- **OUTput** – The OUTput subsystem includes a command that sets the state of the digital output port and a query that returns the state of the digital output port.

Table 2 summarizes the SCPI commands and queries available for programming each subsystem of a TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument. Refer to Chapter 4 starting on page 65 for a detailed description of these commands.

Table 2: Subsystem SCPI Commands for Programming TEMPpoint, VOLTpoint, or MEASURpoint LXI Instruments

Subsystem	Mnemonic	Description
STATus	STATus:OPERation[:EVENt]?	Has no effect on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
	STATus:OPERation:CONDition?	Returns the current value of the Operation Status register, described on page 174.
	STATus:OPERation:ENABle	Has no effect on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
	STATus:OPERation: ENABle?	Always returns 0 for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
	STATus:PRESet	Has no effect on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
	STATus:QUEStionable[:EVENt]?	Always returns 0 for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
	STATus:QUEStionable:CONDition?	Always returns 0 for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
	STATus:QUEStionable:ENABle	Has no effect on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
	STATus:QUEStionable:ENABle?	Always returns 0 for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.
	STATus:SCAn?	Returns the indices of the chronologically oldest and most recent scan records in the circular buffer on the instrument.
SYSTem	SYSTem:BOArd[:NUMber]?	Returns the number of boards currently installed in the instrument.
	SYSTem:BOArd:MODel?	Returns the model number corresponding to a specific board in the instrument.
	SYSTem:BOArd:MODel:NAMe?	Returns the model name of a specific board in the instrument.
	SYSTem:BOArd:RANGe?	Returns the minimum and maximum voltages that are supported by a specific board in the instrument.
	SYSTem:CHANnel?	Returns a list of analog input channels that are supported by the instrument.
	SYSTem:CHANnel:RTD?	Returns a list of analog input channels on the instrument that support RTD measurements.

Table 2: Subsystem SCPI Commands for Programming TEMPpoint, VOLTpoint, or MEASURpoint LXI Instruments (cont.)

Subsystem	Mnemonic	Description
SYSTem (cont.)	SYSTem:CHANnel:TC?	Returns a list of analog input channels on the instrument that support thermocouple measurements.
	SYSTem:CHANnel:VOLTage: RANGe?	Returns a list of analog input channels on the instrument that support programmable voltage ranges.
	SYSTem:DINput?	Returns the number of digital input lines that are supported by the instrument.
	SYSTem:DOUTput?	Returns the number of digital output lines that are supported by the instrument.
	SYSTem:SCAn:RATe:MAX?	Returns the maximum scan rate or scan frequency that is supported by the instrument.
	SYSTem:SCAn:RATe:MIN?	Returns the minimum scan rate or scan frequency that is supported by the instrument.
	SYSTem:CALibrate	Auto-calibrates (auto-zeros) all input channels on the instrument.
	SYSTem:DATE?	Returns the current date of the instrument.
	SYSTem:TIME?	Returns the current time of the instrument.
	SYSTem:TZONe	Sets the time zone currently used by the instrument, as an offset from GMT.
	SYSTem:ERRor?	Reads error message from the error queue and then removes it from the queue.
	SYSTem:ERRor:COUNt?	Queries the error queue for the number of unread items and returns the count.
	SYSTem:VERSion?	Returns the SCPI version number to which the instrument complies.
	SYSTem:PRESet	Sets the LAN configuration to default values.
	SYSTem:COMMunicate:NETwork: IPADdress?	Returns the static IP address currently used by the instrument on the network.
	SYSTem:COMMunicate:NETwork: MASk?	Returns the static subnet mask currently used by the instrument on the network.
CONFigure	CONFigure:RESistance	Configures specified analog input channels on the instrument for resistance measurements.
	CONFigure:TEMPerature:RTD	Configures specified analog input channels on the instrument for RTD temperature measurements.
	CONFigure:TEMPerature:TCouple	Configures specified analog input channels on the instrument for thermocouple temperature measurements using the specified thermocouple type.
	CONFigure:VOLTage	Configures specified analog input channels on the instrument for voltage measurements.

Table 2: Subsystem SCPI Commands for Programming TEMPpoint, VOLTpoint, or MEASURpoint LXI Instruments (cont.)

Subsystem	Mnemonic	Description
CONFigure (cont.)	CONFigure:VOLTage:RANGe	Configures the voltage range for specified analog input channels on the instrument.
	CONFigure?	Returns the configuration of specified analog input channels on the instrument.
	CONFigure:FILTer	Configures the filter type used for analog input operations on the instrument.
	CONFigure:FILTer?	Returns the currently configured filter type used for analog input operations on the instrument.
	CONFigure:SCAn:BUFfer	Returns the size of the circular buffer, in bytes, that is used to store scan data.
	CONFigure:SCAn:CJC	Enables the capability of returning CJC data in the analog input data stream.
	CONFigure:SCAn:CJC?	Returns whether the capability of returning CJC data in the analog input data stream has been enabled or disabled.
	CONFigure:SCAn:LISt	Enables a list of channels to scan on the instrument.
	CONFigure:SCAn:LISt?	Returns the list of channels that are enabled for scanning on the instrument.
	CONFigure:SCAn:RATe	Configures either the time period of each scan, in the number of seconds per scan, or the scan frequency, in Hertz.
	CONFigure:SCAn:RATe?	Returns either the time period of each scan, in the number of seconds per scan, or the scan frequency, in Hertz.
	CONFigure:TRIGger[:SOURce]	Configures the trigger source that starts the analog input operation on the instrument once the **INITiate** command is executed.
	CONFigure:TRIGger[:SOURce]?	Returns the currently configured trigger source that starts the analog input operation on the instrument once the **INITiate** command is executed.
MEASure	MEASureRESistance?	Configures specified channels on the instrument for resistance measurements, and then returns resistance values, in ohms, from the specified channels.
	MEASure:TEMPerature:RTD?	Configures specified channels on the instrument for RTD measurements, and returns temperature values, in degrees C, from the specified channels.
	MEASure:TEMPerature:TCouple?	Configures specified channels on the instrument for thermocouple measurements, and returns temperature values, in degrees C, from the specified channels.

Table 2: Subsystem SCPI Commands for Programming TEMPpoint, VOLTpoint, or MEASURpoint LXI Instruments (cont.)

Subsystem	Mnemonic	Description
MEASure (cont.)	MEASure:VOLTage?	Configures specified channels on the instrument for voltage measurements, and then returns voltage values, from the specified channels.
INITiate	INITiate	Initiates a continuous scan operation on the instrument using the configured channels, channel scan list, scan rate, and trigger source.
ABORt	ABORt	Stops a continuous scan operation on the instrument, if it is in progress.
FETCh	FETCh?	Returns scan records from the circular buffer on the instrument.
INPut	INPut?	Returns the current state of all 8 digital input lines of the digital input port as a weighted sum of all lines that are on (logic ‘1’).
OUTput	OUTPut	Sets the state of all 8 output lines of the digital output port.
	OUTput?	Returns the current state of all 8 output lines of the digital output port as a weighted sum of all lines that are on (logic ‘1’).

Syntax of Program Messages

A program message consists of one or more properly formatted SCPI commands sent from the controller to the instrument to request some action or to query the instrument for a response.

Figure 1 shows the syntax of a program message:

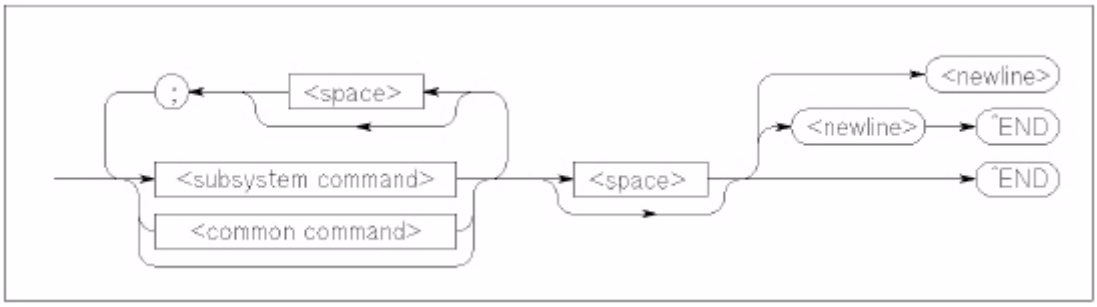


Figure 1: Syntax of Program Messages

A semicolon (;) is used to separate commands within the same command group, and can also minimize typing. For example, you could send the following program message to set the state of the digital output port (all 8 digital output lines) and read the status of the digital output lines:

```
:OUTPut:255; :OUTput?
```

Use a semicolon and a colon to link commands from different groups. For example, this program message returns the contents of the Operation Status register, and then sets the state of the digital output port:

```
:STATus:OPERation:CONDition? ;:OUTPut:255
```

To terminate a program message, use one of the following program message terminators:

- <newline> or the <NL> character
- <^END>

  <^END> means that the IEEE-488 EOI (End-Or-Identify) message was asserted at the same time that the last data byte was sent. <^END> is interpreted as a <NL> character and can be used to terminate a command string in place of a <NL> character.
- <newline><^END>

Terminating the program message always resets the current SCPI command path to the root level.

The following subsections describe the syntax of both the common SCPI commands and the subsystem SCPI commands.

Syntax of Common SCPI Commands

Figure 2 shows the syntax of common SCPI commands.

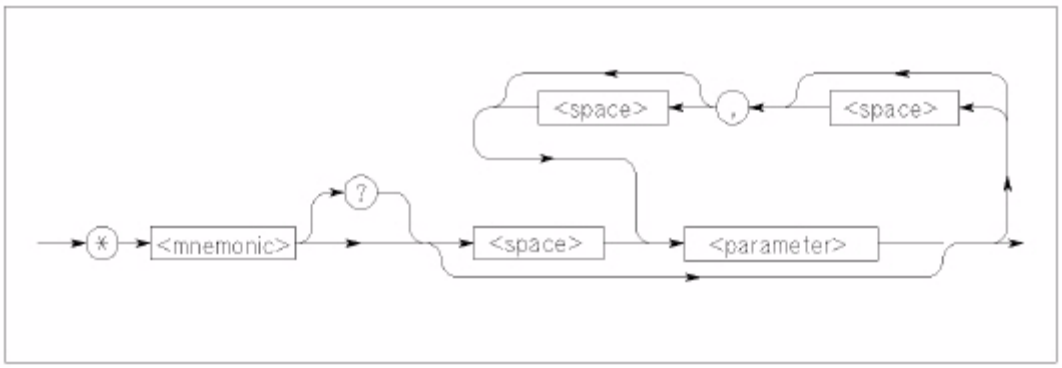


Figure 2: Syntax of Common SCPI Commands

Common SCPI commands begin with an asterisk (*). The command mnemonic is case-insensitive. For example, the following commands have the same effect:

```
*RST
*rst
*Rst
```

Queries requires a question mark (?) at the end of the command header, as follows:

```
*IDN?
```

Syntax of SCPI Subsystem Commands

Figure 3 shows the syntax of SCPI subsystem commands.

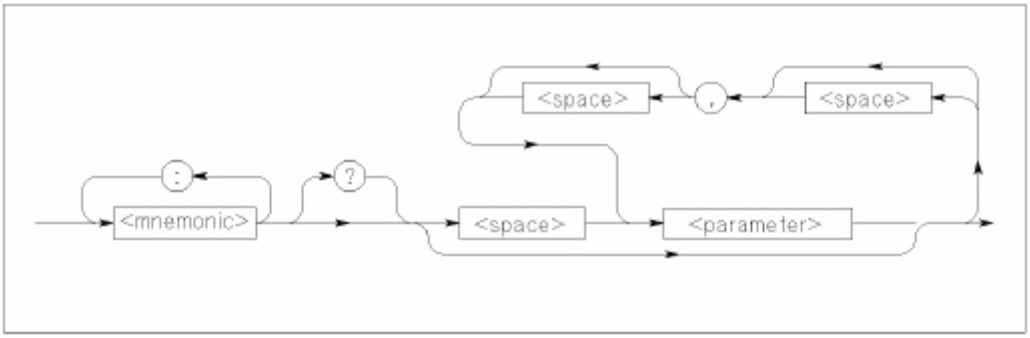


Figure 3: Syntax of SCPI Subsystem Commands

Use a colon (:) to separate command keywords or mnemonics, as shown below:

```
:STATus:OPERation:ENABle
```

Queries require a question mark (?) at the end of the command header, as follows:

```
:STATus:OPERation:CONDition?
```

About Short- and Long-Form Mnemonics

Note that the command syntax shows most command mnemonics (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, use the abbreviated form; for better program readability, use the long form.

You can use either upper- or lower-case letters to specify the command, as the mnemonic is case-insensitive. For example, here is the long form of a command:

```
SYSTem:COMMunicate:NETwork:MASk?
```

And, here is the short-form of this command:

```
Syst:Comm:NET:Mas?
```

About Brackets, Braces, and Vertical Bars

Some parameters are enclosed in square brackets ([ ]), indicating that the parameter is optional and can be omitted. The brackets are not sent with the command. If you do not specify a value for an optional parameter, the instrument uses a default value.

Triangle brackets (< >) indicate that you must specify a value for the enclosed parameter. The brackets are not sent with the command.

Braces ({ }) enclose the parameter choices for a given command. The braces are not sent with the command.

A vertical bar (|) separates multiple parameter choices for a given command.

Syntax of Response Messages

A response message consists of data in a specific SCPI format that was requested from the instrument by the controller.

Figure 4 shows the syntax of a response message from the instrument:

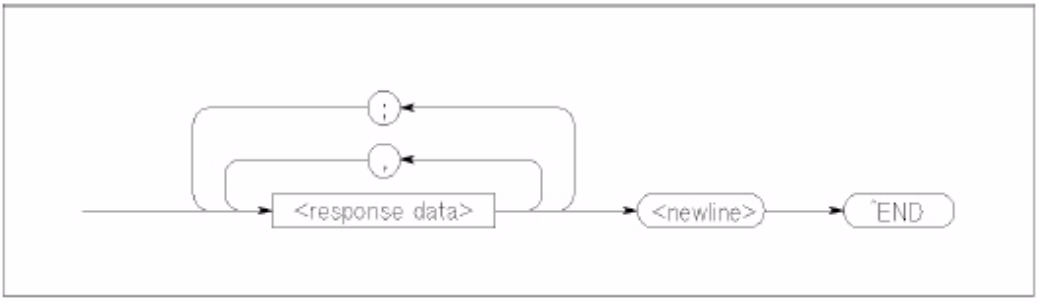


Figure 4: Response Message Syntax

Response messages may contain both commas (,) and semicolons (;) as separators. When a single query command returns multiple values, a comma is used to separate each data item. When multiple queries are sent in the same message, the groups of data items corresponding to each query are separated by semicolons.

The terminator for a response message is always <newline><^END>.

Note: For character data types in response messages, only the short-form of the mnemonic is returned in all uppercase letters.

SCPI Data Types

SCPI defines several different data types for use in program messages sent to an instrument and in response messages received from an instrument.

TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments use the following subset of SCPI data types:

- Character
- String
- <NR1>
- <NR2>
- <NRr>
- <NRf>
- <Boolean>
- <Block>

This section summarizes these data types. Refer to the SCPI standards document for more information about these data types.

Character Data Types

If a command parameter takes a character data type, a specific number of settings are allowed for the parameter. For example, in the following command, you can specify one of the following character data types: *TCouple* for thermocouple measurements, *RTD* for RTD measurements, or *DEFault* for the default configuration for the instrument type:

```
:CONFigure:TEMP {TCouple|RTD|DEFault}
```

Character data types have the following characteristics:

- Can have either the short or long form in program messages and are returned in short-form only in response messages
- Are case insensitive in program messages and are in uppercase only in response messages
- Must have a specific length

String Data Types

Strings used in command parameters and responses follow these rules:

- Strings are enclosed in double quotes " "
  For example,

  ```
  "This is an example"
  ```

  specifies the following string: This is an example

- Use double quotes within double quotes to indicate the part of the string that should appear in quotes; note that double and single quotes used inside the string must be duplicated. For example,

  ```
  "This is the ""example""
  ```

  specifies the following string: This is the “example”

- ? Strings are case sensitive

<NR1>Value Data Type

The <NR1> value data type is used to specify zero, and positive and negative integer decimal values, including optional signs. If you need to indicate decimal points, use the <NR2> value data type, instead.

The following values are examples of the <NR1> data type:

0 255 –2

<NR2> Value Data Type

The <NR2> value data type is used to specify zero, and positive and negative decimal values, including optional signs and decimal points.

The difference between <NR1> and <NR2> is the explicit decimal point. Note that 0 is a special case and redundant decimal points are ignored.

The following values are examples of the <NR2> data type:

–1.234 1.0 0.0

<NRr>Value Data Type

The <NRr> data type is used to specify a non-decimal numeric value, such a hexadecimal, octal, or binary numeric value.

Figure 5 shows the format of the <NRr> data type:

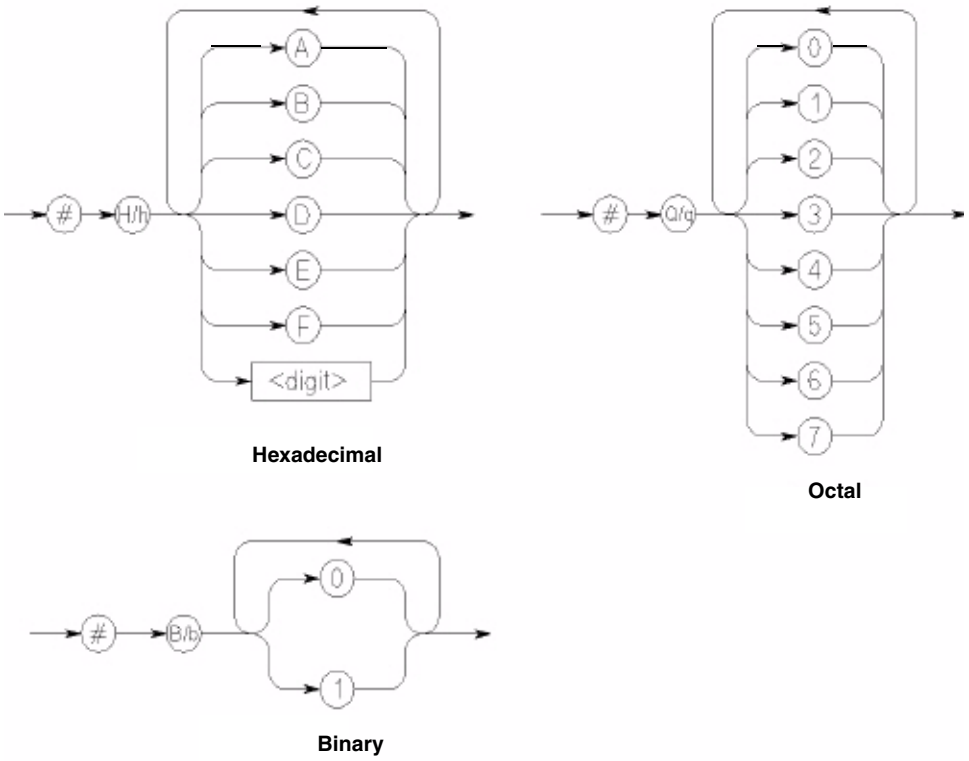


Figure 5: <NRr>Value Data Type

The following examples show how the number 16384 in decimal format is represented as a <NRr> data type:

- *Hexadecimal <NRr> value:* #H4000
- *Octal <NRr> value:* #Q40000
- *Binary <NRr> value:* #B100000000000000

<NRf>Value Data Type

The <NRf> data type is used to specify a floating-point value. These values include digits with an implied decimal point, an explicit decimal point, or an explicit decimal point and an exponent.

The following values are examples of the <NRf> data type:

```
6553          1.525e-4          0.100000
```

<Boolean> Data Type

A Boolean data type for a parameter and response represents a single binary condition that is either True or False. Boolean values are defined as follows:

- 0 or OFF – indicates that the condition is False
- 1 or ON – indicates that the condition is True

Note that the characters OFF and ON are not case sensitive. While a TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument accepts the characters OFF and ON instead of 0 and 1, if queried, these instruments return Boolean responses as either 0 or 1.

<Block> Data Type

The <Block> data type is used to transfer array and system-defined blocks of data between the controller and the instrument. This is the most efficient data format for transferring data.

Figure 6 shows the format of the <Block> data type:

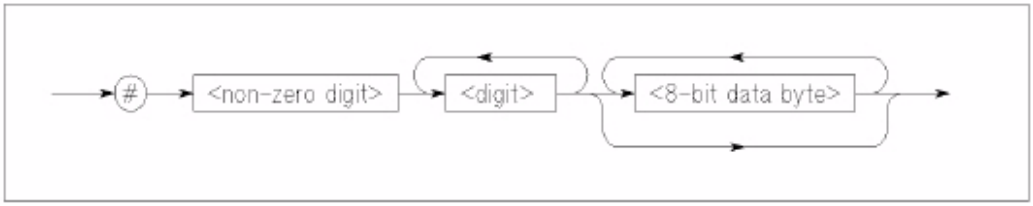


Figure 6: Block Data Type

where:

- # is the starting character of the block
- <non-zero digit> is a single decimal value that specifies how many digits will follow in the next field
- <digit> is a value in <NR1> format that specifies how many <8-bit data byte>s follow. In effect, this field specifies the length, in bytes, of the remainder of the block.
- <8-bit data byte> specifies each 8-bit byte of the block. (The number of 8-bit data bytes is specified in the preceding field.) The contents of this block of bytes is dependent on the specific command.

Note: Prior to interpreting multi-byte values, such as floats, integers, unsigned integers, and so on, you must convert values from network-byte-order (where the highest bytes are sent first; i.e., big-endian) to host-byte-order (where the lowest bytes are read first, i.e., little endian).

The following example shows how a block of five data bytes is formatted:

```
#1<5><b0><b1><b2><b3><b4>
```

SCPI Expression Types

SCPI defines five types of expressions:

- Numeric expressions
- Channel lists
- Numeric lists
- Data Interchange Format (DIF) expressions
- Instrument-specifier expressions

The following subsections summarize these expressions. Refer to the SCPI standard document for more information about these expressions.

Numeric Expressions

A numeric expression is a collection of terms which evaluates to a trace, number, array, or other data element. Expressions can contain terms which are numbers, traces, variables, or expressions. The syntax of a numeric expression is shown in Figure 7:

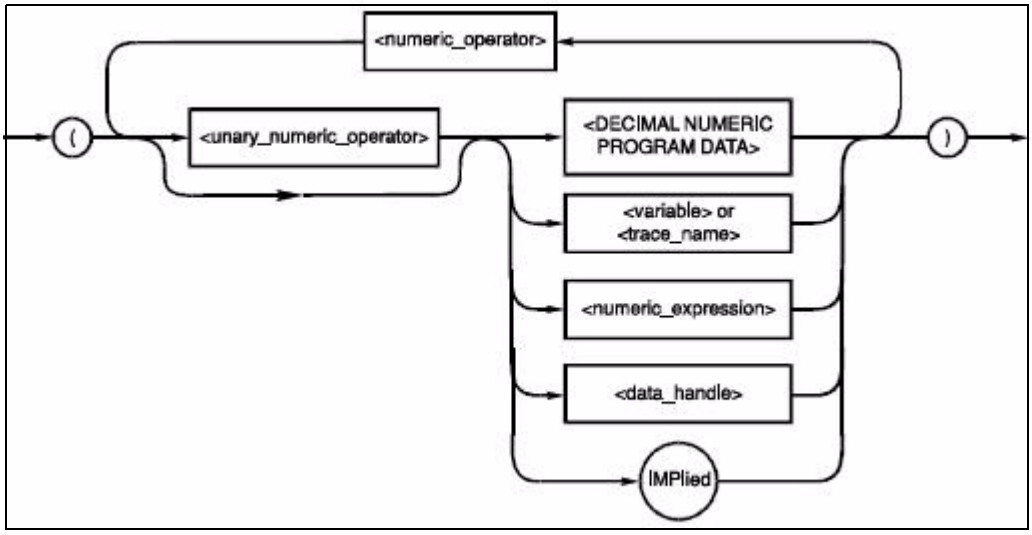


Figure 7: Syntax of a Numeric Expression

where,

- <numeric_operator> is defined as one of the following operators: +, –, *, /, ^, MOD, DIV, ADD, OR, EXOR
- <unary_numeric_operator> is defined as one of the following operators: –, +, NOT. Unary operators should not be used with signed numbers.
- <variable> or <trace_name> is defined as character program data

Expressions are evaluated according to the following precedence rules:

1. Enclosed by parentheses
2. Unary operators (+ and -)
3. ^(exponentiation)
4. * (multiplication), / (division), MOD and DIV
5. + (addition) and - (subtraction)
6. NOT
7. AND
8. OR and EXOR
9. Left to right

Elements in a numeric expression are promoted to the size and type of the most complex element, and the result of the expression is of that type. For example, an expression containing a <trace_name>is evaluated according to the rules for arithmetic on traces, and the result is a trace. If an expression contains both a <trace_name> and scalar data, a trace is created with all elements set to the value of the scalar data before arithmetic is performed. For example, if TREF is a trace_name, the expression (TREF-3) results in a trace that is the same size as TREF, with each data element lower by three.

Channel Lists

TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments use channel lists as parameters in certain commands and in responses to certain queries.

Channel lists are used to specify the analog input channels that are used to measure a combination of either thermocouple, voltage, or RTD inputs. A channel list may appear in a measurement, configuration, or command. By design, all analog input channels that are specified in the channel list are measured simultaneously.

The syntax of a channel list expression is shown in Figure 8:

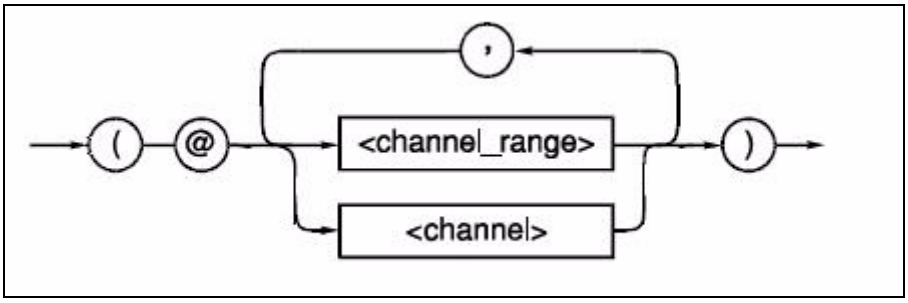


Figure 8: Syntax of a Channel List Expression

where:

- (is the starting character of the channel list
- @ is the next character of the channel list
- <channel range> consists of two channels in <NR1> format separated by a colon.

  For TEMPpoint, VOLTpoint, and MEASURpoint instruments, the number of channels ranges from 0 up to 48, depending on the configuration of your instrument. The first channel in the range must be lower than the second in the range.

  Separate multiple <channel_range> elements with commas.
- <channel> consists of one channel number in < NR1> format. For TEMPpoint, VOLTpoint, and MEASURpoint instruments, this is a number from 0 to 48, depending on the configuration of your instrument. Separate multiple <channel> elements with commas.
-) terminates the channel list expression

For example, to measure the voltage on analog input channels 4 through 6, use one of the following commands:

```
MEAS:VOLT? (@4:6)
```

```
MEAS:VOLT? (@4,5,6)
```

To measure the voltage of analog input channel 4 only, use this command:

```
MEAS:VOLT? (@4)
```

Numeric Lists

A numeric list is a an expression format for compactly expressing numbers and ranges of numbers in a single parameter. The syntax of a numeric list expression is shown in Figure 9:

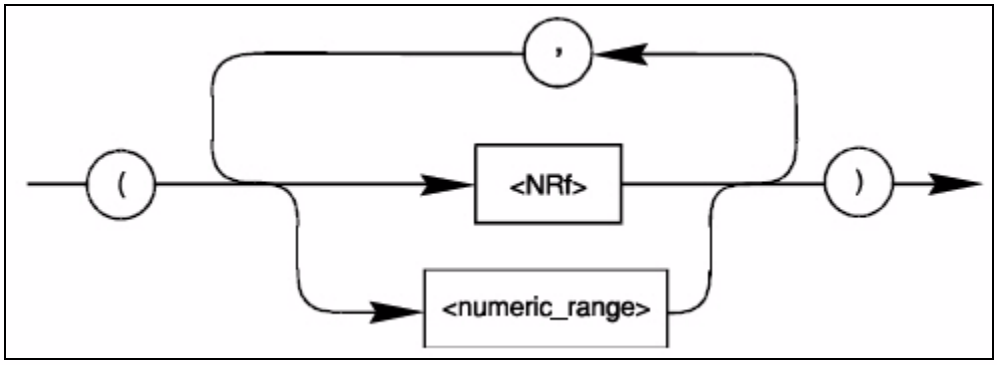


Figure 9: Syntax of Numeric List Expressions

where:

- <NRf> is an extended format, described on page 25.
- <numeric_range> is defined as two <NRf> data types separated by colons. The range is inclusive of the specified numbers.

Data Interchange Format (DIF) Expressions

The data interchange format is block-structured and lets software packages and instruments share waveform and other data.

The following block types are available in DIF expressions:

- DATA block – Contains the data.
- IDENtify block – Describes the manner and environment in which the data was obtained.
- DIMension, ORDer, and ENCode blocks – Describe how the data is physically represented and logically organized.
- TRACe and VIEW blocks – Provide semantic information about the data.
- REMark block – Contains textual comments regarding the data.
- DIF block – Identifies the block as a <dif_expression> and describes the version of SCPI that is used.

In a DIF expression, each hierarchical level of a block is introduced by a block name with its subordinate elements enclosed in parentheses. A block may have a modifier and may contain subordinate blocks and keyword units, or both. Keyword units consist of a keyword followed by one or more values. If a keyword has more than one value, the values are separated by commas. The following example shows a simple data set. All blocks and keywords are indented to show their hierarchical relationship:

```
(DIF (VERSion 1993.0)
IDENtify (
      NAME "Data Format Example"
      TEST (
            NUMBer "7D4", "2.4"))
      ENCode (
            HRANge 75
            RANge 25)
DIMension=X (
      TYPE IMPLicit
      SCALe 0.01
      SIZE 7
      UNITs "S")
DIMension=Y (
      TYPE EXPLicit
      SCALe 0.02
      OFFSet 0.1UNITs "V")
DATA (
   CURVe(
      VALues 49.0, 48.0, 50.2, 61.3, 68.5, 38.6, 48.0)))
```

The data interchange format overall is formatted as an IEEE 488.2 <EXPRESSION PROGRAM DATA> element. Within this element, the various blocks, modifiers, keywords, and value types are composed of syntactic elements that, for the most part, are identical to the corresponding types specified in IEEE 488.2 or a subset of them. Refer to the IEEE 488.2 standard for more information.

Instrument-Specifier Expressions

An <instrument_specifier> is a combination of one or more base functionality keywords along with optional additional functionality keywords that define an instrument class. The syntax of an instrument-specifier expression is shown in Figure 10.

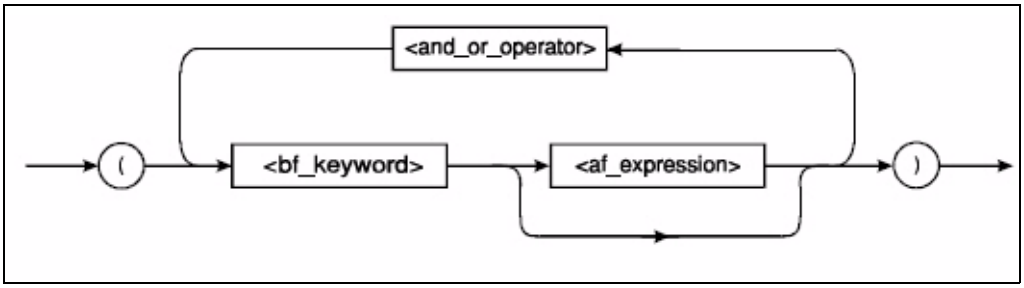


Figure 10: Syntax of an Instrument-Specifier Expression

where:

- (is the starting character of the instrument-specifier expression
- <and_or_operator> is either '&' (ASCII hexadecimal 26) or '|' (ASCII hexadecimal 7C)
- <bf_keyword> is a base functionality keyword
- <af_expression> includes additional <and_or_operator>s and additional functionality keywords
-) terminates the instrument-specifier expression

Using SCPI Commands with LXI Measurement Instruments

Installing SCPI Support Files

Install the SCPI support files and the rest of the software for your instrument from the web at **http://mccdaq.com/downloads/DTSoftware/MEASURpoint**.

The installation program guides you through the installation process.

To access the SCPI documentation and examples, from the Windows Start menu, click **Programs -> Data Translation, Inc -> Measurement SCPI Support -> SCPI Programmer's Manual for Measurement**

Determining the LAN Settings of Your Instrument

The Ethernet address of a TEMPpoint, VOLTpoint, or MEASURpoint instrument consists of three parts:

- The IP address – The "Internet Protocol" numeric address that identifies where messages are sent or received on the LAN (Local Area Network).
- Subnet mask – A 32-bit value that enables the recipient of IP packets to distinguish the network ID and host ID portions of the IP address.
- Gateway address –The address of the network router that allows the instrument to communicate outside of the local subnet.

The instrument can acquire an Ethernet address in one of the following ways:

- DHCP (Dynamic Host Configuration Protocol server) – The address is set by the network server automatically when the instrument is powered on. The address is different each time the instrument is powered on.

  By default, DHCP is enabled for TEMPpoint, VOLTpoint, and MEASURpoint instruments.
- Auto-IP – If the DHCP server is not available, the instrument configures its own IP address in the range of 169.254.0.0 to 169.254.255.255 with a subnet mask of 255.255.0.0. Like with DHCP, the address is different each time the instrument is powered on.

  By default, Auto-IP is enabled for TEMPpoint, VOLTpoint, and MEASURpoint instruments.
- Static IP – Using the web interface provided with the instrument, you can specify the static IP address of the instrument. The static IP address does not change when the instrument is powered on. Refer to the documentation for your instrument for more information about configuring a static IP address.

Using SCPI queries, you can return the following information about each TEMPpoint, VOLTpoint, and MEASURpoint instrument on the LAN:

- IP address – Use the **SYSTem:COMMunicate:NETwork:IPADdress?** query, described on page 80, to return the IP address of the instrument, regardless of the method (DHCP, Auto-IP, static IP) used to acquire the address.
- Subnet mask – Use the **SYSTem:COMMunicate:NETwork:MASk?** query, described on page 80, to return the subnet mask of the instrument, regardless of the method (DHCP, Auto-IP, static IP) used to acquire the subnet mask.

To restore the default LAN settings to their factory default values, use the **SYSTem:PRESet** command, described on page 80. The factory default configuration enables both DHCP and Auto-IP and disables static IP.

Using Password-Protected Commands

TEMPpoint, VOLTpoint, and MEASURpoint instruments implement authentication using a single, user-configurable password. The password is saved in permanent memory in the instrument.

Note: The instrument's web interface, IVI-COM driver, and SCPI interface use the same password.

On power up, all SCPI commands and queries that either change the configuration of the instrument or operate it are disabled. This is to prevent unauthorized access to an instrument by some client on the network.

By using the **SYSTem:PASSword[:CENable]** command, described on page 83, you can enable password-protection. When password protection is enabled, the correct password must be issued to use the following SCPI commands:

- **OUTPut[:STATe]**, described on page 151
- **CONFigure:VOLTage**, described on page 109
- **CONFigure:RESistance**, described on page 103
- **CONFigure:TEMPerature:TCouple,** described on page 106
- **CONFigure:TEMPerature:RTD**, described on page 104
- **CONFigure:VOLTage:RANGe**, described on page 111
- **CONFigure:SCAn:LISt**, described on page 120
- **CONFigure:SCAn:CJC**, described on page 118
- **CONFigure:SCAn:RATe[:SEC | HZ]**, described on page 123
- **CONFigure:FILTer**, described on page 115
- **CONFigure:TRIGger[:SOURce]**, described on page 127
- **INITiate**, described on page 140
- **ABORt**, described on page 143
- **MEASure:VOLTage?**, described on page 137
- **MEASure:RESistance?**, described on page 130
- **MEASure:TEMPerature:TCouple?**, described on page 134
- **MEASure:TEMPeratuer:RTD?**, described on page 131
- **SYSTem:TZONe**, described on page 100
- **SYSTem:CALibrate**, described on page 77

To disable the use of password-protected commands, use the **SYSTem:PASSword:CDISable** command, described on page 81.

You can determine whether password-protected commands are disabled or enabled using the **SYSTem:PASSword:CENable:STATe?** command, described on page 85.

The default password is *admin* for all TEMPpoint, VOLTpoint, and MEASURpoint instruments.

Note: The DT8871, DT8871U, DT8872, DT8873, and DT8874 instruments with firmware version 2.2.3.1 or greater use the default user name "admin" and the default password "admin". Firmware version 2.2.3.1 and greater support password-protected commands. Therefore, you must enter the appropriate password to change the instrument's configuration or to start and stop a scan.

Firmware versions less than 2.2.3.1 do not support password-protected commands. Therefore, you are not prompted to enter a password to change the instrument's configuration or to start or stop a scan.

You change the password from the current password that is stored in permanent memory in the instrument to a new password using the LAN configuration page of the web interface for the instrument, through the IVI-COM driver, or through the SCPI command **SYSTem:PASSword:NEW**, described on page 86.

A SCPI client that wishes to configure and/or operate a TEMPpoint, VOLTpoint, or MEASURpoint instrument should use these commands as follows:

1. Use the query **:SYSTem:PASSword:CENable:STATe?** to determine if password-protected commands are enabled.

   The following example shows that password-protected commands are disabled:

   ```
   -> *IDN?
   <- Data Translation, DT8874-08T-00R-08V,201129241,2.2.2.0
   -> :SYSTem:PASSword:CENable:STATe?
   <- 0
   ```

2. If password-protected commands are disabled, enable password-protected commands by using **SYSTem:PASSword:CENable**. If this command is successful, the client can configure the instrument and operate it. An example follows:

   ```
   -> :SYST:PASS:CEN admin
   -> :SYSTem:PASSword:CENable:STATe?
   <- 1
   -> :CONF?
   <- PT1000,PT1000,PT1000,PT1000
   -> :CONF:TEMP:RTD PT100
   -> :CONF?
   <- PT100,PT100,PT100,PT100
   ```

3. If this command is successful, the client can configure the instrument and start scans.

4. To prevent some other SCPI client, locally or on the LAN, from stopping the scan and modifying the configuration, the client that enabled password-protected commands should issue **SYSTem:PASSword:CDISable**.

The following example shows an attempt to disable protected commands using an erroneous password:

```
-> :SYSTem:PASSword:CDISable bogus
-> :SYST:ERR?
<- -221,"Settings conflict;:SYST:PASS:CDIS"
```

The following is an example in which the correct password is used to disable protected commands:

```
-> :SYSTem:PASSword:CDISable admin
-> :SYST:ERR?
<- 0,"No error"
-> :SYSTem:PASSword:CENable:STATe?
<- 0
```

Since protected commands are disabled, any attempt to use them will fail, as shown in the following example:

```
-> :CONF?
<- PT1000,PT1000,PT1000,PT1000
-> :CONF:TEMP:RTD PT1000
-> :SYST:ERR?
<- -203,"Command protected"
-> :CONF?
<- PT1000,PT1000,PT1000,PT1000
-> *STB?
<- 0
-> :INIT
-> :SYST:ERR?
<- -203,"Command protected"
-> *STB?
<- 0
```

In this scenario, one “master” SCPI client can configure the instrument, start scans, and disable SCPI commands. Since all queries are permitted regardless of the state of password protection, any client can perform **FETCh?** and other queries. The "master" can eventually enable password-protected commands and stop scans. The password should not be shared and should only be known by the master SCPI client.

5. At any time, the password can be changed using **SYSTem:PASSword:NEW**. Note that this command is never disabled.

   The following example shows an attempt to change the password using a wrong password:

   ```
   -> :SYST:PASS:NEW bogus, admin1
   -> :SYST:ERR?
   <- -221,"Settings conflict;:SYST:PASS:NEW"
   ```

   In the following example, the existing password *admin* is successfully changed to *admin1*:

   ```
   -> :SYST:PASS:NEW admin, admin1
   -> :SYST:ERR?
   <- 0,"No error"
   ```

The following example shows that the old password *admin* is no longer in use and the new password *admin1* is in effect:

```
-> :SYSTem:PASSword:CDISable admin
-> :SYST:ERR?
<- -221,"Settings conflict;:SYST:PASS:CDIS"
-> :SYSTem:PASSword:CDISable admin1
-> :SYST:ERR?
<- 0,"No error"
-> :SYSTem:PASSword:CENable:STATe?
<- 0
```

Determining the System Configuration

Each of the standard TEMPpoint, VOLTpoint, and MEASURpoint products consists of up to eight boards, each with eight channels, for a total of up to 48 channels.

Instruments may be composed of multiple board types/models. For example, a DT8874-24T-08R-16V, contains thermocouple boards, RTD boards, and voltage input boards. To determine programmatically which boards comprise your TEMPpoint, VOLTpoint, or MEASURpoint instrument, use the following SCPI queries:

- **SYSTem:BOArd?** – Returns the number of boards installed in the instrument.
- **SYSTem:BOArd:MODel?** – Returns a number that corresponds to a particular board in the instrument. The following values are supported:
  - 0 – DT8771 (This is a thermocouple board.)
  - 1 – DT8871U (This is a thermocouple board.)
  - 2 – DT8873-100V (This is a voltage board with a fixed range of ±100 V; this is an older board model that has been replaced by the DT8873-MULTI board type.)
  - 3 – DT8873-10V (This is a voltage board with a fixed range of ±10 V. This is an older board model that has been replaced by the DT8873-MULTI board type.)
  - 4 – DT8873-400V (This is a voltage board with a fixed range of ±400 V. This is an older board model that has been replaced by the DT8873-MULTI board type.)
  - 5 – DT8872 (This is an RTD board.)
  - 7 – DT8873-MULTI (This is a voltage board that supports programmable voltage ranges of ±10 V and ±60 V.)
- **SYSTem:BOArd:MODel:NAMe?** – Returns the name that corresponds to a particular board in the instrument. The following names are supported:
  - DT8771 (This is a thermocouple board.)
  - DT8871U (This is a thermocouple board.)
  - DT8873-100V (This is a voltage board with a fixed range of ±100 V. This is an older board type that has been replaced by the DT8873-MULTI board type.)
  - DT8873-10V (This is a voltage board with a fixed range of ±10 V. This is an older board type that has been replaced by the DT8873-MULTI board type.)
  - DT8873-400V (This is a voltage board with a fixed range of ±400 V. This is an older board type that has been replaced by the DT8873-MULTI board type.)
  - DT8872 (This is an RTD board.)
  - DT8873-MULTI (This is a voltage board that supports programmable voltage ranges of ±10 V and ±60 V.)

You can also return the minimum and maximum voltage range that is supported by each board using the **SYSTem:BOArd:RANGe?** command.

Performing Analog Input Operations

This section describes how to use SCPI commands to perform analog input operations on a TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument. The following topics are discussed:

- Analog input channels, described below
- Input ranges, described on page 41
- Filtering, described on page 42
- Conversion modes, described on page 43
- Auto-calibration, described on page 52

Analog Input Channels

Up to 48 analog input channels are supported on the DT8871, DT8871U, DT8872, DT8873, and DT8874 instruments.

To determine the list of all analog input channels that are supported on your instrument, use the **SYSTem:CHANnel?** command, described on page 92.

To determine which analog input channels support thermocouple measurements, use the **SYSTem:CHANnel:TCouple?** command, described on page 94.

To determine which analog input channels support RTD measurements, use the **SYSTem:CHANnel:RTD?** command, described on page 93.

Because TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments use a Delta-Sigma analog-to-digital converter (ADC) for each analog input channel, all analog input channels are sampled simultaneously. You can acquire a single value from specific analog input channels simultaneously, or continuously acquire data from one or more analog input channels simultaneously using a channel list. Refer to page 43 for more information on specifying the channels for each of these conversion modes.

Input Ranges

The input voltage range that is supported by your TEMPpoint, VOLTpoint, or MEASURpoint instrument depends on the specific instrument model that you purchased, as shown in Table 3.

Table 3: Supported Input Ranges

Instrument Type	Models	Input Range
TEMPpoint	DT8871U[a]	±0.75 V for all channels
	DT8871[a]	±1.25 V for all channels
	DT8872[a]	±1.25 V for all channels
VOLTpoint	DT8873[a]	±10 V or ±60 V (software-selectable for each channel)[b]
MEASURpoint	DT8874-xxT-xxR-xxV	±0.75 V for thermocouple channels; ±1.25 V for RTD channels; ±10 V or ±60 V for voltage channels (software-selectable for each channel)[b]

a. Instruments with firmware version 2.2.3.1 or greater are identified in firmware as DT8874-xxT-xxR-xx-V, where *xx*T specifies the number of thermocouple channels, *xx*R specifies the number of RTD channels, and *xx*V specifies the number of voltage input channels.

b. Older versions of this instrument had fixed input ranges of ±10 V, ±100 V, or ±400 V, depending on the model purchased.

VOLTpoint and MEASURpoint instruments provide channels with software-selectable voltage ranges. To determine which channels support programmable voltage ranges, use the **SYSTem:CHANnel:VOLTage:RANGe?** query.

You can set the input voltage range for these channels using the **CONFigure:VOLTage:RANGe** command. By default, these channels are configured to use ±10 V range.

Use the **CONFigure?** command to determine the current configuration of each channel.

Filtering

Each Delta-Sigma A/D converter provided for analog input operations on the TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument provides a filter that rejects noise at 50 Hz and 60 Hz and removes *aliasing*, a condition where high frequency input components erroneously appear as lower frequencies after sampling.

In addition to this filter, you can further reduce noise by selecting one of the following software filters using the **CONFigure:FILTer** command:

- RAW – No filter. Provides fast response times, but the data may be difficult to interpret. Use when you want to filter the data yourself.

  The RAW filter type returns the data exactly as it comes out of the Delta-Sigma A/D converters. Note that Delta-Sigma converters provide substantial digital filtering above the Nyquist frequency.

  Generally, the only time it is desirable to turn off the software filter is if you are using fast responding thermocouples/RTDs, sampling them at higher speeds (> 1 Hz), and need as much response speed as possible.

- AVG – The Moving Average filter provides a compromise of filter functionality and response time. This filter can be used in any application.

  This low-pass filter takes the previous 16 samples, adds them together, and divides by 16.

You can query the current filter configuration using the **CONFigure:FILTer?** query.

Conversion Modes

TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments support simultaneous single-value and continuous scan conversion modes for acquiring data from analog input channels.

In addition, these instrument allows you to read the digital input port (all 8 digital input lines) as part of the analog input data stream. This feature is particularly useful when you want to correlate the timing of analog and digital events.

This section describes each of these conversion modes.

Simultaneous Single-Value Operations

If you want a snapshot of specific analog input channels on a TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument at one point in time, perform a simultaneous single-value operation. The following single-value commands configure particular analog input channels, and then simultaneously acquire a single value from each of these channels:

- **MEASure:TEMPerature:TCouple?** – Configures specified analog input channels for thermocouple measurements, and then returns temperature values, in degrees Celsius, from the specified channels.
- **MEASure:TEMPerature:RTD?** – Configures specified analog input channels for RTD measurements, and then returns temperature values, in degrees Celsius, from the specified channels.
- **MEASure:RESistance?** – Configures the specified analog input channels for resistance measurements, and then returns resistance values, in ohms, from the specified channels.
- **MEASure:VOLTage?** – Configures specified analog input channels for voltage measurements, and then returns voltage values from the specified channels.

Note: If your instrument supports programmable voltage ranges, first configure the voltage ranges using the **CONFigure:VOLTage:RANGe** command before calling **MEASure:VOLTage?**

A single-value operation stops automatically when finished; you cannot stop a single-value operation.

Note: Values returned from single-value operations are based on the configured filter type, described on page 42.

In a mix-and-match configuration, it is easy to accidentally mismatch the software and hardware configuration for a channel. Therefore, it is recommended that you pay particular attention when configuring channels, since the resultant errors may be not large enough to notice initially, but may be significantly larger than the accuracy specification for the instrument.

Continuous Scan Mode

Continuous scan mode takes full advantage of the capabilities of a TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument. Use continuous scan mode if you want to continuously scan a list of channels, including the analog input channels and the digital input port.

To perform a continuous scan operation, perform the following steps:

1. Configure the analog input channels that you want to sample.
2. For thermocouple measurements, optionally enable the capability of returning CJC data in the analog input data stream.
3. Specify a list of channels to scan.
4. Specify the frequency at which to scan the channel list.
5. Specify the trigger source that starts the operation once the scan is initiated.
6. Initiate the scan.
7. Retrieve scan data from the circular buffer on the instrument.

The following sections describe these steps in more detail.

Note: Values returned from continuous scan operations are based on the configured filter type, described on page 42.

Configuring Channels for a Continuous Scan Operation

Using software, configure the analog input channels that you want to sample using one of the following commands:

- **CONFigure:VOLTage** – For channels that do not support programmable voltage ranges, configures specific analog input channels for voltage measurements.
- **CONFigure:VOLTage:RANGe** – For channels that support programmable voltage ranges, configures the channel for voltage measurements and sets the input voltage range. Refer to page 41 for more information.
- **CONFigure:TEMPerature:TCouple** – Configures specific analog input channels for thermocouple measurements based on the specified thermocouple type.

- **CONFigure:TEMPerature:RTD** – Configures specific analog input channels for RTD measurements based on the specified RTD type.
- **CONFigure:RESistance** – For RTD measurements, configures specific analog input channels for resistance measurements.

Note: In a mix-and-match configuration, it is easy to accidentally mismatch the software and hardware configuration for a channel. Therefore, it is recommended that you pay particular attention when configuring channels, since the resultant errors may be not large enough to notice initially, but may be significantly larger than the accuracy specification for the instrument.

You can query the current configuration of specified analog input channels using the **CONFigure?** query.

Returning CJC Values in the Data Stream

Each analog input channel that supports thermocouple inputs has its own cold-junction compensation (CJC) circuit at the input. Using the **CONFigure:SCAn:CJC** command, you can enable the capability of returning the CJC values in the data stream.

This option is seldom used, but is provided if you want to implement your own temperature conversion algorithms in software when using continuous operations. The software takes care of correlating the CJC measurements with the analog input measurements.

Specifying a Channel List for a Continuous Scan Operation

Use the **CONFigure:SCAn:LISt** command to specify a channel list that contains the analog input channels that you want to scan. You can also read the value of the digital input port through the analog input data stream by specifying the digital input channel in the channel list; the number of the digital input channel depends on the configuration of your instrument, as shown in Table 4.

Table 4: Supported Channels for Continuous Operations

Instrument Type	Total Number of Analog Input Channels	Channel for Reading the Digital Input Port
Standard TEMPpoint, VOLTpoint, MEASURpoint (DT8871, DT8871U, DT8872, DT8873, DT8874)	0 to 7	8
	0 to 15	16
	0 to 23	24
	0 to 31	32
	0 to 39	40
	0 to 47	48

Note: You cannot specify the same channel more than once in the channel list.

If a channel is included in the channel list, the sampled data is placed in the circular buffer on the instrument (described on page 47). If the channel is not included in the channel list, the data for that channel is discarded.

Specifying the Scan Rate

Due to the simultaneous nature of TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments, all channels in the list are sampled simultaneously. You specify the scan rate or frequency using the **CONFigure:SCAn:RATe** command.

Note: The scan rate or frequency that you specify is rounded to the closest "correct" value that the instrument can accept without error. Internally, the 10 Hz clock is divided by an integer in the range of 1 to 65535 (the internal clock divider) to determine the closest value. Using software, you can query this setting to determine the actual scan rate or frequency that is used.

To determine the minimum scan rate or frequency that is supported by your instrument use the **SYSTem:SCAn:RATe:MINimum?** command, described on page 98.

To determine the maximum scan rate or frequency that is supported by your instrument use the **SYSTem:SCAn:RATe:MAXimum?** command, described on page 97.

Specifying the Trigger Source

A trigger is an event that occurs based on a specified set of conditions. Using the **CONFigure:TRIGger[:SOURce]** command, you can configure one of the following trigger sources:

- **IMMediate** – Specifies a software trigger. When the **INITiate** command (described below) is executed, acquisition starts immediately. This is the default trigger source.
- **DIN0** – Specifies an external, digital trigger on digital input line 0. When the **INITiate** command (described in the next section) is executed, acquisition does not start until the instrument detects a 3 to 28 V DC signal on digital input line 0 for at least 100 ms.

To determine the currently configured trigger source use the **CONFigure:TRIGger[:SOURce]?** query.

Initiating and Aborting a Continuous Scan Operation

To initiate a continuous scan operation, issue the **INITiate** command. When the specified trigger occurs, the instrument simultaneously samples all the analog input channels, optional CJC inputs (for thermocouple measurement channels), and the digital input port, and converts the analog inputs to temperature, resistance, or voltage based on channel

configuration. The operation continues until you stop the operation using the **ABORt** command.

Note: Use the **ABORt** command to stop the operation regardless of whether the trigger occurred or not.

Figure 11 illustrates continuous scan mode using a channel list with three entries: channel 0, channel 1, and channel 2. In this example, analog input data is acquired simultaneously on all channels on each clock pulse of the input sample clock.

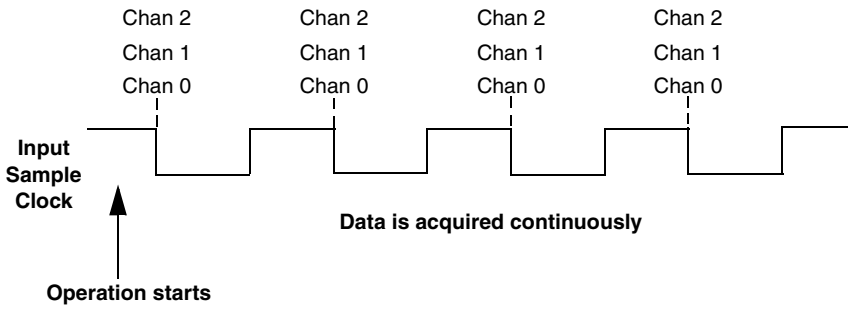


Figure 11: Continuous Scan Mode

Storing Data in the Circular Buffer

TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments have a fixed-size circular buffer (also known as a FIFO) on board for storing scan data. You can return the size of the circular buffer programmatically using the **CONFigure:SCAn:BUFfer** command.

The maximum number of scans that can be stored in the circular buffer before it wraps around is dictated by the number of channels in the scan list (which you define using the **CONFigure:SCAn:LISt** command), whether CJC data is returned in the data stream (which you define using the **CONFigure:SCAn:CJC** command), and the system overhead.

If you return CJC values in the data stream, as described on page 47, two values are returned in the scan for each analog input channel in the channel list. The first value in the pair represents the temperature or voltage of the channel depending on how the channel was configured; the second value in the pair represents the CJC temperature (in degrees C) for that channel.

You can determine the number of scans that can be stored in the circular buffer (also known as the scan count) as follows:

If CJC data is NOT returned in the data stream:

$$\text{Scan Count} = \frac{\text{size of circular buffer}}{\text{\# of enabled channels}} * \text{size of channel data}$$

If CJC data is returned in the data stream:

$$\text{Scan Count} = \frac{\text{size of circular buffer}}{\text{\# of enabled channels}} * \text{size of channel data} * 2$$

Figure 12 shows an example of storing 1000 scans in the circular buffer at a scan frequency of 1 Hz. A scan counter on the instrument is incremented as each scan completes.

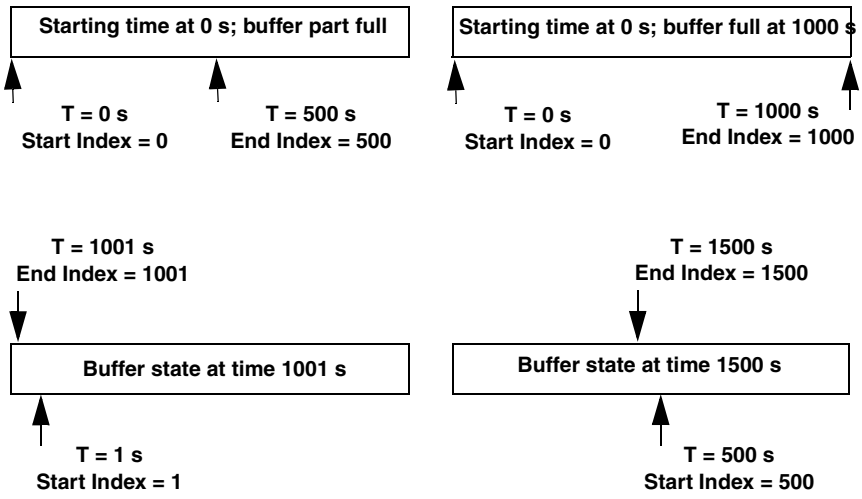


Figure 12: Example of Storing Data in the Circular Buffer

Retrieving Scan Data from the Circular Buffer

At any instant, up to 12 SCPI clients can retrieve a client-specific number of scans concurrently from the circular buffer using the **FETCh?** command.

Note: Of the 12 SCPI clients, 4 can be VXI-11 clients, which use the VISA::INSTR resource to access the instrument.

Up to 8 additional clients can access the instrument concurrently using the web interface provided with the instrument. Refer to the user's manual for your instrument for more information.

At this time, the SCPI and web interfaces cannot be "locked;" therefore, one client can change the configuration of the instrument that another client is accessing. However, you can optionally lock the VXI-11 interface using the VISA APIs viLock/viUnlock; this prevents other VXI-11 clients (including VXI-11 discovery) from accessing the instrument.

The **FETCh?** command takes two parameters:

- *RequestedScansIndex* – a required parameter that specifies where in the circular buffer to begin reading the scan data
- *RequestedScansToRead* – an optional parameter that specifies the number of scans to retrieve from the circular buffer

By using *RequestedScansIndex* and *RequestedScansToRead*, any client can request data at arbitrary intervals. To request all the data from the circular buffer, set the *RequestedScansIndex* to 0 and omit the *RequestedScansToRead* parameter.

Note that the amount of data that is return is limited by the packet size of the network. A client can repeatedly issue a **FETCh?** request; however, be aware that the network traffic is high and that the client has to determine if there is any chronological overlap between responses.

If you want to read only a specified number of scans (instead of all the scans available), specify the number of scans that you want to retrieve in the *RequestedScansToRead* parameter. If more than the requested number scans has been acquired, the instrument returns only the scans that you requested between the starting index (*RequestedScansIndex)* and the ending index *(RequestedScansIndex + RequestedScansToRead)*. Conversely, if fewer than the requested number of scans has been acquired, the instrument returns the subset of the requested scans that are available between the starting index (*RequestedScansIndex)* and the ending index *(RequestedScansIndex + RequestedScansToRead)*.

Scan data is stored in the circular buffer in a structure called a SCAN_RECORD. Each SCAN_RECORD structure contains time stamp information about the acquired data in millisecond granularity, the scan record number (*scanNumber*), the number of values in the record, and the actual samples that were acquired. Refer to page 176 for more information on the SCAN_RECORD structure.

Note: If no scan records exist between the starting index and the ending index, an empty SCAN_RECORD structure is returned.

Samples in SCAN_RECORD are ordered from the lowest channel number to the highest channel number in the scan. Reading data from the circular buffer with **FETCh?** does not destroy the data; therefore, you can read the same data multiple times, if desired, providing that the circular buffer has not been overwritten.

If the client wants to read a number of scans that chronologically follow a previous response, get the *scanNumber* of the last SCAN_RECORD, returned from the last **Fetch?** command, or get the *EndingIndex* returned by the **STATus:SCAn** command, described on page 74, add one to this value, and set the *RequestedScansIndex* parameter of the next **Fetch?** command to this value. For example, if *EndingIndex* returned by **STATus:SCAn** is 2050 and you want to continue reading data from the location where you left off, set *RequestedScansIndex* in the next **Fetch?** command to 2051.

Table 5 illustrates a few scenarios of retrieving scan data from the circular buffer.

Table 5: Scenarios when Retrieving Data from the Circular Buffer

Description	Time, in seconds, for Client's Request	RequestedScansIndex Specified in FETCh?	RequestedScansToRead Specified in FETCh?	Starting Index Returned by STATus:SCAn?	EndingIndex Returned by STATus:SCAn?
Case 1 - Buffer not full The client requests scans at intervals (periodic or non-periodic) faster than the rate at which the buffer wraps around. The returned *StartingIndex* equals the *RequestedScansIndex*. The *EndingIndex* equals the *RequestedScansToRead*.					
Returns 100 most recent scans from 1 to 100 s	100	1	100	1	100
Returns 100 most recent scans from 101 to 200 s; measurements chronologically follow the earlier request (*RequestedScansIndex* = 1 + *EndingIndex* of previous scan)	200	101	200	101	200
Returns 400 most recent scans from 201 to 600 s; measurements chronologically follow the earlier request	600	201	400	201	600
Returns 400 most recent scans from 601 to 1000 s; measurements chronologically follow the earlier request	1000	601	400	601	1000
Case 2 - Buffer not full The client requests measurements that do not chronologically follow the previous measurement.					
Returns 200 most recent scans from 1 to 200 s	200	1	200	1	200
Returns 200 most recent scans from 601 to 800 s; measurements do not chronologically follow the earlier request (*RequestedScanIndex* > 1 + *EndingIndex* of previous scan)	800	601	200	601	800
Case 3 - Buffer not full The client requests more measurements than are available. The instrument returns the actual number of scans acquired, which is less than the requested number of scans.					
Returns 200 most recent scans from 1 to 200 s (*EndingIndex* is less than *RequestedScansToRead*)	200	1	>200	1	200
Returns 600 most recent scans from 201 to 800 s; measurements chronologically follow the earlier request (*RequestedScansIndex* = 1 + *EndingIndex* of previous scan)	800	201	>600	201	800
Case 4 - Buffer not full The client requests more, and then fewer measurements than are available.					
The client requests more scans than are available. The instrument returns 200 most recent scans from 1 to 200 s.	200	1	>200	1	200
The client requests fewer scans than are available. The instrument returns 500 s of data from 201 s to 700 s, rather than the 600 s of data that is available (800s - 201s); the most recent 100 s of data is still in the buffer. Measurements chronologically follow the earlier request (*RequestedScanIndex* > 1 + *EndingIndex* of previous scan)	800	201	500	201	700

Table 5: Scenarios when Retrieving Data from the Circular Buffer (cont.)

Description	Time, in seconds, for Client's Request	RequestedScansIndex Specified in FETCh?	RequestedScansToRead Specified in FETCh?	Starting Index Returned by STATus:SCAn?	EndingIndex Returned by STATus:SCAn?
Case 5 - Buffer not full The client requests more measurements than are available and that chronologically overlap between 101 and 200 s.					
Returns 200 most recent scans from 1 to 200 s	200	1	>200	1	200
Returns 700 most recent scans from 101 to 800 s; measurements chronologically overlap the earlier request by 100 s at t = 200 (*RequestedScanIndex* < 1 + *EndingIndex* of previous scan)	800	101	>700	101	700
Case 6 - Buffer not full The client requests more scans than are available and at intervals slower than the rate at which the buffer wraps around.					
Returns 1000 most recent scans from 1001 to 2000 s; the *starting index* is 1001, not 0 as requested, indicating that the first 1000 samples in the buffer were overwritten before the request was made.	2000	1	>1000	1001	2000
Returns 1000 most recent scans from 2001 to 3000 s; measurements chronologically follow (*RequestedScanIndex* > 1 + *EndingIndex* of previous scan)	3000	2001	>1000	2001	3000
Case 7 - Buffer not full The client first requests more scans than are available and at intervals slower than the rate at which the buffer wraps around. The client then requests measurements that do not chronologically follow the previous measurement, followed by a request for more data than is available. The final request is for more data than is available at a *RequestedScanIndex* that is no longer available.					
Returns 1000 most recent scans from 1001 to 2000 s; the starting index is 1001, not less than 1000 as requested, indicating that the first 1000 samples in the buffer were overwritten before the request was made.	2000	1001	>1000	1001	2000
The client requests less data than is available (*RequestedScansToRead* = 100, not 500); data from 100 scans between 2501 and 2600 s is returned. The most recent 400 s of data is still in the buffer.	3000	2501	100	2501	2600
The client requests more data than is available; data from 900 scans between 2601 to 3500 s is returned.	3500	2601	>900	2601	3500
The client requests more data than is available; data from 1000 scans between 4001 and 5000 s is returned. The returned starting index is 4001, not 3500 as requested, indicating that the *data in the buffer was overwritten before the request was made.*	5000	3501	>1000	4001	5000

Auto-Calibration

TEMPpoint, VOLTpoint, and MEASURpoint instruments are factory-calibrated to meet or exceed their published specifications using standards traceable to NIST.

The A/D on each channel is calibrated for gain and offset; these values (including the zero point) are stored in ROM. Then, for thermocouple measurement instruments, each CJC circuit is calibrated, and for RTD measurement instruments, the reference circuit is characterized.

In addition, these instruments are auto-calibrated on each power-up cycle to guarantee high-accuracy measurements. This process, also known as auto-zeroing, resets the zero point of each A/D. You can also auto-calibrate the instrument at any time (as long as acquisition is not in progress) using the **SYSTem:CALibrate** command.

Performing Digital Input Operations

TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments feature eight, isolated, digital input lines. You can use the **SYSTem:DINput?** query, described on page 96, to return the number of digital input lines that are supported by your instrument.

Digital inputs operate from +3 to +28 V DC, with a switching time of 2 ms maximum. A digital line is high if its value is 1; a digital line is low if its value is 0.

Use the **INPut?** query to return the current state of the digital input port. The value returned represents the weighted bit value of the digital input port, where the value of bit 0 (digital input line 0) corresponds to a decimal value of 1 (2^0) if the bit is set, and the value of bit 7 (digital input line 7) corresponds to a decimal value of 128 (2^7) if the bit is set.

If you want to correlate data from the digital input port with analog input values, use a continuous scan operation, described on page 44, instead.

Performing Digital Output Operations

TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments feature eight, latched and isolated digital output lines. You can use the **SYSTem:DOUTput?** query, described on page 96, to return the number of digital output lines that are supported by your instrument.

The digital outputs are solid-state relays that operate at ±30 V and 400 mA peak (AC or DC). Switching time is 2 ms maximum.

Digital outputs resemble a switch; the switch is closed if the state of the digital output line is 1, and the switch is open if the state of the digital output line is 0. On power up or reset, the digital outputs are disabled.

Use the **OUTPut** command to set the state of the digital output port. The value you specify represents the weighted bit value of the digital output port, where the value of bit 0 (digital output line 0) corresponds to a decimal value of 1 (2^0) if the bit is set, and the value of bit 7 (digital input line 7) corresponds to a decimal value of 128 (2^7) if the bit is set.

You can query the current configuration of the digital output port by using the **OUTPut[:STATe]?** query.

3

Common SCPI Commands

Note: In the examples in this section, the symbols > and < represent communication to and from the device, respectively. Users do not explicitly send or receive these symbols.

Clear Status (*CLS)

Description Clears all event registers summarized in the Status Byte (STB) register, described on page 170.

Syntax `*CLS`

Parameters None

Response Data None

Notes All queues that are summarized in the Status Byte (STB) register, except the output queue, are emptied. The device is forced into the operation complete idle state.

Example

```
> *CLS
```

Standard Event Status Enable Register (*ESE)

Description Enables specified bits in the Standard Event Status Enable register, described on page 171.

Syntax `*ESE <DECIMAL NUMERIC PROGRAM DATA>`

Required Parameters

Name: DECIMAL NUMERIC PROGRAM DATA

Data Format: <0+NR1>

Description: An integer value expressed in base 2 (binary) that represents the weighted bit value of the Standard Event Status Enable register. Values range from 0 to 255.

Response Data None

Notes The following table shows the bits of the Standard Event Status Enable Register and the binary-weighted decimal value for each bit; see page 171 for more information on each of these bits:

Bit	Binary Weight	Description
0	1	OPC (Operation Complete)
1	2	RQC (Request Control)
2	4	QYE (Query ERROR)
3	8	DDE (Device-Dependent ERROR)
4	16	E (Execution ERROR)
5	32	CME (Command ERROR)
6	64	NU (Not Used)
7	128	PON (Power on)

Refer to *IEEE Std 488.2-1992*, section 11.5.1.3, for more information.

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

Example The following command enables bits 0, 2, 3, 4, 5, and 7 of the Standard Event Status Enable register:

```
> *ESE 189
```

See Also ***ESE?**, described next

***ESR?**, described on page 57

Standard Event Status Enable Register Query (*ESE?)

Description Returns the current value of the Standard Event Status Enable register, described on page 171.

Syntax `*ESE?`

Parameters None

Response Data `<NUMERIC RESPONSE DATA>`

Name: NUMERIC RESPONSE DATA

Data Format: <0+NR1>

Description: An integer value expressed in base 2 (binary) that represents the weighted bit value of the Standard Event Status Enable register. Values range from 0 to 255.

Notes Refer to *IEEE Std 488.2-1992*, section 11.4.2.3.2, and *IEEE Std 488.2*, section 8.7.1, for more information.

Example The following command queries the Standard Event Status Enable register:

```
> *ESE?
< 189
```

This value indicates that bits 0, 2, 3, 4, 5, and 7 of the Standard Event Status Enable register are enabled.

See Also ***ESE**, described on page 56

***ESR?**, described on page 57

Standard Event Status Register Query (*ESR?)

Description Returns the current value of the Standard Event Status register, described on page 173, and then clears the register.

Syntax `*ESR?`

Parameters None

Response Data <NUMERIC RESPONSE DATA>

Name: NUMERIC RESPONSE DATA

Data Format: <0+NR1>

Description: An integer value expressed in base 2 (binary) that represents the weighted bit value of the Standard Event Status register.

The bits of the Standard Event Status Register are listed below along with the binary-weighted decimal value for each bit; refer to page 173 for more information on each of these bits:

Bit	Binary Weight	Description
0	1	OPC (Operation Complete)
1	2	RQC (Request Control)
2	4	QYE (Query ERROR)
3	8	DDE (Device-Dependent ERROR)
4	16	E (Execution ERROR)
5	32	CME (Command ERROR)
6	64	NU (Not Used)
7	128	PON (Power on)

Notes Bits in the Standard Event Status register should be unmasked by setting the corresponding bit in the Standard Event Status Enable register. On power up, the Standard Event Status Enable register is '0'; therefore, all bits in the Standard Event Status register are masked. The summary of the Standard Event Status register is reflected in the Standard Event Status Bit Summary (ESB) of the Status Byte register, described on page 170.

Example The following example unmasks all error bits in the Standard Event Status register:

```
> *ESE?;*ESE 255;*ESE?
< 0;;255
```

Then, an illegal command is sent and the Standard Event Status register is queried; a value of 32 is returned, indicating that bit 5 (Command Error) of the Standard Event Status register was set:

```
> *bad
> *ESR?
< 32
```

In the following example, the scan rate is set to an illegal value; a value of 16 is returned, indicating that bit 4 (Execution Error) of the Standard Event Status register was set:

```
> :CONF:SCAN:RATe:HZ 50
> *ESR?
< 16
```

See Also ***ESE**, described on page 56

***ESE?**, described on page 57

***STB?**, described on page 62

Identification Query (*IDN?)

Description This command returns the unique identity of your TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument.

Syntax
```
*IDN?
```

Parameters None

Response Data
```
Manufacturer,Model,
   Serial number,Firmware revision
```

Data Format
```
<ARBITRARY ASCII RESPONSE DATA>
```

Name: Manufacturer

Description: Defines the manufacturer of the instrument. For TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments, this response is Data Translation.

Name: Model

Description: Identifies the model of the instrument.

Name: Serial number

Description: Identifies the serial number of the instrument.

Name: Firmware revision

Description: Identifies the version of firmware that is loaded on the instrument.

Notes Since the data format of the response is <ARBITRARY ASCII RESPONSE DATA>, the ***IDN?** query should be the last <QUERY MESSAGE UNIT> in a <TERMINATED PROGRAM MESSAGE>.

Refer to *IEEE 488.2-1992*, sections 6.5.7.5, 8.7.1, and 10.14, for more information.

Example
```
> *IDN?
< Data Translation,DT8874-08T-00R-08V,201129241,
   2.2.0.0
```

This response indicates that Data Translation is the manufacturer of the device, DT8874-08T-00R-08V is the model of the instrument (where *08T* indicates that the instrument contains 8 thermocouple channels , *00R* indicates that the instruments contains 0 RTD channels, and *08V* indicates that the instrument contains 8 voltage channels), 201129241 is the serial number of the instrument, and 2.2.0.0 is the version of the firmware.

Operation Complete (*OPC)

Description The Operation Complete bit (bit 0) of the Standard Event Status register, described on page 173, is always enabled. Therefore, this command has no effect when used with TEMPpoint, VOLTpoint, or MEASURpoint LXI instruments.

Syntax `*OPC`

Parameters None

Response Data None

Notes This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example
```
> *OPC
```

See Also ***OPC?**, described below

Operation Complete Query (*OPC?)

Description The Operation Complete bit (bit 0) of the Standard Event Status register, described on page 173, is always enabled. Therefore, this command always places the ASCII character 1 into the device's Output Queue.

Syntax `*OPC?`

Parameters None

Response Data <NUMERIC RESPONSE DATA>

Name: NUMERIC RESPONSE DATA

Data Format: <NR1>

Description: A single ASCII-encoded byte for 1 (31, 49 decimal).

Example
```
> *OPC?
< 31
```

Reset (*RST)

Description Clears the Standard Event Status register, message queue, error queue, and Status Byte register, and stop any scans that are in progress.

Syntax `*RST`

Parameters None

Response Data None

Notes This command has no effect on the instrument's password or password enable/disable state.

Refer to *IEEE 488.2-1992*, section 10.32, for more information.

Example

```
> *RST
```

Self-Test Query (*TST?)

Description Always returns 0 for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.

Syntax

```
*TST?
```

Parameters None

Response Data <NUMERIC RESPONSE DATA>

Name: NUMERIC RESPONSE DATA

Data Format: <NR1>

Description: This value is always 0.

Notes This query has no effect. This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example

```
> *TST?
< 0
```

Service Request Enable (*SRE)

Description The Service Request Enable register is not used on these instruments. Therefore, this command has no effect when used with TEMPpoint, VOLTpoint, or MEASURpoint LXI instruments.

Syntax

```
*SRE <value>
```

Required Parameters

Name: value

Data Format: <0+NR1>

Description: A positive decimal value; this value is ignored.

Response Data None

Notes This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example

```
> *SRE 255
```

See Also ***SRE?**, described on page 62

Service Request Enable Query (*SRE?)

Description The Service Request Enable register is not used on these instruments. Therefore, this command places the ASCII character 0 into the device's Output Queue.

Syntax `*SRE?`

Parameters None

Response Data <NUMERIC RESPONSE DATA>

Name: NUMERIC RESPONSE DATA

Data Format: <NR1>

Description: A single ASCII-encoded byte for 0.

Notes This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example

```
> *SRE?
< 0
```

Read Status Byte Query (*STB?)

Description Returns the current value of the Status Byte register, described on page 170.

Syntax `*STB?`

Parameters None

Response Data <NUMERIC RESPONSE DATA>

Name: NUMERIC RESPONSE DATA

Data Format: <NR1>

Description: The weighted sum of the bit values of the Status Byte register, ranging from 0 to 255. The following bits, described in *1999 SCPI Syntax & Style*, section 9, are supported:

- Bit 7 (weighted bit value = 128) – Summary of device dependent Operation Status register
- Bit 5 (weighted bit value = 32) – Event Status Bit Summary (ESB), '1'= ESR is non-zero, '0' otherwise
- Bit 4 (weighted bit value = 16) – Message Available Queue Summary (MAV), '1'=message queue not empty
- Bit 4 (weighted bit value = 16) – Message Available Queue Summary (MAV), '1'=message queue not empty
- Bit 2 (weighted bit value = 4) – Error/Event Queue Summary, '1'=Error queue not empty

Notes Refer to *IEEE 488.2-1992*, section 10.36, for more information.

Example The following example shows a query that is correct and causes no errors:

```
> *IDN?;*ESR?;*STB?
< Data Translation,DT8874-08T-00R-08V,-1, 1.2;0;16
```

This example shows an illegal command being sent and the status of the Status Byte register and the error queue:

```
> bad
> *STB?
< 36
```

A value of 36 indicates that bits 5 (Standard Event Status Bit Summary) and 2 (Error / Event Queue Summary) of the Status Byte register are set.

The following example shows the status of the Event Status register:

```
> *ESR?
< 32
```

A value of 32 indicates that bit 5 (Command Error) of the Event Status register is set. The following updates the status of the Status Byte register:

```
> *STB?
< 4
```

A value of 4 indicates that bit 2 (Error / Event Queue Summary) of the Status Byte register is set. The following shows the error codes that are returned, and updates the status of the Status Byte register:

```
> :SYST:ERR?
< -110,"Command header error;bad"
> :SYST:ERR?
< 0,"No error"
> *STB?
< 0
```

Wait-to-Continue (*WAI)

Description This command has no effect when used with TEMPpoint, VOLTpoint, or MEASURpoint LXI instruments.

Syntax `*WAI`

Parameters None

Response Data None

Notes This command is implemented for SCPI compliance to avoid any error message when it is sent by the controller to the instrument.

Example

```
> *WAI
```

SCPI Subsystem Commands

Note: In the examples in this section, the symbols > and < represent communication to and from the device, respectively. Users do not explicitly send or receive these symbols.

SCPI Subsystem Command Hierarchy

SCPI subsystem commands are hierarchical and are organized as an inverted tree structure with the "root" at the top. Table 6 shows the hierarchy of SCPI subsystem commands for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.

Table 6: Hierarchy of SCPI Subsystem Commands for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments

STATus	:OPERation	[:EVENt]?	
		:CONDition?	
		:ENABle[?]	
	:PRESet		
	:QUEStionable	[:EVENt]?	
		: CONDition?	
		:ENABle[?]	
	:SCAn?		
SYSTem	:BOArd	[:NUMber]?	
		:MODel?	
		:MODel	:NAMe?
		:RANGe?	
	:CALibrate		
	:CHANnel?		
	:CHANnel	:RTD?	
		:TCouple?	
	:CHANnel	:VOLTage	:RANGe?
	:COMMunicate	:NETwork	:IPADdress?
			:MASk?
	:DATE?		
	:DINput?		
	:DOUTput?		
	:ERRor?		
	:ERRor?	:COUNt?	
	:PASSword	:NEW	
		:CDISable	
		[:CENable]	
		:CENable	:STATe?

Table 6: Hierarchy of SCPI Subsystem Commands for TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments (cont.)

SYSTem (cont.)	:PRESet		
	:SCAn	:RATe	:MAX?
			:MIN?
	:TIME?		
	:TZONe[?]		
	:VERSion?		
CONFigure	:RESistance		
	:TEMPerature	:RTD	
		:TCouple	
	:VOLTage		
	:VOLTage	:RANGe	
	?		
	:FILTer[?]		
	:SCAn	:BUFfer?	
		:CJC[?]	
		:LISt[?]	
		:RATe[?]	
	:TRIGger	[:SOURce][?]	
MEASure	:RESistance?		
	:TEMPerature	:RTD?	
		:TCouple?	
	:VOLTage?		
INITiate			
ABORt			
FETCh	?		
INPut	[:STATe]?		
OUTPut	[:STATe][?]		

Looking at the STATus subsystem, for example, STATus is the root keyword of the command, OPERation is a second-level keyword, and CONDition is a third-level keyword.

The next section describes the syntax of program messages and SCPI commands from the controller to the instrument.

STATus Subsystem Commands

The STATus subsystem includes the commands listed in Table 7 for determining the operational status of the TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument. This section describes each of these commands in detail.

Table 7: STATus Subsystem Commands

Type	Mnemonic	See
Operation Condition Query	STATus:OPERation:CONDition?	page 69
Operation Enable Register	STATus:OPERation:ENABle	page 70
Operation Enable Register Query	STATus:OPERation:ENABle?	page 70
Operation Event Register Query	STATus:OPERation[:EVENt]?	page 71
Presetting Registers	STATus:PRESet	page 71
Questionable Condition Register Query	STATus:QUEStionable:CONDition?	page 72
Questionable Enable Register	STATus:QUEStionable:ENABle	page 72
Questionable Enable Register Query	STATus:QUEStionable:ENABle?	page 73
Questionable Event Register Query	STATus:QUEStionable[:EVENt]?	page 73
Scan Record Status Query	STATus:SCAn?	page 74

Operation Condition Query

Description Returns the current value of the Operation Status register, described on page 174.

Syntax `:STATus:OPERation:CONDition?`

Parameters None

Response Data `<NUMERIC RESPONSE DATA>`

Name: NUMERIC RESPONSE DATA

Data Format: <0+NR1>

Description: The weighted bit value of the Operation Status register, where bit 0 corresponds to a decimal value of 1 (2^0) if the bit is set and bit 14 corresponds to a decimal value of 16384 (2^{14}) if the bit is set. Values for the response range from 0 to 32767.

Notes Currently, only bit 4 (Scan Status) with a weighted binary value of 16 and bit 5 (Trigger Status) with a weighted binary value of 32 are implemented in this register.

Example The following example shows the status of the Operation Status register and the Status Byte register when a scan is in progress and a software trigger is used:

```
> :STAT:OPER:COND?
< 16
> *STB?
< 128
```

A value of 16 indicates that bit 4 (Scan Status) of the Operation Status register is set to 1. A value of 128 indicates that bit 7 (Operation Status Register Summary) of the Status Byte register is set to 1.

The following example shows the status of the Operation Status register and the Status Byte register when a scan is in progress and the instrument is waiting for an external digital trigger:

```
> :STAT:OPER:COND?
< 48
> *STB?
< 128
```

A value of 48 indicates that bit 4 (Scan Status) and bit 5 (Trigger Status) of the Operation Status register are set to 1. A value of 128 indicates that bit 7 (Operation Status Register Summary) of the Status Byte register is set to 1.

The following example shows the status of the Operation Status register and the Status Byte register when the instrument is idle:

```
> :STAT:OPER:COND?
< 0
> *STB?
< 0
```

Operation Event Register Enable

Description The Operation Event register is not used on TEMPpoint, VOLTpoint, or MEASURpoint LXI instruments; therefore, this command has no effect.

Syntax `:STATus:OPERation:ENABle <bitmask>`

Required Parameters

Name: bitmask

Data Format: <NRr>

Description: A non-decimal numeric value; this value is ignored by TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.

Response Data None

Notes This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example

```
> :STAT:OPER:ENAB #B00000000
```

See Also **STATus:OPERation:CONDition?**, described on page 68

Operation Enable Register Query

Description The Operation Enable register is not used on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments; therefore, this query always returns 0.

Syntax `:STATus:OPERation:ENABle?`

Parameters None

Response Data `<bitmask>`

Name: bitmask

Data Format: <0+NR1>

Description: The Operation Enable register is not used. Therefore, this value is always 0.

Notes This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example

```
> :STAT:OPER:ENAB?
```

See Also **STATus:OPERation:CONDition?**, described on page 68

Operation Event Register Query

Description The Operation Event register is not used on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments; therefore, this query always returns 0.

Syntax `:STATus:OPERation[:EVENt]?`

Parameters None

Response Data <NUMERIC RESPONSE DATA>

Name: NUMERIC RESPONSE DATA

Data Format: <0+NR1>

Description: The Operation Event register is not used. Therefore, the value of this response is always 0.

Notes This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example
```
> :STAT:OPER:EVEN?
< 0
```

See Also **STATus:OPERation:CONDition?**, described on page 68

Presetting Registers

Description This command has no effect when used with a TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument.

Syntax `:STATus:PRESet <value>`

Required Parameters

Name: value

Data Format: <NR1>

Description: For TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments, this value is ignored.

Response Data None

Notes This command is implemented for SCPI compliance.

Example
```
> :STAT:PRES 1
```

Questionable Condition Register Query

Description The Questionable Condition register is not used on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments; therefore, this query always returns 0.

Syntax `:STATus:QUEStionable:CONDition?`

Parameters None

Response Data `<regvalue>`

Name: regvalue

Data Format: <0+NR1>

Description: The Questionable Condition register is not used. Therefore, the value of this response is always 0.

Notes This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example
```
> :STAT:QUES:COND?
< 0
```

See Also **STATus:OPERation:CONDition?**, described on page 68

Questionable Enable Register

Description The Questionable Enable register is not used on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments. Therefore, this command has no effect.

Syntax `:STATus:QUEStionable:ENABle <bitmask>`

Required Parameters

Name: bitmask

Data Format: <NRr>

Description: A non-decimal numeric value; this value is ignored by TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments.

Response Data None

Notes This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example
```
> :STAT:QUES:ENAB #B00000000
```

Questionable Enable Register Query

Description The Questionable Enable register is not used on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments; therefore, this query always returns 0.

Syntax `:STATus:QUEStionable:ENABle?`

Parameters None

Response Data `<bitmask>`

Name: bitmask

Data Format: <NR1>

Description: The Questionable Enable register is not used. Therefore, the value of this response is always 0.

Notes This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example
```
> :STAT:QUES:ENAB?
< 0
```

Questionable Event Register Query

Description The Questionable Event register is not used on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments; therefore, this query always returns 0.

Syntax `:STATus:QUEStionable[:EVENt]?`

Parameters None

Response Data `<regvalue>`

Name: regvalue

Data Format: <0+NR1>

Description: The Questionable Event register is not implemented. Therefore, the value of this response is always 0.

Notes This command is implemented for SCPI compliance to avoid error messages when it is sent by the controller to the instrument.

Example
```
> :STAT:QUES:EVEN?
< 0
```

See Also **STATus:OPERation:CONDition?**, described on page 68

Scan Record Status Query

Description Returns the indices of the chronologically oldest and most recent scan records in the circular buffer on the instrument.

Syntax `:STATus:SCAn?`

Parameters None

Response Data `<StartingIndex>,<EndingIndex>`

Name: StartingIndex

Data Format: <0+NR1>

Description: A decimal number that represents the index of the chronologically oldest scan record available in the circular buffer on the instrument.

Name: EndingIndex

Data Format: <0+NR1>

Description: A decimal number that represents the index of the most recent scan record available in the circular buffer on the instrument.

Notes If the circular buffer is empty (because a scan has not been started or started and stopped), both *StartingIndex* and *EndingIndex* will be 0. Otherwise, these values will be non-zero.

Refer to page 176 for information on the structure of a scan record.

Example The follow example shows the *StartingIndex* (1001) and *EndingIndex* (1050) when the circular buffer consists of scan records 1001 to 1050:

```
> :STAT:SCA?
< 1001,1050
```

See Also **FETCh?**, described on page 145

SYSTem Subsystem Commands

The SYSTem subsystem includes the commands listed in Table 8. Use these commands to calibrate TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments, query the status of scan records, and configure or query global system settings, including the time, date, time zone, and network address of the instrument. This section describes each of these commands in detail.

Table 8: SYSTem Subsystem Commands

Type	Mnemonic	See
Auto-Calibrate	SYSTem:CALibrate	page 77
DATE Query	SYSTem:DATE?	page 77
ERRor Query	SYSTem:ERRor?	page 78
Error Count Query	SYSTem:ERRor:COUNt?	page 79
LAN Configuration Reset	SYSTem:PRESet	page 80
LAN IP Address Query	SYSTem:COMMunicate:NETwork:IPADdress?	page 80
LAN IP Subnet Mask Query	SYSTem:COMMunicate:NETwork:MASk?	page 80
Password - Disable Password-Protected Commands	SYSTem:PASSword:CDISable	page 81
Password - Enable Password-Protected Commands	SYSTem:PASSword[:CENable]	page 83
Password - Query Enable State	SYSTem:PASSword:CENable:STATe?	page 85
Password - Set New Password	SYSTem:PASSword:NEW	page 86
SCPI Version Query	SYSTem:VERSion?	page 88
Supported Board Number Query	SYSTem:BOArd[:NUMber]?	page 88
Supported Board Model Query	SYSTem:BOArd:MODel?	page 89
Supported Board Model Name Query	SYSTem:BOArd:MODel:NAMe?	page 90
Supported Board Voltage Range Query	SYSTem:BOArd:RANGe?	page 91
Supported Channels Query	SYSTem:CHANnel?	page 92
Supported Channels - RTD Query	SYSTem:CHANnel:RTD?	page 93
Supported Channels - Thermocouple Query	SYSTem:CHANnel:TCouple?	page 94
Supported Channel - Voltage Range Query	SYSTem:CHANnel:VOLTage:RANGe?	page 95
Supported Digital Input Lines Query	SYSTem:DINput?	page 96
Supported Digital Output Lines Query	SYSTem:DOUTput?	page 96
Supported Maximum Scan Rate Query	SYSTem:SCAn:RATe:MAX?	page 97
Supported Minimum Scan Rate Query	SYSTem:SCAn:RATe:MIN?	page 98

Table 8: SYSTem Subsystem Commands (cont.)

Type	Mnemonic	See
TIME Query	SYSTem:TIME?	page 99
Time Zone Query	SYSTem:TZONe?	page 100
Time Zone Set	SYSTem:TZONe	page 100

Auto-Calibrate

Description Auto-calibrates (auto-zeros) all analog input channels on the instrument.

Syntax `:SYSTem:CALibrate`

Parameters None

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

Ensure that the instrument is not performing a scan when you execute this command to avoid returning an error.

Example

```
> :SYST:CAL
```

This command auto-zeros all analog input channels on the instrument.

DATE Query

Description Returns the current date of the instrument. This date is updated automatically by an SNTP (Simple Network Time Protocol) server.

Syntax `:SYSTem:DATE?`

Parameters None

Response Data `<year>,<month>,<day>`

Name: year

Data Format: <NR1>

Description: A number representing the year, such as 2008.

Name: month

Data Format: <NR1>

Description: A number from 1 to 12 representing the month.

Name: day

Data Format: <NR1>

Description: A number from 1 to 31 representing the day.

Example

```
> :SYST:DATE?
< 2008,1,15
```

This response indicates that the date of the instrument is January 15th, 2008.

ERRor Query

Description This command, which is mandatory for SCPI-compliant devices, reads an error message from the error queue and then removes it from the queue.

Syntax

```
:SYSTem:ERRor[:NEXT]?
```

Parameters None

Response Data

```
<Error/event_number>,<Error/event_description>,
   <Device-dependent info>
```

Data Format <CHARACTER RESPONSE DATA>

Name: Error/event_number

Description: A unique integer in the range of –32768 to 32767. A value of 0 indicates that no error or event has occurred. Refer to Appendix A starting on page 163 for a list of errors that can be returned.

Name: Error/event_description

Description: A quoted string that contains a description of the error that was read from the Error/Event Queue. Refer to Appendix A starting on page 163 for a list of errors that can be returned.

Name: Device-dependent info

Description: Optional text that provides device-dependent information about the error that was read from the Error/Event Queue. Refer to Appendix A starting on page 163 for a list of errors that can be returned.

Notes The maximum string length of <*Error/event_description*> plus <*Device-dependent info*> is 255 characters.

The error queue is a first-in, first-out (FIFO) with a capacity of 32 error messages. By querying the error count before and after a SCPI command (in a single command string), you can unambiguously determine whether the command that you issued caused an error. Use the **SYSTem:ERRor:COUNt?** command, described on page 79, to return the number of unread items in the error queue.

When the queue is full, the message "–350,'Queue overflow'" is returned and subsequent errors can not be added to the queue. Use the ***CLS** command, described on page 56, to clear the error queue as well as the Status Byte register.

Refer to *1999 SCPI Command Reference*, section 21.8, for more information.

Example The following shows the responses to this query after an invalid command is sent to the instrument:

```
>:BADc
>:SYST:ERR?
< -110,"Command header error;:BADc"
> :SYST:ERR?
< 0,"No error"
```

ERRor Count Query

Description Queries the error queue for the number of unread items and returns the count.

Syntax `:SYSTem:ERRor:COUNt?`

Parameters None

Response Data `<Count>`

Name: Count

Data Format: <0+NR1>

Description: A unique integer that indicates the number of unread errors in the error queue. A value of 0 indicates that the queue is empty.

Since errors may occur at any time, more items may be present in the error queue at the time that it is actually read.

Notes The error queue is a first-in, first-out (FIFO) with a capacity of 32 error messages. The error queue accumulates errors from all clients. By querying the error count before and after a SCPI command (in a single program message), you can unambiguously determine whether the command that you issued caused an error.

When the queue is full, the message "–350,'Queue overflow'" is returned and subsequent errors can not be added to the queue. Use the **SYSTem:ERRor** command, described on page 78, to read the error and remove if from the queue. Use the ***CLS** command, described on page 56, to clear the error queue as well as the Status Byte register.

Example The following shows how to query the number of errors in the error queue both before and after the **INITialize** command.

```
> :SYST:ERR:COUN?;:INIT;:SYST:ERR:COUN?
< 0, 0
```

LAN Configuration Reset

Description Sets the LAN configuration to default values. The effect of this command is the same as pushing the LAN reset switch on the rear panel of the instrument.

Syntax `:SYSTem:PRESet`

Parameters None

Response Data None

Notes This command resets the instrument to use the default password. Refer to page 36 for more information on the default password.

Example
```
> :SYST:PRES
```

LAN IP Address Query

Description Returns the static IP address that is currently used by the instrument on the network.

Syntax `:SYSTem:COMMunicate:NETwork:IPADdress?`

Parameters None

Response Data `<ipaddress>`

Name: ipaddress

Data Format: String

Description: String of four fields, separated by periods, that contains a maximum of 15 characters, such as "192.43.218.41".

Notes The instrument is configured to use the DHCP server, by default.

Example
```
> :SYST:COMM:NET:IPAD?
< 192.43.218.85
```

This string represents the IP address of the instrument.

LAN IP Subnet Mask Query

Description Returns the static IP subnet mask that is currently used by the instrument on the network.

Syntax `:SYSTem:COMMunicate:NETwork:MASk?`

Parameters None

Response Data `<mask>`

Name: mask

Data Format: String

Description: String of four fields, separated by periods, that contains a maximum of 15 characters, such as "255.255.255.0".

Notes TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments are configured to use the DHCP server, by default.

Example
```
> :SYST:COMM:NET:MAS?
< 255.255.255.0
```

This string represents the IP subnet mask of the instrument.

Password - Disable Password-Protected Commands

Description Disables use of the following commands and queries, which are password protected:

- **OUTPut[:STATe]**, described on page 151
- **CONFigure:VOLTage**, described on page 109
- **CONFigure:RESistance,** described on page 103
- **CONFigure:TEMPerature:TCouple,** described on page 106
- **CONFigure:TEMPerature:RTD**, described on page 104
- **CONFigure:VOLTage:RANGe**, described on page 111
- **CONFigure:SCAn:LISt**, described on page 120
- **CONFigure:SCAn:CJC**, described on page 118
- **CONFigure:SCAn:RATe[:SEC|HZ]**, described on page 123
- **CONFigure:FILTer**, described on page 115
- **CONFigure:TRIGger[:SOURce]**, described on page 127
- **INITiate**, described on page 140
- **ABORt**, described on page 143
- **MEASure:VOLTage?**, described on page 137
- **MEASure:RESistance?**, described on page 130
- **MEASure:TEMPerature:TCouple?**, described on page 134
- **MEASure:TEMPeratuer:RTD?**, described on page 131
- **SYSTem:TZONe**, described on **page 100**
- **SYSTem:CALibrate**, described on page 77

Syntax
```
:SYSTem:PASSword:CDISable <password>
```

Parameters

Name: password

Data Format: <CHARACTER PROGRAM DATA>

Description: Specifies the password that is stored in permanent memory on the instrument. This string is case-sensitive.

Response Data None

Notes

On power up, all SCPI password-protected commands and queries are disabled. If the instrument is powered down, you must enable the password-protected commands when the instrument is powered back up if you want to configure or operate the instrument.

Once the password-protected commands are disabled, issuing any of the password-protected commands will result in error –203, Command protected.

By default, the password is *admin*. You can change the password using the **SYSTem:PASSword:NEW** command, described on page 86.

Note: The DT8871, DT8871U, DT8872, DT8873, and DT8874 instruments with firmware version 2.2.3.1 or greater use the default user name "admin" and the default password "admin". Firmware version 2.2.3.1 and greater support password-protected commands. Therefore, you must enter the appropriate password to change the instrument's configuration or to start and stop a scan.

Firmware versions less than 2.2.3.1 do not support password-protected commands. Therefore, you are not prompted to enter a password to change the instrument's configuration or to start or stop a scan.

You can re-enable password-protected commands using the **SYSTem:PASSword[:CENable]** command, described on page 83.

Example

The following example shows an attempt to disable protected commands using an erroneous password:

```
> :SYSTem:PASSword:CDISable bogus
> :SYST:ERR?
< -221,"Settings conflict;:SYST:PASS:CDIS"
```

The following is an example in which the correct password is used to disable protected commands:

```
> :SYSTem:PASSword:CDISable admin
> :SYST:ERR?
< 0,"No error"
> :SYSTem:PASSword:CENable:STATe?
< 0
```

Since protected commands are disabled, any attempt to use them will fail, as shown in the following example:

```
> :CONF?
< PT1000,PT1000,PT1000,PT1000
> :CONF:TEMP:RTD PT1000
> :SYST:ERR?
< -203,"Command protected"
```

Example (cont.)

```
> :CONF?
< PT1000,PT1000,PT1000,PT1000
> *STB?
< 0
> :INIT
> :SYST:ERR?
< -203,"Command protected"
> *STB?
< 0
```

See Also

SYSTem:PASSword:NEW, described on page 86

SYSTem:PASSword[:CENable], described on page 83

SYSTem:PASSword:CENAble:STATe?, described on page 85

Password - Enable Password-Protected Commands

Description

Enables use of the following commands and queries, which are password protected:

- **OUTPut[:STATe]**, described on page 151
- **CONFigure:VOLTage**, described on page 109
- **CONFigure:RESistance,** described on page 103
- **CONFigure:TEMPerature:TCouple,** described on page 106
- **CONFigure:TEMPerature:RTD**, described on page 104
- **CONFigure:VOLTage:RANGe**, described on page 111
- **CONFigure:SCAn:LISt**, described on page 120
- **CONFigure:SCAn:CJC**, described on page 118
- **CONFigure:SCAn:RATe[:SEC|HZ]**, described on page 123
- **CONFigure:FILTer**, described on page 115
- **CONFigure:TRIGger[:SOURce]**, described on page 127
- **INITiate**, described on page 140
- **ABORt**, described on page 143
- **MEASure:VOLTage?**, described on page 137
- **MEASure:RESistance?**, described on page 130
- **MEASure:TEMPerature:TCouple?**, described on page 134
- **MEASure:TEMPeratuer:RTD?**, described on page 131
- **SYSTem:TZONe**, described on page 100
- **SYSTem:CALibrate**, described on page 77

Syntax

```
:SYSTem:PASSword[:CENable] <password>
```

Parameters

Name: password

Data Format: <CHARACTER PROGRAM DATA>

Description: Specifies the password that is stored in permanent memory in the instrument. This string is case-sensitive.

Response Data None

Notes On power up, the SCPI password-protected commands and queries are disabled. If the instrument is powered down, you must enable the password-protected commands when the instrument is powered back up if you want to configure or operate the instrument.

Once the password-protected commands are disabled, issuing any of the password-protected commands will result in error –203, Command protected.

By default, the password is *admin*. You can change the password using the **SYSTem:PASSword:NEW** command, described on page 86.

Note: The DT8871, DT8871U, DT8872, DT8873, and DT8874 instruments with firmware version 2.2.3.1 or greater use the default user name "admin" and the default password "admin". Firmware version 2.2.3.1 and greater support password-protected commands. Therefore, you must enter the appropriate password to change the instrument's configuration or to start and stop a scan.

Firmware versions less than 2.2.3.1 do not support password-protected commands. Therefore, you are not prompted to enter a password to change the instrument's configuration or to start or stop a scan.

Example In the following example, the command to enable password-protected commands is successful; therefore, the client can configure the instrument and operate it.:

```
> :SYST:PASS:CEN admin
> :SYSTem:PASSword:CENable:STATe?
< 1
> :CONF?
< PT1000,PT1000,PT1000,PT1000
> :CONF:TEMP:RTD PT100
> :CONF?
< PT100,PT100,PT100,PT100
```

See Also **SYSTem:PASSword:NEW**, described on page 86

SYSTem:PASSword:CDISable, described on page 81

SYSTem:PASSword:CENAble:STATe?, described on page 85

Password - Query Password Enable State

Description Returns whether password-protected commands are enabled or disabled.

Syntax `:SYSTem:PASSword:CENable:STATe?`

Parameters None

Response Data `<state>`

Name: state

Data Format: <0+NR1>

Description: If password-protected commands are disabled, 0 is returned.

If password-protected commands are enabled, 1 is returned.

Notes On power up, the SCPI password-protected commands and queries are disabled. If the instrument is powered down, you must enable the password-protected commands when the instrument is powered back up if you want to configure or operate the instrument.

You can disable password-protected commands using the **SYSTem:PASSword:DISable** command, described on page 81.

You can enable password-protected commands using the **SYSTem:PASSword[:CENable]** command, described on page 83.

When the SCPI password-protected commands and queries are disabled, the instrument generates the following error if any of these commands is issued: –203, Command protected.

This error indicates that a legal password-protected command or query could not be executed because the command was disabled.

Example In the following example, the state is 1, indicating that password-protected commands are enabled.

```
> :SYST:PASS:CEN:STAT?
< 1
```

See Also **SYSTem:PASSword:NEW**, described on page 86

SYSTem:PASSword:CDISable, described on page 81

SYSTem:PASSword[:CENAble], described on page 86

Password - Set New Password

Description

Changes the existing password to a new password. The new password overwrites the existing password if, and only if, the user-specified *<current password>* matches the password that is currently being used.

The password is used with the following password-protected commands and queries:

- **OUTPut[:STATe]**, described on page 151
- **CONFigure:VOLTage**, described on page 109
- **CONFigure:RESistance,** described on page 103
- **CONFigure:TEMPerature:TCouple,** described on page 106
- **CONFigure:TEMPerature:RTD**, described on page 104
- **CONFigure:VOLTage:RANGe**, described on page 111
- **CONFigure:SCAn:LISt**, described on page 120
- **CONFigure:SCAn:CJC**, described on page 118
- **CONFigure:SCAn:RATe[:SEC|HZ]**, described on page 123
- **CONFigure:FILTer**, described on page 115
- **CONFigure:TRIGger[:SOURce]**, described on page 127
- **INITiate**, described on page 140
- **ABORt**, described on page 143
- **MEASure:VOLTage?**, described on page 137
- **MEASure:RESistance?**, described on page 130
- **MEASure:TEMPerature:TCouple?**, described on page 134
- **MEASure:TEMPeratuer:RTD?**, described on page 131
- **SYSTem:TZONe**, described on page 100
- **SYSTem:CALibrate**, described on page 77

Syntax

```
:SYSTem:PASSword:NEW <current password>,
   <new password>
```

Parameters

Name: current password

Data Format: <CHARACTER PROGRAM DATA>

Description: Specifies the current password that is stored in permanent memory in the instrument. This string is case-sensitive is transmitted in clear text format.

The default password is *admin* for the all TEMPpoint, VOLTpoint, and MEASURpoint instruments.

Description (cont.):

Note: The DT8871, DT8871U, DT8872, DT8873, and DT8874 instruments with firmware version 2.2.3.1 or greater use the default user name "admin" and the default password "admin". Firmware version 2.2.3.1 and greater support password-protected commands. Therefore, you must enter the appropriate password to change the instrument's configuration or to start and stop a scan.

Firmware versions less than 2.2.3.1 do not support password-protected commands. Therefore, you are not prompted to enter a password to change the instrument's configuration or to start or stop a scan.

Name: new password

Data Format: <CHARACTER PROGRAM DATA>

Description: Specifies the new password that will overwrite the current password and be saved in permanent memory in the instrument. This string is case-sensitive and is transmitted in clear text format.

Response Data None

Notes The new password becomes effective immediately. The instrument does not need to be rebooted. The new password is reflected in the LAN configuration web page for the instrument (see the user's manual for your instrument for more information on this web page).

The new password is enforced when any attempt is made to configure the instrument using SCPI commands, the instrument's web pages, or the IVI-COM driver.

Since the <*current password*> and <*new password*> are strings that are transmitted in clear text format, they can be determined easily by snooping LAN traffic.

Example The following example shows an attempt to change the password using a wrong password:

```
> :SYST:PASS:NEW bogus, admin1
> :SYST:ERR?
< -221,"Settings conflict;:SYST:PASS:NEW"
```

In the following example, the existing password *admin* is successfully changed to *admin1*:

```
> :SYST:PASS:NEW admin, admin1
> :SYST:ERR?
< 0,"No error"
```

See Also **SYSTem:PASSword[:CENable]**, described on page 83

SYSTem:PASSword:CDISable, described on page 81

SYSTem:PASSword:CENAble:STATe?, described on page 85

SCPI Version Query

Description This command, which is mandatory for SCPI-compliant devices, returns the SCPI version number to which the instrument complies.

Syntax `:SYSTem:VERSion?`

Parameters None

Response Data `<YYYY>.<V>`

Name: YYYY

Data Format: <NR2>

Description: The year of the version, such as 2008.

Name: V

Data Format: <NR2>

Description: The approved SCPI revision number for that year, such as 0.

Notes Refer to *1999 SCPI Command Reference*, section 21.21 for more information.

Example

```
> :SYST:VERS?
< 1999.0
```

In this example, the version is year 1999 and the SCPI revision is 0.

Supported Board Number Query

Description Returns the number of boards installed in the instrument.

Syntax `:SYSTem:BOArd[:NUMber]?`

Parameters None

Response Data `<board number>`

Name: board number

Data Format: <0+NR1>

Description: The number of boards that are installed in the instrument. This value can range from 0 to 6.

Example The following example returns the number of boards installed in a MEASURpoint instrument; in this case, 6 boards are installed:

```
> :SYST:BOA?
< 6
```

See Also **SYSTem:BOArd:MODel?**, described on page 89

SYSTem:BOArd:MODel:NAMe?, described on page 90

Supported Board Model Query

Description Returns the model of a specific board installed in the instrument.

Syntax `:SYSTem:BOArd:MODel? <board number>`

Parameters

Name: board number

Data Format: <0+NR1>

Description: Specifies the board number to query. This value can range from 1 to 8.

Response Data `<model>`

Name: model

Data Format: <0+NR1>

Description: The model of the specified board in the instrument. The following values are supported:

- 0 – DT8771 (This is a thermocouple board.)
- 1 – DT8871U (This is a thermocouple board.)
- 2 – DT8873-100V (This is a voltage board with a fixed range of ±100 V. This is an older board model that has been replaced by the DT8873-MULTI board type.)
- 3 – DT8873-10V (This is a voltage board with a fixed range of ±10 V. This is an older board model that has been replaced by the DT8873-MULTI board type.)
- 4 – DT8873-400V (This is a voltage board with a fixed range of ±400 V. This is an older board model that has been replaced by the DT8873-MULTI board type.)
- 5 – DT8872 (This is an RTD board.)
- 7 – DT8873-MULTI (This is a voltage board that supports programmable voltage ranges of ±10 V and ±60 V.)

Notes DT8871, DT8871U, DT8872, and DT8873 instruments with firmware version 2.2.3.1 or greater are identified in firmware as DT8874-xxT-xxR-xx-V, where xxT specifies the number of thermocouple channels, xxR specifies the number of RTD channels, and xxV specifies the number of voltage input channels.

Instruments may contain multiple board names/models. For example, a DT8874-24T-08R-16V, contains thermocouple boards, RTD boards, and voltage input boards. By querying the board name/model, you can determine which boards comprise your instrument.

Example The following example returns the model of board number 3 in a MEASURpoint instrument; in this case, the model is 5, representing the DT8872 RTD board:

```
> :SYST:BOA:MOD? 3
< 5
```

See Also **SYSTem:BOArd:MODel?**, described on page 89

SYSTem:BOArd:MODel:NAMe?, described on page 90

SYSTem:BOArd:RANGe?, described on page 91

Supported Board Model Name Query

Description Returns the name of the board that is installed in the instrument.

Syntax `:SYSTem:BOArd:MODel:NAMe? <board number>`

Parameters

Name: board number

Data Format: <0+NR1>

Description: Specifies the board number to query. This value can range from 1 to 8.

Response Data `<name>`

Name: name

Data Format: <CHARACTER RESPONSE DATA>

Description: The name of the specified board in the instrument. The following names are supported:

- DT8771 (This is a thermocouple board.)
- DT8871U (This is a thermocouple board.)
- DT8873-100V (This is a voltage board with a fixed range of ±100 V. This is an older board model that has been replaced by the DT8873-MULTI board type)
- DT8873-10V (This is a voltage board with a fixed range of ±10 V. This is an older board model that has been replaced by the DT8873-MULTI board type)
- DT8873-400V (This is a voltage board with a fixed range of ±400 V.) This is an older board model that has been replaced by the DT8873-MULTI board type
- DT8872 (This is an RTD board.)
- DT8873-MULTI (This is a voltage board that supports programmable voltage ranges of ±10 V and ±60 V.)

Notes DT8871, DT8871U, DT8872, and DT8873 instruments with firmware version 2.2.3.1 or greater are identified in firmware as DT8874-xxT-xxR-xx-V, where xxT specifies the number of thermocouple channels, xxR specifies the number of RTD channels, and xxV specifies the number of voltage input channels.

Instruments may contain multiple board names/models. For example, a DT8874-24T-08R-16V, contains thermocouple boards, RTD boards, and voltage input boards. By querying the board name/model, you can determine which boards comprise your instrument.

Example The following example returns the name of board number 3 in a MEASURpoint instrument; in this case, the name is DT8872 (an RTD board):

```
> :SYST:BOA:MOD:NAM? 3
< DT8872
```

See Also **SYSTem:BOArd?**, described on page 88

SYSTem:BOArd:MODel?, described on page 89

SYSTem:BOArd:RANGe?, described on page 91

Supported Board Voltage Range Query

Description Returns the minimum and maximum voltage range that is supported by the specified board in the instrument.

Syntax `:SYSTem:BOArd:RANGe? <board number>`

Parameters

Name: board number

Data Format: <0+NR1>

Description: Specifies the board number to query. This value can range from 1 to 6.

Response Data `<min>,<max>`

Name: min

Data Format: <NRf>

Description: The minimum voltage range that is supported by the instrument.

Name: max

Data Format: <NRf>

Description: The maximum voltage range that is supported by the instrument.

Example The following example returns the minimum and maximum voltage range that is supported by a DT8873-MULTI board (board 0, in this case) in a MEASURpoint instrument:

```
> :SYST:BOA:RANG? 0
< -60.000,60.000
```

This example returns the minimum and maximum voltage range that is supported by a DT8872 board (board 1, in this case) in a MEASURpoint instrument:

```
> :SYST:BOA:RANG? 1
< -1.250,1.250
```

See Also **SYSTem:BOArd?**, described on page 88

SYSTem:BOArd:MODel?, described on page 89

SYSTem:BOArd:MODel:NAMe?, described on page 90

Supported Channels Query

Description Returns a list of all the analog input channels that are supported on the instrument.

Syntax `:SYSTem:CHANnel?`

Parameters None

Response Data `<channel_list>`

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: The list of all the analog input channels that are supported on the instrument.

If no analog input channels are supported on the instrument, an empty list (@) is returned.

Notes Depending on the model of the instrument, you can configure the channel to measure temperature, voltage, or resistance using the following commands:

- **CONFigure:TEMPerature:TCouple,** described on page 106
- **CONFigure:TEMPerature:RTD**, described on page 104
- **CONFigure:RESistance**, described on page 103
- **CONFigure:VOLTage**, described on page 109
- **CONFigure:VOLTage:RANGe**, described on page 111

Example The following example returns the list of supported analog input channels on an instrument; in this case, 24 channels (0 to 23) are supported:

```
> :SYST:CHAN?
< @0:23
```

See Also **CONFigure:VOLTage**, described on page 109

CONFigure:VOLTage:RANGe, described on page 111

CONFigure:TEMPerature:TCouple, described on page 106

CONFigure:TEMPerature:RTD, described on page 104

CONFigure:RESistance, described on page 103

SYSTem:DINput?, described on page 96

SYSTem:DOUTput?, described on page 96

Supported RTD Channels Query

Description Returns a list of analog input channels that support RTDs on the instrument.

Syntax `:SYSTem:CHANnel:RTD?`

Parameters None

Response Data `<channel_list>`

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: The list of analog input channels that support RTDs on the instrument.

If no channels support RTDs on the instrument, an empty list (@) is returned.

Notes If a channel supports an RTD, you can configure the channel to measure temperature, voltage, or resistance using the following commands:

- **CONFigure:TEMPerature:RTD**, described on page 104
- **CONFigure:RESistance**, described on page 103
- **CONFigure:VOLTage**, described on page 109

Example The following example returns the list of analog input channels that are supported on the instrument as well as the channels that support RTDs; in this case, all 48 channels (0 to 47) support RTDs:

```
> :SYST:CHAN?
< @0:47
> :SYST:CHAN:RTD?
< @0:47
```

Example (cont.) In the following example, only channels 8 to 15 of the available 48 channels support RTDs:

```
> :SYST:CHAN?
< @0:47
> :SYST:CHAN:RTD?
< @8:15
```

See Also **CONFigure:TEMPerature:RTD**, described on page 104

CONFigure:RESistance, described on page 103

CONFigure:VOLTage, described on page 109

SYSTem:CHANnel?, described on page 92

SYSTem:CHANnel:TCouple?, described on page 94

SYSTem:CHANnel:VOLTage:RANGe?, described on page 95

Supported Thermocouple Channels Query

Description Returns a list of analog input channels that support thermocouples on the instrument.

Syntax `:SYSTem:CHANnel:TCouple?`

Parameters None

Response Data `<channel_list>`

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: The list of analog input channels that support thermocouples on the instrument.

If no channels support thermocouples on the instrument, an empty list (@) is returned.

If a channel supports a thermocouple, you can configure the channel to measure temperature or voltage using the following commands:

- **CONFigure:TEMPerature:TCouple,** described on page 106
- **CONFigure:VOLTage**, described on page 109

Example The following example returns the list of analog input channels that are supported on the instrument as well as those that support thermocouples; in this case, all 48 channels (0 to 47) support thermocouples:

```
> :SYST:CHAN?
< @0:47
> :SYST:CHAN:TC?
< @0:47
```

Example (cont.) In the following example, only channels 0 to 15 of the available 48 channels support thermocouples:

```
> :SYST:CHAN?
< @0:47
> :SYST:CHAN:TC?
< @0:15
```

See Also **CONFigure:TEMPerature:TCouple**, described on page 106

CONFigure:VOLTage, described on page 109

SYSTem:CHANnel?, described on page 92

SYSTem:CHANnel:RTD?, described on page 93

SYSTem:CHANnel:VOLTage:RANGe?, described on page 95

Supported Voltage Range Query

Description Returns a list of channels that support programmable voltage ranges on the specified instrument.

Syntax `:SYSTem:CHANnel:VOLTage:RANGe?`

Parameters None

Response Data `<channel_list>`

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: The list of analog input channels that support programmable voltage ranges on the instrument.

If no channels support programmable voltage ranges on the instrument, an empty list (@) is returned.

Notes If a channel supports programmable voltage ranges, you can configure the channel for the range using the **CONFigure:VOLTage:RANGe** command, described on page 111**.**

Example The following example returns which channels support programmable voltage ranges; in this case, channels 0 to 7 support thermocouples, while channels 8 to 15 support RTDs, and channels 16 through 23 support programmable voltage ranges:

```
> *IDN?
< Data Translation,DT8874-08T,08R,08V,-1,1.8,0.0
>:SYSTem:CHANnel?
< (@0:23)
>:SYSTem:CHANnel:RTD?
< (@8:15)
>:SYSTem:CHANnel:TC?
< (@0:7)
>:SYST:CHAN:VOLT:RANG?
< (@16:23)
```

See Also **CONFigure:VOLTage:RANGe**, described on page 111

CONFigure:VOLTage, described on page 109

SYSTem:CHANnel?, described on page 92

SYSTem:CHANnel:VOLTage:RANGe?, described on page 95

SYSTem:CHANnel:RTD?, described on page 93

SYSTem:CHANnel:TCouple?, described on page 94

SYSTem:BOArd:RANGe?, described on page 91

Supported Digital Input Lines Query

Description Returns the number of digital input lines that are supported by the instrument.

Syntax `:SYSTem:DINput?`

Parameters None

Response Data `<DINLines>`

Name: DINLines

Data Format: <NR1>

Description: The number of digital input lines that are supported by the instrument.

Example The following example returns the number of digital input lines that are supported by the instrument:

```
> :SYST:DIN?
< 8
```

See Also **INPut?**, described on page 149

SYSTem:DOUTput?, described next

SYSTem:CHANnel?, described on page 92

SYSTem:CHANnel:TCouple?, described on page 94

SYSTem:CHANnel:RTD?, described on page 93

Supported Digital Output Lines Query

Description Returns the number of digital output lines that are supported by the instrument.

Syntax `:SYSTem:DOUTput?`

Parameters None

Response Data `<DOUTLines>`

Name: DOUTLines

Data Format: <NR1>

Description: The number of digital output lines that are supported by the instrument.

Example The following example returns the number of digital output lines that are supported by the instrument:

```
> :SYST:DOUT?
< 8
```

See Also **OUTPut**, described on page 151

SYSTem:DINput?, described on page 96

SYSTem:CHANnel?, described on page 92

SYSTem:CHANnel:TCouple?, described on page 94

SYSTem:CHANnel:RTD?, described on page 93

Supported Maximum Scan Rate Query

Description Returns the maximum scan rate or scan frequency that is supported by the instrument.

Syntax `:SYSTem:SCAn:RATe:MAXimum[:SEC|HZ]?`

Optional Keywords

Name: SEC | HZ

Data Format: <CHARACTER PROGRAM DATA>

Description: Optional enumerated type that specifies whether to return the maximum scan rate in seconds (*SEC*) or the maximum scan frequency, in Hertz (*HZ*).

If this keyword is omitted, *SEC* is used by default.

Parameters None

Response Data `<MaxRate>`

Name: MaxRate

Data Format: <NRf>

Description: If *SEC* is specified or if neither *SEC* nor *HZ* is specified for the *SEC | HZ* keyword, returns a floating-point value that represents the maximum time period of each scan, in seconds.

If *HZ* is specified for the *SEC | HZ* keyword, returns a floating-point value that represents the maximum scan frequency, in Hertz.

Currently, all TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments support a maximum scan rate of 0.1 s and a maximum scan frequency of 10 Hz.

Notes You can configure the scan rate or scan frequency of the instrument using the **CONFigure:SCAn:RATe** command, described on page 123.

Example The following example returns the maximum scan rate that is supported by the instrument, in seconds:

```
> :SYST:SCA:RAT:MIN:SEC?
< 0.100000
```

This example returns the minimum scan frequency that is supported by the instrument, in Hertz:

```
> :SYST:SCA:RAT:MIN:HZ?
< 10.000000
```

See Also **SYSTem:SCAn:RATe:MIN?**, described on page 98

CONFigure:SCAn:RATe command, described on page 123

Supported Minimum Scan Rate Query

Description Returns the minimum scan rate or scan frequency that is supported by the instrument.

Syntax `:SYSTem:SCAn:RATe:MINimum[:SEC|HZ]?`

Optional Keywords

Name: SEC|HZ

Data Format: <CHARACTER PROGRAM DATA>

Description: Optional enumerated type that specifies whether to return the minimum scan rate in seconds (*SEC*) or the minimum scan frequency, in Hertz (*HZ*).

If this keyword is omitted, *SEC* is used by default.

Parameters None

Response Data `<MinRate>`

Name: MinRate

Data Format: <NRf>

Description: If *SEC* is specified or if neither *SEC* nor *HZ* is specified for the *SEC|HZ* keyword, returns a floating-point value that represents the minimum time period of each scan, in seconds.

If *HZ* is specified for the *SEC|HZ* keyword, returns a floating-point value that represents the minimum scan frequency, in Hertz.

Currently, all TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments support a minimum scan rate of 6553.5 s and a minimum scan frequency of 1.525e-4 Hz (10 Hz/65535).

Notes You can configure the scan rate or scan frequency of the instrument using the **CONFigure:SCAn:RATe** command described on page 123.

Example The following example returns the minimum scan rate that is supported by the instrument, in seconds:

```
> :SYST:SCA:RAT:MIN:SEC?
< 6553.5
```

This example returns the minimum scan frequency that is supported by the instrument, in Hertz:

```
> :SYST:SCA:RAT:MIN:HZ?
< 1.525e-4
```

See Also **SYSTem:SCAn:RATe:MAX?**, described on page 97

CONFigure:SCAn:RATe, described on page 123

TIME Query

Description Returns the current time used by the instrument. This date is updated automatically by an SNTP server.

Syntax `:SYSTem:TIME?`

Parameters None

Response Data `<hour>,<minute>,<second>`

Name: hour

Data Format: <NR1>

Description: A number from 0 to 23 representing the current hour of the instrument.

Name: minute

Data Format: <NR1>

Description: A number from 0 to 59 representing the current minute of the instrument.

Name: second

Data Format: <NR1>

Description: A number from 0 to 59 representing the current second of the instrument.

Example

```
> :SYST:TIME?
< 15,31,45
```

This response indicates that the current time of the instrument is 3:31:45 pm (15 is the hour, 31 is the number of minutes, and 45 is the number of seconds).

Time Zone Query

Description Returns the time zone that is currently used by the instrument, as an offset from GMT (Greenwich Mean Time).

Syntax `:SYSTem:TZONe?`

Required Parameters None

Response Data

Name: hour

Data Format: <NR1>

Description: A number from –12 to +12 representing the current hour relative to GMT.

Name: minute

Data Format: <NR1>

Description: A number from –59 to +59 representing the current minute relative to GMT. Minutes are rounded up to 30.

Response Data None

Example

```
> :SYST:TZON
< +5,-45
```

This response indicates that the current time zone of the instrument is four hours and 30 minutes ahead of GMT. Minutes are rounded up to 30.

Time Zone Set

Description Sets the time zone currently used by the instrument, as an offset from GMT (Greenwich Mean Time). The specified hour and minute is added to the UTC (Coordinated Universal Time) time that is maintained by the instrument.

Syntax `:SYSTem:TZONe <hour>[,minute]`

Required Parameters

Name: hour

Data Format: <NR1>

Description: A number from –12 to +12 representing the current hour relative to GMT. The default value is 0.

Optional Parameters

Name: minute

Data Format: <NR1>

Description: A number from –59 to +59 representing the current minute relative to GMT. The default value is 0.

Minutes are rounded up to 30.

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

Example

```
> :SYST:TZON +5,-45
```

This commands sets the current time zone used by the instrument to four hours and 30 minutes ahead of GMT. Minutes are rounded up to 30.

CONFigure Subsystem Commands

The CONFigure subsystem is used to configure and query settings of a TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument. Table 9 lists the commands in the CONFigure subsystem. This section describes each of these commands in detail.

Table 9: CONFigure Subsystem Commands

Type	Mnemonic	See
Channel Configuration for Resistance	CONFigure: RESistance	page 103
Channel Configuration for RTD Temperature Measurements	CONFigure:TEMPerature:RTD	page 103
Channel Configuration for Thermocouple Temperature Measurements	CONFigure:TEMPerature:TCouple	page 106
Channel Configuration for Voltage	CONFigure:VOLTage	page 109
Channel Configuration for Programmable Voltage Ranges	CONFigure:VOLTage:RANGe	page 111
Channel Configuration Query	CONFigure?	page 113
Filter Configuration	CONFigure:FILTer	page 115
Filter Query	CONFigure:FILTer?	page 116
Scan Circular Buffer Query	CONFigure:SCAn:BUFfer?	page 117
Scan CJC Configuration	CONFigure:SCAn:CJC	page 118
Scan CJC Query	CONFigure:SCAn:CJC?	page 119
Scan List Configuration	CONFigure:SCAn:LISt	page 120
Scan List Query	CONFigure:SCAn:LISt?	page 122
Scan Rate Configuration	CONFigure:SCAn:RATe	page 123
Scan Rate Query	CONFigure:SCAn:RATe?	page 125
Trigger Source Configuration	CONFigure:TRIgger[:SOURce]	page 127
Trigger Source Query	CONFigure:TRIgger[:SOURce]?	page 128

Channel Configuration for Resistance

Description For channels that support RTDs, configures specified channels for resistance measurements. This command affects the configuration of the specified channels only.

Syntax `:CONFigure:RESistance [channel_list]`

Required Parameters None

Optional Parameters

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: Specifies the channels to configure for resistance measurements.

The number of channels that you can specify depends on the configuration of your instrument.

To determine the list of all analog input channels that are supported on your instrument, use the **SYSTem:CHANnel?** command, described on page 92.

Use the **SYSTem:CHANnel:RTD?** command, described on page 93, to determine which channels support RTDs; if a channel supports RTDs, you can configure it for temperature, voltage, or resistance measurements.

If this parameter is omitted, all analog input channels are configured for resistance measurements, by default.

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

A Command Error is generated if the specified channel list includes a channel number less than 0 or greater than the maximum number of supported channels. If bit 5 (CME) of the Standard Event Status Enable register is enabled, a Command Error sets bit 5 (CME) of the Standard Event Status register.

An Execution Error is generated if the instrument is scanning, that is an **INITiate** command was issued and was not aborted, prior to issuing this command. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

Refer to *1999 SCPI Command Reference*, section 3.1 and 3.7.2, and *1999 SCPI Syntax & Style*, section 8.3.2 for more information.

Example The following command configures analog input channels 0, 3 through 7, and 47 on the instrument for resistance measurements:

```
> :CONF:RES (@0,3:7,47)
```

This command configures all analog input channels on the instrument for resistance measurements:

```
> :CONF:RES
```

This command configures analog input channels 1, 2, and 8 through 46 on the instrument for resistance measurements:

```
> :CONF:RES (@1,2,8:46)
```

See Also **SYSTem:CHANnel?**, described on page 92

SYSTem:CHANnel:RTD?, described on page 93

CONFigure?, described on page 113

CONFigure:TEMPerature:RTD, described on page 104

CONFigure:VOLTage, described on page 109

Channel Configuration for RTD Temperatures

Description Configures specified channels on the instrument for RTD temperature measurements. This command affects the configuration of the specified channels only.

Syntax

```
:CONFigure:TEMPerature:RTD {PT100|PT500|PT1000|
   A_PT100|A_PT500|A_PT1000|PT100_3|PT500_3|
   PT1000_3|A_PT100_3|A_PT500_3|A_PT1000_3|DEFault
   } [,channel_list]
```

Required Parameters

Name: {PT100 | PT500 | PT1000 | A_PT100 | A_PT500 | A_PT1000 | PT100_3 | PT500_3 | PT1000_3 | A_PT100_3 | A_PT500_3 | A_PT1000_3 | DEFault}

Data Format: <CHARACTER PROGRAM DATA>

Description: Enumerated type that specifies one of the following RTD types: PT100, PT500, or PT1000 for 2- or 4- wire European RTDs, A_PT100, A_PT500, or A_PT1000 for 2- or 4-wire American RTDs, PT100_3, PT500_3, or PT1000_3 for 3-wire European RTDs, or A_PT100_3, A_PT500_3, or A_PT1000_3 for 3-wire American RTDs.

If DEFault is specified, the PT100 RTD type is used by default.

Optional Parameters

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: Specifies the channels to configure for RTD temperature measurements.

Description (cont.): The number of supported channels depends on the configuration of your instrument.

To determine the list of all analog input channels that are supported, use the **SYSTem:CHANnel?** command, described on page 92.

Use the **SYSTem:CHANnel:RTD?** command, described on page 93, to determine which channels on your instrument support RTDs; if a channel supports RTDs, you can configure it for temperature, voltage, or resistance measurements.

If *channel list* is omitted, all channels are configured for RTD temperature measurement, by default. If a channel does not support RTDs, error –221, "Settings conflict" is generated.

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

A Command Error is generated if one of the following conditions is detected:

- A *TCouple* transducer type was specified for an RTD measurement instrument or an *RTD* transducer type was specified for a thermocouple measurement instrument
- The specified transducer type is not one of the enumerated types
- The specified channel list includes a channel number less than 0 or greater than the maximum number of supported channels

If bit 5 (CME) is enabled in the Standard Event Status Enable register, a Command Error sets bit 5 (CME) of the Standard Event Status register.

An Execution Error is generated if one of the following conditions is detected:

- The specified sensor type is one of the following for a thermocouple measurement instrument: PT100, PT500, PT1000, A_PT100, A_PT500, A_PT1000, PT100_3, PT500_3, PT1000_3, A_PT100_3, A_PT500_3, or A_PT1000_3.
- The specified sensor type is one of the following for an RTD measurement instrument: J | K | B | E | N | R | S | T
- A scan is in progress

If bit 4 (E) is enabled in the Standard Event Status Enable register, an Execution Error sets bit 4 (E) of the Standard Event Status register.

Notes (cont.) A summary of the Standard Event Status register is available in bit 5 (Standard Event Status Bit Summary) of the Status Byte register.Whenever an error is encountered, an error string is appended to the error queue, and bit 2 (Error / Event Queue Summary) of the Status Byte register is set.

For more information, refer to *1999 SCPI Command Reference*, section 3.1 and 3.7.7, and *1999 SCPI Syntax & Style*, section 8.3.2.

Example This example configures analog input channel 8 to use a PT1000 2- or 4-wire European RTD:

```
> :CONF:TEMP:RTD PT1000,(@8)
> *STB?
< 0
```

The following example tries to configure all analog input channels on the instrument to use a PT100 2- or 4-wire European RTD. However, in this example, no channels support RTD inputs; therefore, an Execution Error occurs. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register. This, in turn, sets bits 2 and 5 of the Status Byte register:

```
> *ESE 189
> *ESR?
< 0
> :CONF:TEMP:RTD PT100
> *STB?
< 36
> *ESR?
< 16
> :SYST:ERR?
< -200,"Execution error;CONF:TEMP:RTD invalid"
> *STB?
< 0
```

See Also **SYSTem:CHANnel?**, described on page 92

SYSTem:CHANnel:RTD?, described on page 93

CONFigure?, described on page 113

CONFigure:RESistance, described on page 103

CONFigure:VOLTage, described on page 109

Channel Configuration for Thermocouple Temperatures

Description Configures specified channels on the instrument for temperature measurements. This command affects the configuration of the specified channels only.

Syntax

```
:CONFigure:TEMPerature:TCouple
   {J|K|B|E|N|R|S|T|DEFault} [,channel_list]
```

Required Parameters

Name: {J | K | B | E | N | R | S | T | DEFault}

Data Format: <CHARACTER PROGRAM DATA>

Description: Enumerated type that specifies one of the following thermocouple types: J, K, B, E, N, R, S, T.

If DEFault is specified, a type J thermocouple is used.

Optional Parameters

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: Specifies the channels to configure for thermocouple temperature measurements.

The number of supported channels depends on the configuration of your instrument.

To determine the list of all analog input channels that are supported on your instrument, use the **SYSTem:CHANnel?** command, described on page 92.

Use the **SYSTem:CHANnel:TC?** command, described on page 94, to determine which channels on your instrument support thermocouples. If a channel supports thermocouples, you can configure it for temperature or voltage measurements.

If *channel list* is omitted, all channels are configured for thermocouples, by default. If a channel does not support thermocouples, error –221, "Settings conflict" is generated.

Response Data

None

Notes

This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

A Command Error is generated if one of the following conditions is detected:

- A *TCouple* transducer type was specified for an RTD measurement instrument or an *RTD* transducer type was specified for a thermocouple measurement instrument
- The specified transducer type is not one of the enumerated types
- The specified channel list includes a channel number less than 0 or greater than the maximum number of supported channels

If bit 5 (CME) is enabled in the Standard Event Status Enable register, a Command Error sets bit 5 (CME) of the Standard Event Status register.

Notes (cont.) An Execution Error is generated if one of the following conditions is detected:

- The specified sensor type is one of the following for a thermocouple measurement instrument: PT100, PT500, PT1000, A_PT100, A_PT500, A_PT1000, PT100_3, PT500_3, PT1000_3, A_PT100_3, A_PT500_3, or A_PT1000_3.
- The specified sensor type is one of the following for an RTD measurement instrument: J|K|B|E|N|R|S|T
- A scan is in progress

If bit 4 (E) is enabled in the Standard Event Status Enable register, an Execution Error sets bit 4 (E) of the Standard Event Status register.

A summary of the Standard Event Status register is available in bit 5 (Standard Event Status Bit Summary) of the Status Byte register.

Whenever an error is encountered, an error string is appended to the error queue, and bit 2 (Error / Event Queue Summary) of the Status Byte register is set.

For more information, refer to *1999 SCPI Command Reference*, section 3.1 and 3.7.7, and *1999 SCPI Syntax & Style*, section 8.3.2.

Example This example configures analog input channel 3 to use a type K thermocouple:

```
> :CONF:TEMP:TCouple K,(@3)
> *STB?
< 0
```

The following example tries to configure the analog input channels to use a type S thermocouple. In this example, the instrument does not support thermocouple channels; therefore, an Execution Error occurs. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register. This, in turn, sets bits 2 and 5 of the Status Byte register:

```
> *ESE 189
> *ESR?
< 0
> :CONF:TEMP:TCouple S
> *STB?
< 36
> *ESR?
< 16
> :SYST:ERR?
< -200,"Execution error;CONF:TEMP:TC invalid"
> *STB?
< 0
```

See Also

SYSTem:CHANnel?, described on page 92

SYSTem:CHANnel:TC?, described onpage 94

CONFigure?, described on page 113

CONFigure:VOLTage, described on page 109

Channel Configuration for Voltage

Description

Configures specified RTD and thermocouple channels on the instrument to measure voltages. This command affects the configuration of the specified channels only.

Syntax

```
:CONFigure:VOLTage [channel_list]
```

Required Parameters

None

Optional Parameters

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: Specifies the channels to configure for voltage measurements.

The number of channels depends on the configuration of your instrument.

To determine the list of all analog input channels that are supported on your instrument, use the **SYSTem:CHANnel?** command, described on page 92.

Use the **SYSTem:CHANnel:TCouple?** command, described on page 94, to determine which channels support thermocouples on your instrument; if a channel supports thermocouples, you can configure it for temperature or voltage measurements.

Use the **SYSTem:CHANnel:RTD?** command, described on page 93, to determine which channels on your instrument support RTDs; if a channel supports RTDs, you can configure it for temperature, voltage, or resistance measurements.

If this parameter is omitted, all the channels are configured for voltage measurements, by default.

Response Data

None

Notes

This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

This command does not modify the voltage ranges of channels that support programmable voltage ranges. For channels that support programmable voltage ranges, use the **CONFigure:VOLTage:RANGe** command, described on page 111.

Notes (cont.)

A Command Error is generated if the specified channel list includes a channel number less than 0 or greater than the maximum number of supported channels. If bit 5 (CME) of the Standard Event Status Enable register is enabled, a Command Error sets bit 5 (CME) of the Standard Event Status register.

An Execution Error is generated if the instrument is scanning, that is an **INITiate** command was issued and was not aborted, prior to issuing this command. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

For more information, refer to *1999 SCPI Command Reference*, section 3.1 and 3.7.2, and *1999 SCPI Syntax & Style*, section 8.3.2.

Example

The following example configures analog input channels 0, 3 through 7, and 47 for voltage measurements:

```
> :CONF:VOLT (@0,3:7,47)
```

This example configures all analog input channels for voltage measurements:

```
> :CONF:VOLT
```

This example configures analog input channels 1, 2, and 8 through 46 for voltage measurements:

```
> :CONF:VOLT (@1,2,8:46)
```

See Also

SYSTem:CHANnel?, described on page 92

SYSTem:CHANnel:TCouple?, described on page 94

SYSTem:CHANnel:RTD?, described on page 93

SYSTem:CHANnel:VOLTage:RANGe?, described on page 95

CONFigure?, described on page 113

CONFigure:RESistance, described on page 103

CONFigure:TEMPerature:RTD, described on page 104

CONFigure:TEMPerature:TCouple, described on page 106

CONFigure:VOLTage:RANGe, described on page 111

Channel Configuration for Programmable Voltage Ranges

Description For VOLTpoint and MEASURpoint LXI instruments that support programmable input ranges, configures the voltage range for specified channels on the instrument. This command affects the configuration of the specified channels only.

Syntax

```
:CONFigure:VOLTage:RANGe {BIP100MV|BIP1V|BIP10V|
   BIP100V|BIP400V|BIP60V|DEFault},
   [<channel_list]>
```

Required Parameters

Name: {BIP100MV | BIP1V | BIP10V | BIP100V | BIP400V | | BIP60V | DEFault}

Data Format: <CHARACTER PROGRAM DATA>

Description: Specifies one of the following voltage ranges:

- **BIP100MV** – Specifies an input voltage range of ±0.1 V.
- **BIP1V** – Specifies an input voltage range of ±1 V.
- **BIP10V** – Specifies an input voltage range of ±10 V.
- **BIP100V** – Specifies an input voltage range of ±100 V.
- **BIP400V** – Specifies an input voltage range of ±400 V.
- **BIP60V** – Specifies an input voltage range of ±60 V.
- **DEFault** – Selects the default voltage range of ±10 V.

Note: MEASURpoint instruments currently support only the ±10 V and ±60 V ranges.

Optional Parameters

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: Specifies the channels to configure for the specified voltage range.

The number of channels that you can specify depends on the configuration of your instrument.

To determine the list of all analog input channels that are supported on your instrument, use the **SYSTem:CHANnel?** command, described on page 92.

To determine the list of all analog input channels that support programmable voltage ranges on your instrument, use the **SYSTem:CHANnel:VOLTage:RANGe?** command, described on page 95.

Response Data None

Notes

This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

A Command Error is generated if the specified channel list includes a channel number less than 0 or greater than the maximum number of supported channels. If bit 5 (CME) of the Standard Event Status Enable register is enabled, a Command Error sets bit 5 (CME) of the Standard Event Status register.

An Execution Error is generated if the instrument is scanning, that is an **INITiate** command was issued and was not aborted, prior to issuing this command. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

For more information, refer to *1999 SCPI Command Reference*, section 3.1 and 3.7.2, and *1999 SCPI Syntax & Style*, section 8.3.2.

Example

On an instrument that supports programmable voltage ranges, the following example configures analog input channels 0 to 3 for a voltage range of ±10 V, and channels 4 to 7 for a voltage range of ±60 V:

```
>:CONF:VOLT:RANG BIP10V, (@0:3)
>:CONF:VOLT:RANG BIP60V, (@4:7)
>:CONF? (@0:7)
< BIP10V,BIP10V,BIP10V,BIP10V,BIP60V,BIP60V,
   BIP60V,BIP60V
```

See Also

SYSTem:CHANnel?, described on page 92

SYSTem:CHANnel:TCouple?, described on page 94

SYSTem:CHANnel:RTD?, described on page 93

SYSTem:CHANnel:VOLTage:RANGe?, described on page 95

CONFigure:RESistance, described on page 103

CONFigure:TEMPerature:RTD, described on page 104

CONFigure:TEMPerature:TCouple, described on page 106

CONFigure?, described on page 113

Channel Configuration Query

Description Returns the configuration of specified analog input channels on the instrument.

Syntax `:CONFigure? [channel_list]`

Required Parameters None

Optional Parameters

Name: channel_list

Data Format: <0+NR1>

Description: Specifies the channels for which to return configuration information. If this parameter is omitted, the configuration of all channels is returned.

The number of supported channels depends on the configuration of your instrument.

To determine the list of all analog input channels that are supported on your instrument, use the **SYSTem:CHANnel?** command, described on page 92.

Use the **SYSTem:CHANnel:TCouple?** command, described on page 94, to determine which analog input channels on your instrument support thermocouples; if a channel supports thermocouples, you can configure it for temperature or voltage measurements.

Use the **SYSTem:CHANnel:RTD?** command, described on page 93, to determine which analog input channels on your instrument support RTDs; if a channel supports RTDs, you can configure it for temperature, voltage, or resistance measurements.

Response Data up to 48 fields of comma-separated values; each value belongs to an enumerated set:

`<type>,<type>,<type>,....,<type>`

Name: type

Data Format: <CHARACTER RESPONSE DATA>

Description: The first character corresponds to the configuration of the first channel specified in *channel list*, the second character corresponds to the configuration of the next channel in *channel list*, and so on.

If a channel is configured for a fixed-range voltage input with the **CONFigure:VOLTage** command, V is returned.

If a channel is configured for a programmable voltage range with the **CONFigure:VOLTage:RANGe** command on a MEASURpoint instrument, one of the following values is returned for each channel: BIP10V or BIP60V.

If a channel is configured for a thermocouple input, one of the following thermocouple types is returned: J, K, R, S, T, B, E, or N.

Description (cont.): If a channel is configured for an RTD input, one of the following RTD types is returned: PT100, PT500, PT1000, A_PT100, A_PT500, A_PT1000, PT100_3, PT500_3, PT1000_3, A_PT100_3, A_PT500_3, or A_PT1000_3.

If a channel is configured for resistance, OHM is returned.

Notes For more information on enumerated sets, refer to *1999 SCPI Data Interchange Format*, section 3.4.10.

For more information on character response data, refer to *IEEE Std 488.2*, section 8.7.1.

Example The following example returns the configuration of all channels on a MEASURpoint instrument; in this case, all channels on the instrument can be programmed for thermocouple measurements:

```
> :CONF?
< V,J,J,V,J,V,J,J,V,V,V,V,V,V,V,V,
   V,V,V,V,V,V,V,V,V,V,V,V,V,V,V,V,
   V,V,V,V,V,V,V,V,V,V,V,V,V,V,V,V
```

This example configures all channels for a type J thermocouple, and then reconfigures channels 0, 3, and 5 for voltage inputs. In the first query, the configuration of channels 0 and 7 is returned. In the second query, the configuration of channels 0 through 7 is returned:

```
> :CONF:TEMP:TC J
> :CONF:VOLT (@0,3,5)
> :CONF? (@0,7)
< V,J
> :CONFigure? (@0:7)
< V,J,J,V,J,V,J,J
```

The following example returns the configuration of all channels on a MEASURpoint instrument; in this case, all channels on the instrument can be programmed for thermocouple measurements:

```
> :CONF?
< V,J,J,V,J,V,J,J,V,V,V,V,V,V,V,V,
   V,V,V,V,V,V,V,V,V,V,V,V,V,V,V,V,
   V,V,V,V,V,V,V,V,V,V,V,V,V,V,V,V
```

This example configures all channels for a type J thermocouple, and then reconfigures channels 0, 3, and 5 for voltage inputs. In the first query, the configuration of channels 0 and 7 is returned. In the second query, the configuration of channels 0 through 7 is returned:

```
> :CONF:TEMP:TC J
> :CONF:VOLT (@0,3,5)
> :CONF? (@0,7)
< V,J
> :CONFigure? (@0:7)
< V,J,J,V,J,V,J,J
```

Example (cont.) In this example, the configuration of channels 0 through 7 of a MEASURpoint instrument that supports programmable voltage ranges is returned:

```
> :CONF? (@0:7)
< BIP10V,BIP10V,BIP60V,BIP60V,BIP60V,BIP60V,
   BIP60V,BIP60V
```

See Also

CONFigure:RESistance, described on page 103

CONFigure:TEMPerature:RTD, described on page 104

CONFigure:TEMPerature:TCouple, described on page 106

CONFigure:VOLTage, described on page 109

CONFigure:VOLTage:RANGe, described on page 111

SYSTem:CHANnel?, described on page 92

SYSTem:CHANnel:TCouple?, described on page 94

SYSTem:CHANnel:RTD?, described on page 93

SYSTem:CHANnel:VOLTage:RANGe?, described on page 95

Filter Configuration

Description Configures the filter type used for single-value and continuous analog input operations on the instrument.

Syntax `:CONFigure:FILTer [{RAW|AVG}]`

Required Parameters None

Optional Parameters

Name: {RAW | AVG}

Data Format: <CHARACTER PROGRAM DATA>

Description: Specifies one of the following filter types:

- **RAW** – No filter. Provides fast response times, but the data may be difficult to interpret. Use when you want to filter the data yourself.

  The RAW filter type returns the data exactly as it comes out of the Delta-Sigma A/D converters. Note that Delta-Sigma converters provide substantial digital filtering above the Nyquist frequency.

  Generally, the only time it is desirable to turn off the software filter is if you are using fast responding thermocouples/RTDs, sampling them at higher speeds (> 1 Hz), and need as much response speed as possible.

Description (cont.):

- **AVG** – (Moving Average) Provides a compromise of filter functionality and response time. This filter can be used in any application.

  This low-pass filter takes the previous 16 samples, adds them together, and divides by 16.

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

An Execution Error is generated if the instrument is scanning, that is an **INITiate** command was issued and was not aborted, prior to issuing this command. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

Example The following examples set the filter type, and then return the current filter configuration:

```
> :CONF:FILT AVG
> :CONF:FILT?
< AVG

> :CONF:FILT RAW
> :CONF:FILT?
< RAW
```

See Also **CONFigure:FILTer?,** described next

CONFigure?, described on page 113

CONFigure:SCAn:LISt, described on page 120

CONFigure:SCAn:CJC, described on page 118

Filter Query

Description Returns the currently configured filter type for the instrument.

Syntax `:CONFigure:FILTer?`

Command Parameters None

Response Data `<filter_type>`

Name: filter_type

Data Format: <CHARACTER RESPONSE DATA>

Description: Returns one of the following filter types:

- **RAW** – No filter. Provides fast response times, but the data may be difficult to interpret. Use when you want to filter the data yourself.

  The RAW filter type returns the data exactly as it comes out of the Delta-Sigma A/D converters. Note that Delta-Sigma converters provide substantial digital filtering above the Nyquist frequency.

  Generally, the only time it is desirable to turn off the software filter is if you are using fast responding thermocouples/RTDs, sampling them at higher speeds (> 1 Hz), and need as much response speed as possible.

- **AVG** – (Moving Average) Provides a compromise of filter functionality and response time. This filter can be used in any application.

  This low-pass filter takes the previous 16 samples, adds them together, and divides by 16.

Example The following examples set the filter type, and then return the current configuration of the filter type:

```
> :CONF:FILT AVG
> :CONF:FILT?
< AVG

> :CONF:FILT RAW
> :CONF:FILT?
< RAW
```

See Also **CONFigure:FILTer,** described on page 115

CONFigure?, described on page 113

Scan Circular Buffer Query

Description Returns the size of the circular buffer, in bytes, that is used to store scan data.

Syntax `:CONFigure:SCAn:BUFfer[:LEN]?`

Required Parameters None

Response Data <Buffer_Size>

Name: Buffer_Size

Data Format: <+NR1>

Description: A decimal number that represents the size of the circular buffer on the instrument, in bytes.

Notes Refer to *1999 SCPI Data Interchange Format*, section 3.4.2, for more information.

Example The following example returns the size of the circular buffer that is used to store scan data on the instrument:

```
> :CONFigure:SCAn:BUFfer?
< 1048576
> :CONFigure:SCAn:BUF:LEN?
< 1048576
> :CONFigure:SCAn:BUFfer?
< 1048576
> :CONFigure:SCAn:BUF?
< 1048576
```

See Also **CONFigure?**, described on page 113

CONFigure:SCAn:LISt, described on page 120

Scan CJC Configuration

Description Enables the capability of returning CJC data in the analog input data stream.

Syntax

```
:CONFigure:SCAn:CJC
   [{OFF|ON|DEFault|<NR1>}]
```

Required Parameters None

Optional Parameters

Name: {OFF | ON | DEFault | <NR1>}

Data Format: <CHARACTER PROGRAM DATA>

Description: If you want to return CJC data in the analog input data stream, specify ON or enter any non-zero numeric value.

If you do not want to return CJC data in the analog input data stream, specify OFF, DEFault, or enter 0 for this parameter.

If this parameter is omitted, no CJC data is returned in the analog input data stream.

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

If returning CJC data in the analog input data stream is enabled, twice the amount of scan data is returned.

An Execution Error is generated if the instrument is scanning, that is an **INITiate** command was issued and was not aborted, prior to issuing this command. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

Notes (cont.) The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register. When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

Example Any of the following commands disables the capability of returning CJC data in the analog input data stream:

```
> :CONF:SCAn:CJC;:CONF:SCAn:CJC?
< 0

> :CONF:SCAn:CJC OFF;:CONF:SCAn:CJC?
< 0

> :CONF:SCAn:CJC DEF;:CONF:SCAn:CJC?
< 0

> :CONF:SCAn:CJC 0;:CONF:SCAn:CJC?

< 0
> :CONF:SCAn:CJC ON;:CONF:SCAn:CJC?
< 1

> :CONF:SCAn:CJC 1;:CONF:SCAn:CJC?
< 1

> :CONF:SCAn:CJC 34;:CONF:SCAn:CJC?
< 1
```

See Also **CONFigure?**, described on page 113

CONFigure:SCAn:LISt, described on page 120

CONFigure:SCAn:CJC?, described on below

Scan CJC Query

Description Returns whether the capability of returning CJC data in the analog input data stream has been enabled or disabled.

Syntax `:CONFigure:SCAn:CJC?`

Required Parameters None

Response Data `<CJC_Reporting>`

Name: CJC_Reporting

Data Format: <Boolean>

Description: If the capability of returning CJC data in the analog input data stream is enabled, a value of 1 is returned.

If the capability of returning CJC data in the analog input data stream is disabled, a value of 0 is returned.

Notes Refer to *1999 SCPI Syntax & Style*, section 7.3 for more information.

If returning CJC data in the analog input data stream is enabled, twice the amount of scan data is returned.

Example Any of the following commands disables the capability of returning CJC data in the analog input data stream:

```
> :CONF:SCAn:CJC;:CONF:SCAn:CJC?
< 0

> :CONF:SCAn:CJC OFF;:CONF:SCAn:CJC?
< 0

> :CONF:SCAn:CJC DEF;:CONF:SCAn:CJC?
< 0

> :CONF:SCAn:CJC 0;:CONF:SCAn:CJC?

< 0
> :CONF:SCAn:CJC ON;:CONF:SCAn:CJC?
< 1

> :CONF:SCAn:CJC 1;:CONF:SCAn:CJC?
< 1

> :CONF:SCAn:CJC 34;:CONF:SCAn:CJC?
< 1
```

See Also **CONFigure?**, described on page 113

CONFigure:SCAn:LISt, described on page 120

CONFigure:SCAn:CJC, described on page 118

Scan List Configuration

Description Enables a list of channels to scan on the instrument.

Syntax `:CONFigure:SCAn:LISt [channel_list]`

Required Parameters None

Optional Parameters

Name: channel_list

Data Format: <0+NR1>

Description: Specifies the channels to enable for scanning. The number of channels that you can enable for scanning depends on the configuration of your instrument.

To determine the list of all analog input channels that are supported on your instrument, use the **SYSTem:CHANnel?** command, described on page 92.

Description (cont.): You can also read the value of the digital input port through the analog input data stream by specifying the digital input channel in the channel list. The number of the digital input channel depends on the configuration of your instrument:

Standard TEMPpoint, VOLTpoint, and MEASURpoint instruments (DT8871, DT8871U, DT8872, DT8873, DT8874):

Total # of A/D channels	Channel # for DIN port
0 - 7	8
0 - 15	16
0 - 23	24
0 - 31	32
0 - 39	40
0 - 47	48

If the *channel_list* parameter is omitted, all channels are disabled by default.

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

A Command Error is generated if the specified channel list includes a channel number less than 0 or greater than the maximum number of supported channels. If bit 5 (CME) of the Standard Event Status Enable register is enabled, a Command Error sets bit 5 (CME) of the Standard Event Status register.

An Execution Error is generated if the instrument is scanning, that is an **INITiate** command was issued and was not aborted, prior to issuing this command. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

Refer to *1999 SCPI Syntax & Style*, section 8.3.2, for more information.

Example This example enables channels 0, 4, 5, and 7 and then returns the list of enabled channels; note that while this command tries to enable channel 5 twice, it is enabled only once:

```
> :CONF:SCAn:LISt (@5,4,7,0,5)
> :CONF:SCAn:LISt?
< (@0,4:5,7)
```

Example (cont.) This example disables all channels; the list of enabled channels is empty:

```
> :CONF:SCAn:LISt
> :CONF:SCAn:LISt?
< (@)
```

This command enables channels 0, 4, 5, and 7 and returns the list of enabled channels:

```
> :CONF:SCAn:LISt (@5,4,7,0)
> :CONF:SCAn:LISt?
< (@0,4:5,7)
```

This command enables channels 0, 4, 5, 6, and 7 and returns the list of enabled channels:

```
> :CONF:SCAn:LISt (@5,4,7,6,0)
> :CONF:SCAn:LISt?
< (@0,4:7)
```

See Also **CONFigure?**, described on page 113

CONFigure:SCAn:LISt?, described next

Scan List Query

Description Returns the list of channels that are enabled for scanning on the instrument.

Syntax `:CONFigure:SCAn:LISt?`

Parameters None

Response Data `<channel_list>`

Name: channel_list

Data Format: <0+NR1>

Description: The list of channels that are enabled for scanning.

The number of channels that can be enabled for scanning depends on the configuration of your instrument.

To determine the list of all analog input channels that are supported on your instrument, use the **SYSTem:CHANnel?** command, described on page 92.

Use the **SYSTem:CHANnel:TC?** command, described on page 94, to determine which analog input channels on your instrument support thermocouples; if a channel supports thermocouples, you can configure it for temperature or voltage measurements.

Description (cont.): Use the **SYSTem:CHANnel:RTD?** command, described on page 93, to determine which analog input channels on your instrument support RTDs; if a channel supports RTDs, you can configure it for temperature, voltage, or resistance measurements.

If no channels are enabled, an empty list (@) is returned.

Example The following example enables channels 0, 4, 5, and 7 and then returns the list of enabled channels; note that while this command tries to enable channel 5 twice, it is enabled only once:

```
> :CONF:SCAn:LISt (@5,4,7,0,5)
> :CONF:SCAn:LISt?
< (@0,4:5,7)
```

This example disables all channels; the list of enabled channels is empty:

```
> :CONF:SCAn:LISt;:CONF:SCAN:LISt?
< (@)
```

This example enables channels 0, 4, 5, and 7 and then returns the list of enabled channels:

```
> :CONF:SCAn:LISt (@5,4,7,0)
> :CONF:SCAn:LISt?
< (@0,4:5,7)
```

This example enables channels 0, 4, 5, 6, and 7 and then returns the list of enabled channels:

```
> :CONF:SCAn:LISt (@5,4,7,6,0)
> :CONF:SCAn:LISt?
< (@0,4:7)
```

See Also **CONFigure?**, described on page 113

CONFigure:SCAn:LISt, described on page 120

Scan Rate Configuration

Description Configures either the time period of each scan, in the number of seconds per scan, or the scan frequency, in Hertz.

Syntax

```
:CONFigure:SCAn:RATe[:SEC|HZ] <DECIMAL NUMERIC
   PROGRAM DATA>
```

Optional Keywords

Name: SEC|HZ

Data Format: <CHARACTER PROGRAM DATA>

Description: Optional enumerated type that specifies whether to return the maximum scan rate in seconds (*SEC*) or the maximum scan frequency, in Hertz (*HZ*).

If this keyword is omitted, *SEC* is used by default.

Required Parameters

Name: <DECIMAL NUMERIC PROGRAM DATA>

Data Format: <0+Numeric>

Description: If *SEC* is specified or if neither *SEC* nor *HZ* is specified for the *SEC|HZ* keyword, enter a floating-point value (greater than 0) for the time period of each scan, in seconds. These values range from 0.1 s to 6553.5 s.

If *HZ* is specified for the *SEC|HZ* keyword, enter a floating-point value (greater than 0) for the scan frequency in Hertz. These values range from 0.000152590219 Hz to 10.0 Hz.

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

The scan rate that you specify is rounded to the closest "correct" value that the instrument can accept without error.

Internally, the 10 Hz clock is divided by an integer in the range of 1 to 65535 (the clock divider) to determine the closest value. You can query this setting after programming it to determine the actual scan rate that is used.

An Execution Error is generated if the instrument is scanning, that is an **INITiate** command was issued and was not aborted, prior to issuing this command. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

Refer to *1999 SCPI Data Interchange Format*, section 3.4.2, for more information.

Example The following command tries to set the scan frequency to 3 Hz, but the actual scan frequency is set to 3.3 Hz, which corresponds to a scan rate of 0.3 s:

```
> :CONF:SCAn:RATe:HZ 3
> :CONF:SCAn:RATe:HZ?
< 3.333333
> :CONF:SCAN:RATe?
< 0.300000
```

Example (cont.) The following command sets the scan frequency to 2 Hz, which corresponds to a scan rate of 0.5 s; the actual scan frequency is set to the same value, since 2 is an exact divisor of 10.0 Hz:

```
> :CONF:SCAn:RATe 0.5
> :CONF:SCAn:RATe:HZ?
< 2.000000
> :CONF:SCAN:RATe?
< 0.500000
```

In this example, an invalid scan frequency is specified, and an Execution Error occurs. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register. This, in turn, sets bits 2 and 5 of the Status Byte register:

```
> :CONF:SCAn:RATe:HZ 200
> *STB?
< 36
> *ESR?
< 16
> *STB?
< 4
> :SYST:ERR?
< -222,"Data out of range; CONF:SCAn:RATe"
> *STB?
< 0
```

See Also **SYSTem:SCAn:RATe:MIN?**, described on page 98

SYSTem:SCAn:RATe:MAX?, described on page 97

CONFigure?, described on page 113

CONFigure:SCAn:RATe?, described next

Scan Rate Query

Description Returns either the time period of each scan, in the number of seconds per scan, or the scan frequency, in Hertz.

Syntax `:CONFigure:SCAn:RATe[:SEC|HZ]?`

Optional Keywords

Name: SEC|HZ

Data Format: <CHARACTER PROGRAM DATA>

Description: Optional enumerated type that specifies whether to return the maximum scan rate in seconds (*SEC*) or the maximum scan frequency, in Hertz (*HZ*).

If this keyword is omitted, *SEC* is used by default.

Parameters None

Response Data `<DECIMAL NUMERIC PROGRAM DATA>`

Name: <DECIMAL NUMERIC PROGRAM DATA>

Data Format: <0+Numeric>

Description: If you specified *SEC* or omitted the *SEC|HZ* keyword in the command, returns a floating-point value that represents the time period of each scan, in seconds. These values range from 0.1 s to 6553.5 s.

If you specified the *HZ* keyword in the command, returns a floating-point value that represents the scan frequency, in Hertz. These values range from 0.000152590219 Hz to 10.0 Hz.

Example The following command tries to set the scan frequency to 3 Hz, but the actual scan frequency is set to 3.3 Hz, which corresponds to a scan rate of 0.3 s:

```
> :CONF:SCAn:RATe:HZ 3
> :CONF:SCAn:RATe:HZ?
< 3.333333
> :CONF:SCAN:RATe?
< 0.300000
```

The following command sets the scan frequency to 2 Hz, which corresponds to a scan rate of 0.5 s; the actual scan frequency is set to the same value, since 2 is an exact divisor of 10.0 Hz:

```
> :CONF:SCAn:RATe 0.5
> :CONF:SCAn:RATe:HZ?
< 2.000000
> :CONF:SCAN:RATe?
< 0.500000
```

In this example, an invalid scan frequency is specified and an Execution Error occurs. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register. This, in turn, sets bits 2 and 5 of the Status Byte register:

```
> :CONF:SCAn:RATe:HZ 200
> *STB?
< 36
> *ESR?
< 16
> *STB?
< 4
> :SYST:ERR?
< -222,"Data out of range; CONF:SCAn:RATe"
> *STB?
< 0
```

See Also **CONFigure?**, described on page 113

CONFigure:SCAn:RATe, described on page 123

SYSTem:SCAn:RATe:MIN?, described on page 98

SYSTem:SCAn:RATe:MAX?, described on page 97

Trigger Source Configuration

Description Configures the trigger source used to start the analog input operation once the **INITiate** command, described on page 140, is executed.

Syntax

```
:CONFigure:TRIGger[:SOURce]
   {IMMediate|DIN0|DEFault}
```

Required Parameters

Name: {IMMediate | DIN0 | DEFault}

Data Format: <CHARACTER PROGRAM DATA>

Description: Specifies one of the following trigger sources:

- **IMMediate** – Specifies a software trigger. When the **INITiate** command is executed, acquisition starts immediately.
- **DIN0** – Specifies an external, digital trigger on digital input line 0. When the **INITiate** command is executed, acquisition does not start until the instrument detects a 3 to 28 V DC signal on digital input line 0.

  Initially, the external signal must be low and then go high for at least 100 ms to be detected as a trigger. Once triggered, the state of digital input 0 is ignored.

If DEFault is specified, the IMMediate (software) trigger is used by default.

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

To terminate an operation that was started with **INITiate**, regardless of whether the trigger occurred or not, use the **ABORt** command, described on page 143.

Response Data None

Example The following command sets the trigger source to the external, digital trigger:

```
> :CONF:TRIG DIN0
```

See Also **CONFigure:TRIGger[:SOURce]?**, described next

Trigger Source Query

Description Returns the currently configured trigger source for the instrument.

Syntax `:CONFigure:TRIGger[:SOURce]?`

Parameters None

Response Data `{IMMediate|DIN0}`

Name: {IMMediate|DIN0}

Data Format: <CHARACTER RESPONSE DATA>

Description: Returns one of the following trigger sources:

- **IMMediate** – A software trigger is configured. When the **INITiate** command is executed, acquisition starts immediately.
- **DIN0** – Specifies an external, digital trigger on digital input line 0. When the **INITiate** command is executed, acquisition does not start until the instrument detects a 3 to 28 V DC signal on digital input line 0.

  Initially, the external signal must be low and then go high for at least 100 ms to be detected as a trigger. Once triggered, the state of digital input 0 is ignored.

Example The following returns the currently configured trigger source of the instrument; in this case, an external digital trigger is configured:

```
> :CONF:TRIG?
< DIN0
```

See Also **CONFigure:TRIGger[:SOURce]**, described on page 127

MEASure Subsystem Commands

The MEASure subsystem includes the commands listed in Table 10. Use these commands to perform a single-value analog input operation on a TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument. This section describes each of these command in detail.

Table 10: MEASure Subsystem Commands

Type	Mnemonic	See
Read Single Resistance Values	MEASure:RESistance?	page 130
Read Single RTD Temperature Values	MEASure:TEMPerature:RTD?	page 134
Read Single Thermocouple Temperature Values	MEASure:TEMPerature:TCouple?	page 134
Read Single Voltage Values	MEASure:VOLTage?	page 137

Measure Single Resistance Values

Description

For channels that support RTDs, configures specified channels for resistance measurements, and then returns resistance values, in ohms, from the specified channels. All analog input channels are read simultaneously.

If you need to read time-stamped, sequenced samples, **FETCh?**, described on page 145, instead.

Syntax

```
:MEASure:RESistance? [channel_list]
```

Required Parameters

None

Optional Parameters

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: Optional parameter that specifies the analog input channels to configure for resistance measurements and to read.

The number of supported channels depends on the configuration of your instrument. To determine the list of all analog input channels that are supported on your instrument, use the **SYSTem:CHANnel?** command, described on page 92.

Use the **SYSTem:CHANnel:RTD?** command, described on page 93, to determine which analog input channels on your instrument support RTDs; if a channel supports RTDs, you can configure it for temperature, voltage, or resistance measurements.

If this parameter is omitted, all channels are configured for resistance measurements and read.

Response Data

```
<resistance_values>
```

Name: resistance_values

Data Format: <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>

Description: Data block of up to 48 single-precision, floating-point values, where each value (in ohms) corresponds to a channel in the *channel list*.

Notes

This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

The filter that was configured with **CONFigure:FILTer**, described on page 115, is applied to the measurement values.

A Command Error is generated if the channel list includes a channel number less than 0 or greater than the maximum number of supported channels. If bit 5 (CME) of the Standard Event Status Enable register is enabled, a Command Error sets bit 5 (CME) of the Standard Event Status register.

Notes (cont.)

An Execution Error is generated if the instrument is scanning, that is an **INITiate** command was issued and was not aborted, prior to issuing this command. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

For more information on measurements, see *1999 SCPI Command Reference*, section 3.1 and 3.4. For more information on <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>, see *IEEE Std 488.2-1992*, section 8.7.9.

Example

The following example configures analog input channels 0 for a resistance measurement and reads the resistance value from this channel:

```
> :MEAS:RES? (@0)
< 2331344488fe4f0a
```

where:

- 23 = '#' denotes the start of the block response
- 31 = '1' is the length of the decimal number for the block length
- 34 = '4' is the block length (that is 4-bytes per channel)
- 4488fe4f = 1095.947 ohms; this is the resistance measurement value from channel 0
- 0a = carriage return; this is the standard ASCII terminator

See Also

CONFigure:FILTer, described on page 115

CONFigure?, described on page 113

CONFigure:RESistance, described on page 103

SYSTem:CHANnel:RTD?, described on page 93

INITiate, described on page 140

Measure Single RTD Temperature Values

Description

Configures specified channels for RTD measurements and returns temperature values, in degrees Celsius, from the specified channels. All analog input channels are read simultaneously.

If you need to read time-stamped, sequenced samples, use **FETCh?**, described on page 145, instead.

Syntax

```
:MEASure:TEMPerature:RTD?
   {PT100|PT500|PT1000|A_PT100|A_PT500|A_PT1000|
   PT100_3|PT500_3|PT1000_3|A_PT100_3|A_PT500_3|
   A_PT1000_3|DEFault} [, <channel_list>]
```

Required Parameters

Name: {PT100 | PT500 | PT1000 | A_PT100 | A_PT500 | A_PT1000 | PT100_3 | PT500_3 | PT1000_3 | A_PT100_3 | A_PT500_3 | A_PT1000_3 | DEFault}

Data Format: <CHARACTER PROGRAM DATA>

Description: Enumerated type that specifies one of the following RTD types: PT100, PT500, or PT1000 for 2- or 4- wire European RTDs, A_PT100, A_PT500, or A_PT1000 for 2- or 4-wire American RTDs, PT100_3, PT500_3, or PT1000_3 for 3-wire European RTDs, or A_PT100_3, A_PT500_3, or A_PT1000_3 for 3-wire American RTDs.

If DEFault is specified, the PT100 RTD type is used by default.

Optional Parameters

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: Optional parameter that specifies the analog input channels to configure and read for RTD temperature measurements.

The number of supported channels depends on the configuration of your instrument.

To determine the list of all analog input channels that are supported on the instrument, use the **SYSTem:CHANnel?** command, described on page 92.

Use the **SYSTem:CHANnel:RTD?** command, described on page 93, to determine which analog input channels on the instrument support RTDs; if a channel supports RTDs, you can configure it for temperature, voltage, or resistance measurements.

If this parameter is omitted, all channels are configured for RTD temperature measurements and read. If a channel does not support thermocouples, error –221, "Settings conflict" is generated.

Response Data `<temperature_values>`

Name: temperature_values

Data Format: <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>

Description: Data block of up to 48 single-precision, floating-point values, where each value (in degrees Celsius) corresponds to a channel in the *channel list*.

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

The filter that was configured with **CONFigure:FILTer**, described on page 115, is applied to the measurement values.

A Command Error is generated if one of the following conditions occurs:

- A sensor type is specified and it is either RTD for thermocouple measurement instruments or TCouple for a RTD measurement instruments
- A transducer type is specified and it is not one of the enumerated types
- The channel list includes a channel number less than 0 or greater than 47

If bit 5 (CME) of the Standard Event Status Enable register is enabled, a Command Error sets bit 5 (CME) of the Standard Event Status register.

An Execution Error is generated if one of these conditions occurs:

- The instrument is scanning, that is an **INITiate** command was issued and was not aborted prior to issuing this command.
- One of the following RTD types was specified for a thermocouple measurement instrument: PT100, PT500, PT1000, A_PT100, A_PT500, A_PT1000, PT100_3, PT500_3, PT1000_3, A_PT100_3, A_PT500_3, or A_PT1000_3.
- One of the following thermocouple types was specified for an RTD measurement instrument: J, K, B, E, N, R, S, or T.

If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

For more information on measurements, see *1999 SCPI Command Reference*, section 3.1 and 3.4. For more information on <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>, see *IEEE Std 488.2-1992*, section 8.7.9.

Example

The following example configures analog input channels 0, 1, 7 for the default sensor and transducer type for the instrument and then reads the temperature from these channels:

```
> :MEAS:TEMP:RTD? DEF,(@0,1,7)
< 23323132c7ad9c0041bd99b647c34f800a
```

where:

- 23 = '#' denotes the start of the block response
- 32 = '2' is the length of the decimal number for the block length
- 3132 = '12' is the block length (that is 4-bytes per channel times 3)
- c7ad9c00 = –88888° C; this is the measurement value from channel 0, indicating that the value is too low and out of range
- 41bd99b6 = 27.7° C; this is the measurement value from channel 1
- 47c34f80 = 99999° C; this is the measurement value from channel 7
- 0a = carriage return; this is the standard ASCII terminator

See Also

CONFigure:FILTer, described on page 115

CONFigure?, described on page 113

CONFigure:TEMPerature:RTD, described on page 104

INITiate, described on page 140

Measure Single Thermocouple Temperature Values

Description

Configures specified channels for thermocouple measurements and returns temperature values, in degrees Celsius, from the specified channels. All analog input channels are read simultaneously.

If you need to read time-stamped, sequenced samples, use **FETCh?**, described on page 145, instead.

Syntax

```
:MEASure:TEMPerature:TCouple?
   {J,|K|B|E|N|R|S|T|DEFault}
   [, <channel_list>]
```

Required Parameters

Name: {J | K | B | E | N | R | S | T | DEFault}

Data Format: <CHARACTER PROGRAM DATA>

Description: Enumerated type that specifies one of the following thermocouple types: J, K, B, E, N, R, S, T.

If DEFault is specified, the J thermocouple type is used by default.

Optional Parameters

Name: channel_list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: Optional parameter that specifies the analog input channels to configure and read for thermocouple temperature measurements.

The number of supported channels depends on the configuration of the instrument.

To determine the list of all analog input channels that are supported on the instrument, use the **SYSTem:CHANnel?** command, described on page 92.

Use the **SYSTem:CHANnel:TCouple?** command, described on page 94, to determine which analog input channels on the instrument support thermocouples; if a channel supports thermocouples, you can configure it for temperature or voltage measurements.

If this parameter is omitted, all channels are configured for temperature measurements and read. If a channel does not support thermocouples, error –221, "Settings conflict" is generated.

Response Data

`<temperature_values>`

Name: temperature_values

Data Format: <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>

Description: Data block of up to 48 single-precision, floating-point values, where each value (in degrees Celsius) corresponds to a channel in the *channel list*.

Notes

This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

The filter that was configured with **CONFigure:FILTer**, described on page 115, is applied to the measurement values.

A Command Error is generated if one of the following conditions occurs:

- A sensor type is specified and it is either RTD for thermocouple measurement instruments or TCouple for a RTD measurement instruments
- A transducer type is specified and it is not one of the enumerated types
- The channel list includes a channel number less than 0 or greater than 47

If bit 5 (CME) of the Standard Event Status Enable register is enabled, a Command Error sets bit 5 (CME) of the Standard Event Status register.

Notes (cont.)

An Execution Error is generated if one of these conditions occurs:

- The instrument is scanning, that is an **INITiate** command was issued and was not aborted prior to issuing this command.
- One of the following RTD types was specified for a thermocouple measurement instrument: PT100, PT500, PT1000, A_PT100, A_PT500, A_PT1000, PT100_3, PT500_3, PT1000_3, A_PT100_3, A_PT500_3, or A_PT1000_3.O
- One of the following thermocouple types was specified for an RTD measurement instrument: J, K, B, E, N, R, S, or T.

If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

For more information on measurements, see *1999 SCPI Command Reference*, section 3.1 and 3.4. For more information on <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>, see *IEEE Std 488.2-1992*, section 8.7.9.

Example

The following example configures analog input channels 0, 1, 7 for the default sensor and transducer type for the instrument and then reads the temperature from these channels:

```
> :MEAS:TEMP:TC? DEF,(@0,1,7)
< 23323132c7ad9c0041bd99b647c34f800a
```

where:

- 23 = ’#’ denotes the start of the block response
- 32 = ’2’ is the length of the decimal number for the block length
- 3132 = ’12’ is the block length (that is 4-bytes per channel times 3)
- c7ad9c00 = –88888° C; this is the measurement value from channel 0, indicating that the value is too low and out of range
- 41bd99b6 = 27.7° C; this is the measurement value from channel 1
- 47c34f80 = 99999° C; this is the measurement value from channel 7, indicating that an open thermocouple exists on that channel
- 0a = carriage return; this is the standard ASCII terminator

See Also

CONFigure:FILTer, described on page 115

CONFigure?, described on page 113

CONFigure:TEMPerature:TCouple, described on page 106

INITiate, described on page 140

Measure Single Voltage Values

Description

Configures specified channels for voltage measurements, and then returns voltage values from the specified channels. All analog input channels are read simultaneously.

If you need to read time-stamped, sequenced samples, use **FETCh?**, described on page 145, instead.

Syntax

```
:MEASure:VOLTage? [channel_list]
```

Required Parameters

None

Optional Parameters

Name: channel list

Data Format: <0+NR1><CHARACTER PROGRAM DATA>

Description: Optional parameter that specifies the analog input channels to configure for voltage measurements and to read.

The number of supported channels depends on the configuration of the instrument. To determine the list of all analog input channels that are supported on the instrument, use the **SYSTem:CHANnel?** command, described on page 92.

Use the **SYSTem:CHANnel:TC?** command, described on page 94, to determine which analog input channels on the instrument support thermocouples; if a channel supports thermocouples, you can configure it for temperature or voltage measurements.

Use the **SYSTem:CHANnel:RTD?** command, described on page 93, to determine which analog input channels on your instrument support RTDs; if a channel supports RTDs, you can configure it for temperature, voltage, or resistance measurements.

If this parameter is omitted, all channels are configured for voltage measurements and read.

Response Data

```
<voltage_values>
```

Name: voltage_values

Data Format: <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>

Description: Data block of up to 48 single-precision, floating-point values, where each value corresponds to a channel in the *channel list*.

Notes

This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

For channels that support programmable input range, the voltage ranges that were configured with **CONFigure:VOLTage:RANGe**, described on page 111, is applied to the measurement values.

The filter that was configured with **CONFigure:FILTer**, described on page 115, is also applied to the measurement values.

A Command Error is generated if the channel list includes a channel number less than 0 or greater than the maximum number of channels. If bit 5 (CME) of the Standard Event Status Enable register is enabled, Command Error sets bit 5 (CME) of the Standard Event Status register.

An Execution Error is generated if the instrument is scanning, that is an **INITiate** command was issued and was not aborted, prior to issuing this command. If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

A summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

For more information on measurements, see *1999 SCPI Command Reference*, section 3.1 and 3.4. For more information on <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>, see *IEEE Std 488.2-1992*, section 8.7.9.

Example

The following example configures analog input channels 0, 1, 7 for voltage measurements and then reads the values from these channels:

```
> :MEAS:VOLT? (@0,1,7)
< 233231323f0f8aec3edefa51bf2844b80a
```

where:

- 23 = '#' denotes the start of the block response
- 32 = '2' is the length of the decimal number for the block length
- 3132 = '12' is the block length (that is 4-bytes per channel times 3)
- 3f0f8aec = 0.56071 V; this is the measurement value from channel 0
- 3edefa51 = 0.43550 V; this is the measurement value from channel 1

Example (cont.)

- bf2844b8 = –0.65729 V; this is the measurement value from channel 7
- 0a = carriage return; this is the standard ASCII terminator

See Also

CONFigure:FILTer, described on page 115

CONFigure?, described on page 113

CONFigure:VOLTage, described on page 109

INITiate, described on page 140

SYSTem:CHANnel?, described on page 92

SYSTem:CHANnel:TCouple?, described on page 94

SYSTem:CHANnel:RTD?, described on page 93

INITiate Subsystem Command

The INITiate subsystem includes the INITiate Scan command, described below, that starts a timed scan on the TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument.

INITiate Scan

Description Initiates a continuous scan operation on a instrument using the configured channels, scan list, scan rate, and trigger source.

Acquisition starts when the configured trigger source is detected.

Syntax `:INITiate`

Parameters None

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

For information on configuring channels for voltage, refer to page 109. For information on configuring channels for resistance, refer to page 103. For information on configuring channels for RTD temperatures, refer to page 104. For information on configuring channels for thermocouple temperature measurements, refer to page 106.

For information on configuring the scan list, refer to page 120 and page 118. For information on configuring the scan rate, refer to page 123.

For information on specifying the trigger source, refer to page 127.

This command does not affect the **MEASure:RESistance?** query (described on page 130), **MEASure:TEMPerature:RTD?** query (described on page 131), **MEASure:TEMPerature:TCouple?** query (described on page 134), or **MEASure:VOLTage?** query (described on page 137).

To terminate an operation that was started with **INITiate**, regardless of whether the specified trigger occurred or not, use the **ABORt** command, described on page 143.

An Execution Error is generated by this command if one of the following conditions occurs:

- The instrument is already scanning
- No channels are enabled for scanning in the channel list
- The scan rate is invalid

If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

Notes (cont.)

To determine if an Execution Error occurred, query bit 4 of the Standard Event Status register using the ***ESR?** command, described on page 57.

Use the **STATus:OPERation?** command to query bits 4 and 5 of the Operation Status register to determine whether a scan is in progress or the instrument is waiting for a trigger. Refer to page 71 for information on the **STATus:OPERation?** command.

To read measurements, use the **FETCh?** command, described on page 145.

Example

The following example configures the instrument to scan channels 0 to 5 at approximately 2 Hz when an external digital trigger is detected, and queries the Operation Status register to verify that a scan operation is not in process:

```
> :CONF:SCA:LIS?
< (@)
>:CONF:SCA:LIS (@0:5)
>:CONF:TRIG IMM
> :CONF:SCA:RAT:HZ 2
> :CONF:SCA:RAT:HZ?
< 1.875000
> :STAT:OPER:COND?
< 0
```

The scan is then initiated, and bit 7 of the Status Byte register and the Operation Status register are queried to determine the status of the scan and whether the instrument has detected the trigger:

```
> :INIT
> *STB?
< 128
> :STAT:OPER:COND?
< 48
```

In this case, the scan has started, and the instrument is waiting for the trigger. The next query confirms that the trigger occurred and the instrument is scanning:

```
> *STB?
< 128
> :STAT:OPER:COND?
< 16
```

The scan is then stopped and bit 7 of the Status Byte register and the Operation Status register are cleared:

```
> :ABOR
> :STAT:OPER:COND?
< 0
> *STB?
< 0
```

See Also

ABORt, described on page 143

STATus:OPERation:CONDition?, described on page 69

CONFigure:RESistance, described on page 103

CONFigure:TEMPerature:RTD, described on page 104

CONFigure:TEMPerature:TCouple, described on page 106

CONFigure:VOLTage, described on page 109

CONFigure:SCan:CJC, described on page 118

CONFigure:SCAn:LISt, described on page 120

CONFigure:SCAn:RATe, described on page 123

CONFigure:TRIGger[:SOURce], described on page 127

FETCh?, described on page 145

ABORt Subsystem Command

The ABORt subsystem includes the ABORt Scan command, described below, that stops a scan on the TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument, if it is in progress.

ABORt Scan

Description Stops a scan operation on the instrument, if it is in progress, regardless of whether the specified trigger occurred or not.

Syntax `:ABORt`

Parameters None

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

This command does not affect the **MEASure:RESistance?** query (described on page 130), **MEASure:TEMPerature:RTD?** query (described on page 131), **MEASure:TEMPerature:TCouple?** query (described on page 134), or **MEASure:VOLTage?** command (described on page 137).

Use the **STATus:OPERation?** command to query bits 4 and 5 of the Operation Status register to determine whether a scan is in progress or the instrument is waiting for a trigger. Refer to page 71 for information on the **STATus:OPERation?** command.

Example The following example configures the instrument to scan channels 0 to 5 at approximately 2 Hz when a software trigger is detected and queries the Operation Status register to verify that scans are stopped:

```
> :CONF:SCA:LIS?
< (@)
> :CONF:SCA:LIS (@0:5)
> :CONF:TRIG IMM
> :CONF:SCA:RAT:HZ 2
> :CONF:SCA:RAT:HZ?
< 1.875000
> :STAT:OPER:COND?
< 0
```

The scan is then started, and bit 7 of the Status Byte register the Operation Status register are queried to determine the status of the scan:

```
> :INIT
> *STB?
< 128
> :STAT:OPER:COND?
< 16
```

Example (cont.) The scan is then stopped and bit 7 of the Status Byte register and the Operation Status register are cleared:

```
> :ABOR
> :STAT:OPER:COND?
< 0
> *STB?
< 0
```

See Also **INITiate**, described on page 140

STATus:OPERation:CONDition?, described on page 69

FETCh Subsystem Command

The FETCh subsystem includes the **FETCh?** command, described next. Use this command to return scan records from the circular buffer on the instrument. Refer to page 44 for conceptual information, including examples, about using the **FETCh?** command.

FETCh Data

Description For scans that were started using the **INITiate** command, described on page 140, returns a number of time-stamped, sequenced measurements from the circular buffer on the instrument, in the form of scan records.

Syntax

```
:FETCh? <RequestedScansIndex>
   [, RequestedScansToRead]
```

Required Parameters

Name: RequestedScansIndex

Data Format: <0+NR1>

Description: Specifies the index of the scan record (the offset in the circular buffer) from which to retrieve data.

To read the first scan record in the circular buffer, specify 1 for *RequestedScansIndex*.

To request all of the data in the circular buffer (limited by the network packet size), set the *RequestedScansIndex* to 0 and omit the *RequestedScansToRead* parameter.

To read a sequence of measurements that chronologically follow the sequence of measurements from an earlier **FETCh?**, specify a *RequestedScansIndex* that is one greater than the number of the last scan record, returned by the previous **FETCh?** command, or that is one greater the *EndingIndex*, returned by the **STATus:SCAn?** command, described on page 74.

If only a subset of the scan records that you requested are available (either because the scan is not yet complete or the scan location in the circular buffer was overwritten with a later scan record), the instrument returns the scan records that exist between the starting index (*RequestedScansIndex*) and the ending index (*RequestedScansIndex+RequestedScansToRead)*.

For example, assume that you want to read 10 scan records starting at index 5, but the scan records at indices 5 through 8 have been overwritten. In this case, **FETCh? 5, 10** returns only scan records 9 through 15.

If no scan records exist between the starting index and the ending index, an empty SCAN_RECORD structure is returned.

Optional Parameters

Name: RequestedScansToRead

Data Format: <+NR1>

Description: An optional parameter that specifies the number of scans to retrieve from the circular buffer, starting with the index specified by *RequestedScansIndex*.

If this parameter is omitted, all scans currently in the circular buffer are returned (limited by the network packet size).

Response Data <SCAN_RECORD>

Name: SCAN_RECORD

Data Format: <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>

Description: Data block with a sequence of consecutive SCAN_RECORD structures (<SCAN_RECORD><SCAN_RECORD>... <SCAN_RECORD>), described on page 176. The scan records are chronologically ordered from the oldest to the most recent. The unit of measurement for each channel depends on its configuration (VOLTage is measured in volts, RESistance in ohms, and TEMPerature in degrees Celsius).

Notes A client can repeatedly issue a **FETCh?** request; however, be aware that the network traffic is high and that the client has to determine if there is any chronological overlap between responses.

Use the **STATus:SCAn?** command, described on page 74, to determine the starting index and the ending index of the available scan records in the circular buffer.

An Execution Error is generated if one of the following conditions occurs:

- There are no measurements in the instrument's circular buffer
- The *RequestedScansIndex* is invalid

If bit 4 (E) of the Standard Event Status Enable register is enabled, an Execution Error sets bit 4 (E) of the Standard Event Status register.

The summary of the Standard Event Status register is available in bit 5 (ESB) of the Status Byte register.

When an error is encountered, an error string is appended to the error queue, and bit 2 (EAV) of the Status Byte register is set.

For more information on measurements, see *1999 SCPI Command Reference*, section 3.1 and 3.4. For more information on <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA>, see *IEEE Std 488.2-1992*, section 8.7.9.

Example 1 The following example returns scan records, starting with index 0, on an instrument that has one channel (channel 0) enabled in the scan list; note that the comments are shown in blue:

```
> :FETC? 0
<
23 ASCII # char that starts the IEEE block
34 ASCII 4, meaning that the next 4 chars are the
   length of the IEEE block
32303430 ASCII character 2040, representing the
   length of the entire IEEE block
4a806d65 Scan record time stamp, in seconds
00000000 Scan record time stamp, in milliseconds
00000001 Scan record scan number (1)
00000001 Scan record number of values; 1 floating
   point value per scan
3a86c3ff Value of chan 0 in floating-point
   6.5565103e-4 (use
   http://babbage.cs.qc.edu/IEEE-754/32bit.html
   for help converting)
4a806d65 Time stamp of next record, in seconds
00000064 Time stamp, in milliseconds
00000002 Scan number (2)
00000001 Number of values (1)
3a9a4bff Value of chan 0

4a806d65 Timestamp of next record, in seconds
000000c8 Time stamp, in milliseconds
00000003 Scan number (3)
00000001 Number of values (1)
3ac543ff Value of chan 0
.
.
.
4a806d6c Timestamp of next record, in seconds
00000064 Time stamp, in milliseconds
00000048 Scan number (48)
00000001 Number of values (1)
3a5ea800 Value of chan 0
```

Example 2 This example returns two scan records (5 and 6) from an instrument that is scanning one channel:

```
> STATus:SCAn?
< 1,1083
> FETCh? 5, 2  (fetch records 5 and 6)
23 ASCII # char that starts the IEEE block
34 ASCII 4, meaning that the next 4 chars are the
   length of the IEEE block
30303430 ASCII character 0040, the length of the
   entire IEEE block (10 4-byte fields)
```

Example 2 (cont.)

```
4a807ad3 Time stamp, in seconds
00000190 Time stamp, in milliseconds
00000005 Scan number (5)
00000001 Number of values (1)
3984cfff Value of channel

4a807ad3 Time stamp of next record, in seconds
000001f4 Time stamp, in milliseconds
00000006 Scan number (6)
00000001 Number of values (1)
393b7fff Value of channel

0a Carriage Return. This is the standard SCPI
   Terminator.
```

See Also

CONFigure?, described on page 113

CONFigure:RESistance, described on page 103

CONFigure:TEMPerature:RTD, described on page 104

CONFigure:TEMPerature:TCouple, described on page 106

CONFigure:VOLTage, described on page 109

INITiate, described on page 140

STATus:SCAn?, described on page 74

Digital INPut Subsystem Command

The Digital INPut subsystem includes the Digital INPut Query State command, described below, that returns the value of the digital input port on the TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument.

Digital INPut Query State

Description Returns the current state of the digital input port on the instrument.

Syntax `:INPut[:STATe]?`

Parameters None

Response Data `<inputport>`

Name: inputport

Data Format: <0+NR1>

Description: The weighted bit value of the digital input port, where the value of bit 0 (digital input line 0) corresponds to a decimal value of 1 (2^0) if the bit is set, and the value of bit 7 (digital input line 7) corresponds to a decimal value of 128 (2^7) if the bit is set.

Values for *inputport* range from 0 to 255.

Notes Refer to the *1999 SCPI Data Exchange Format*, section 3.4.6.

Example

```
> :INP:STAT?
< 130
```

This response indicates that digital input lines 1 and 7 (bits 1 and 7) of the digital input port are set to 1, and all the other digital input lines are set to 0.

Digital OUTPut Subsystem Commands

The Digital OUTPut subsystem includes the commands listed in Table 11. Use these commands when updating the digital output port on the TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument. This section describes each of these commands in detail.

Table 11: Digital OUTPut Subsystem Commands

Name	Mnemonic	See
Digital OUTPut Set State	OUTPut[:STATe]	page 151
Digital OUTPut Query State	OUTput[:STATe]?	page 151

Digital OUTPut Query State

Description Returns the current state the digital output port on the instrument.

Syntax `:OUTPut[:STATe]?`

Parameters None

Response Data `<outputport>`

Name: outputport

Data Format: <0+NR1>

Description: The weighted bit value of the digital output port, where the value of bit 0 (digital output line 0) corresponds to a decimal value of 1 (2^0) if the bit is set, and the value of bit 7 (digital output line 7) corresponds to a decimal value of 128 (2^7) if the bit is set.

Values for *outputport* range from 0 to 255.

Notes Refer to the *1999 SCPI Data Exchange Format*, section 3.4.6.

Example

```
>:OUTP:STAT?
< 255
```

This response indicates that all the digital output lines of the digital output port are set to 1.

See Also **OUTPut**, described next

Digital OUTPut Set State

Description Sets the state the digital output port on the instrument.

Syntax `:OUTPut[:STATe] <value>`

Required Parameters

Name: value

Data Format: <0+NR1>

Description: The weighted bit value of the digital output port, where the value of bit 0 (digital output line 0) corresponds to a decimal value of 1 (2^0) if the bit is set, and the value of bit 7 (digital output line 7) corresponds to a decimal value of 128 (2^7) if the bit is set.

Values for *outputport* range from 0 to 255.

Response Data None

Notes This is a password-protected command. To enable this command to function, use the **SYSTem:PASSword[:CENable]** command, described on page 83.

Refer to the *1999 SCPI Data Exchange Format*, section 3.4.6, for more information on the data format.

Example

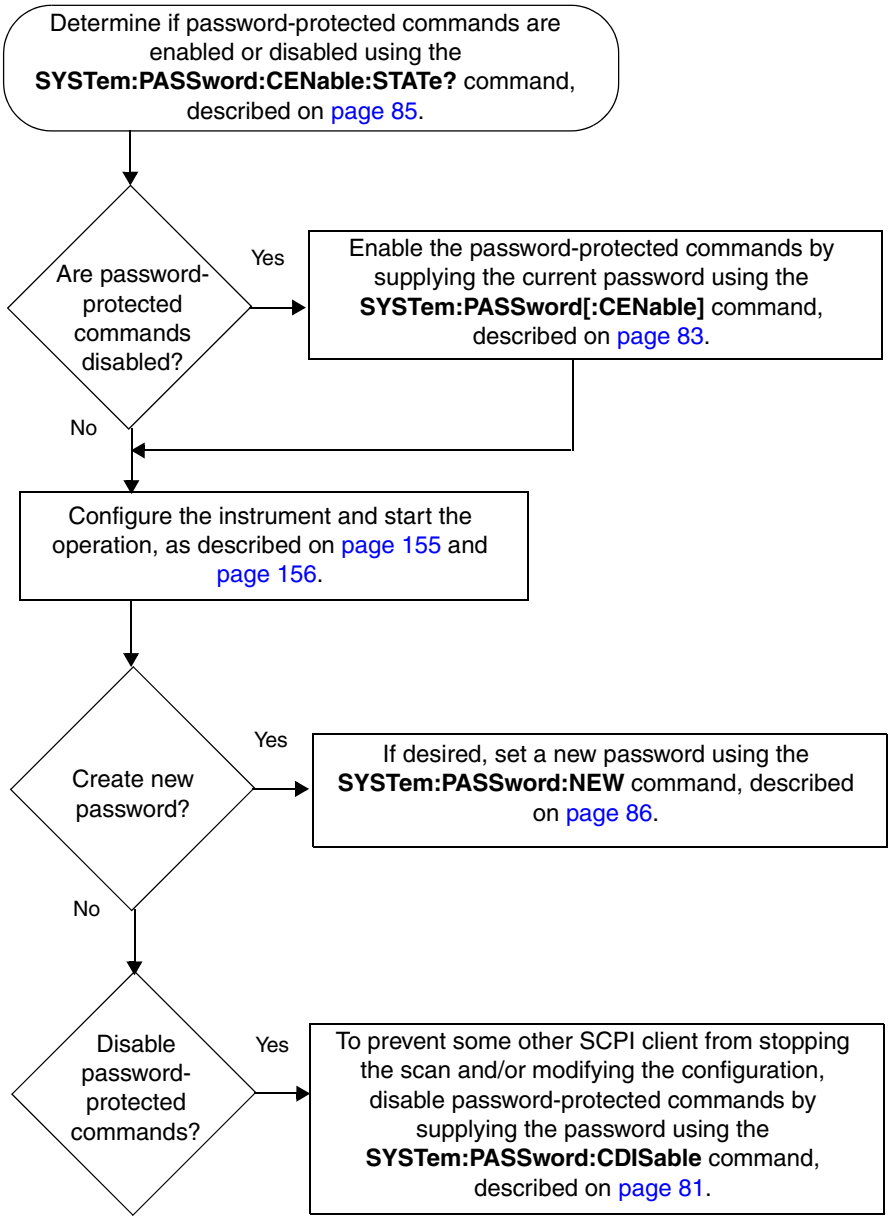
```
> :OUTP:STAT 129
```

This command sets digital output lines 0 and 7 (bits 0 and 7) to 1, and all the other digital output lines (bits) to 0.

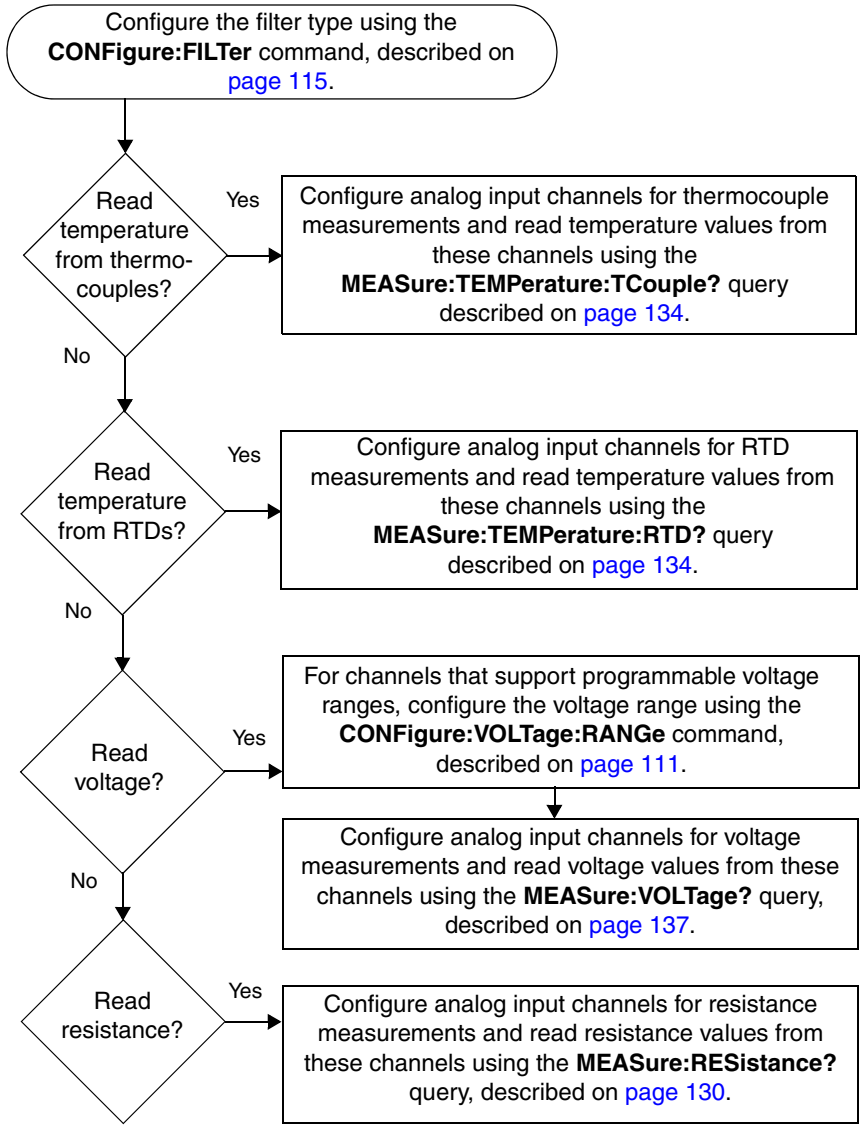
See Also **OUTPut?**, described on page 151

Programming Flowcharts

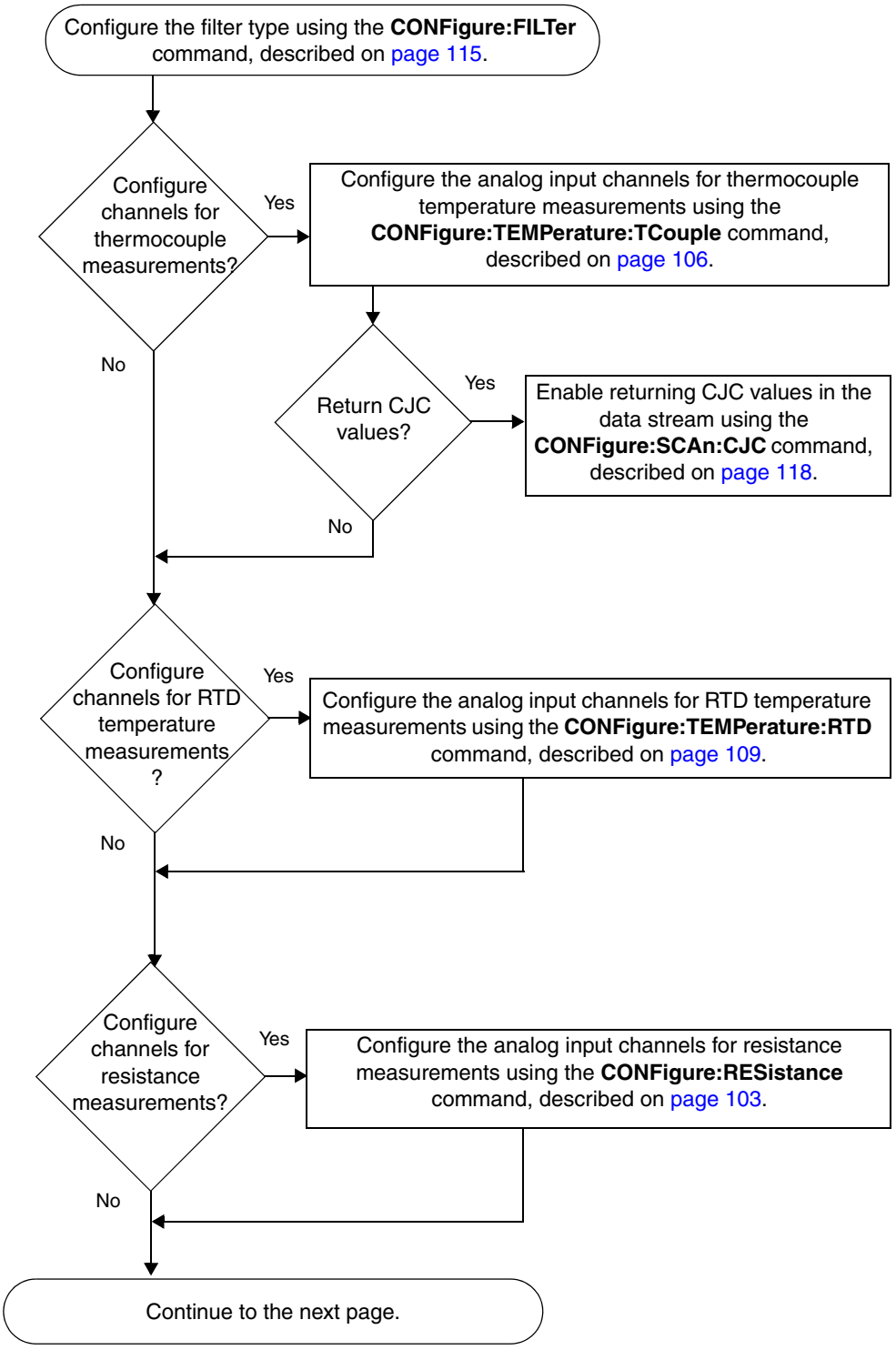
Using Password Protected Command



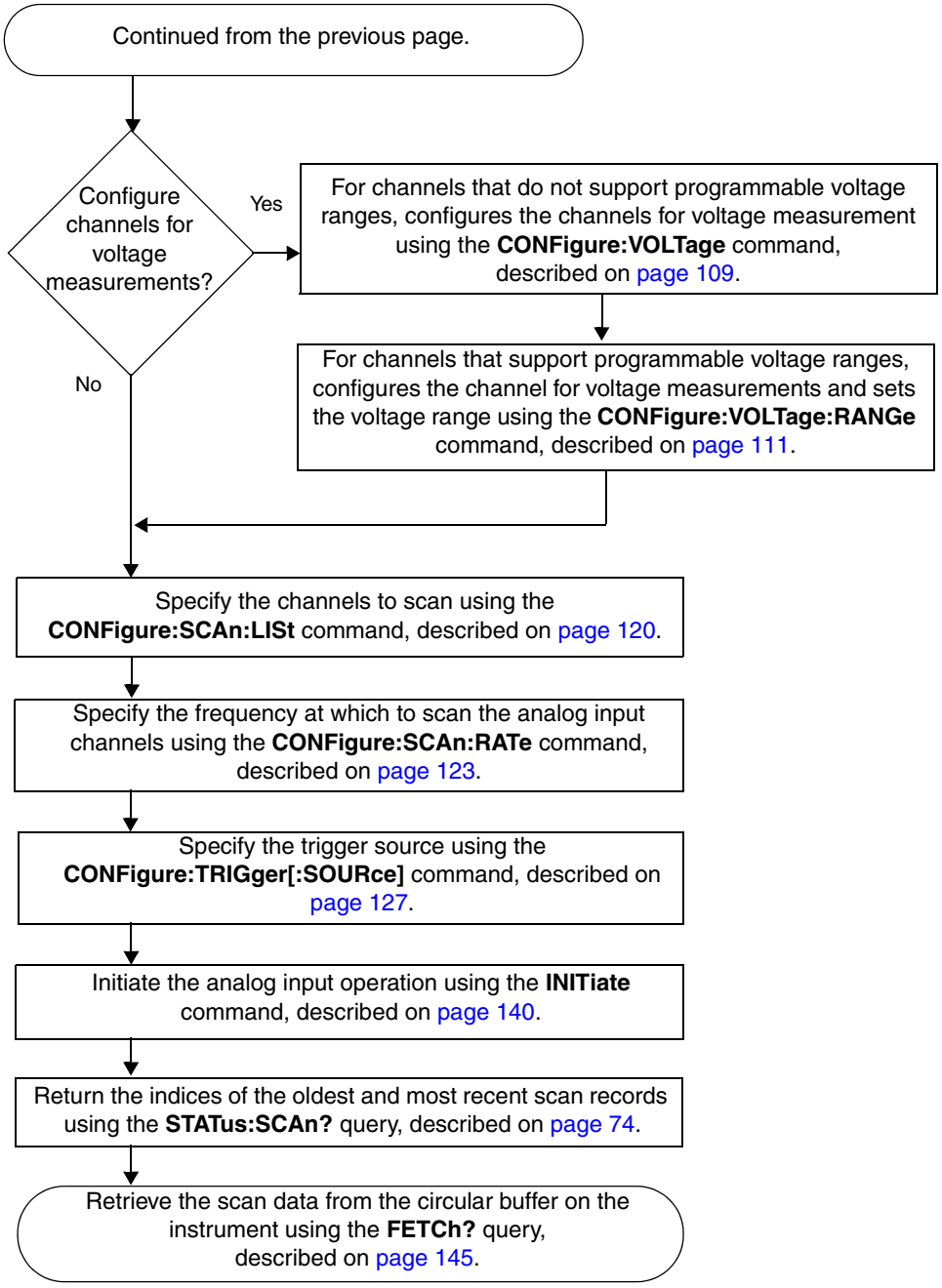
Analog Input - Single Value Operations



Analog Input - Continuous Scan Operations



Analog Input - Continuous Scan Operations (cont.)



Digital Input Operations

Read the state of the digital input port using the **INPut?** query, described on page 149.

Digital Output Operations

Set the state of the digital output port using the **OUTPut** command, described on page 151.

Product Support

Should you experience problems using SCPI to program a TEMPpoint, VOLTpoint, or MEASURpoint LXI instrument, follow these steps:

1. Read all the documentation provided for your product, including any "Read This First" information.
2. Install the latest software from the web at **https://www.mccdaq.com/downloads/DTSoftware/MEASURpoint**.
3. Check that you have installed your hardware devices properly. For information, refer to the documentation supplied with your devices.
4. Check that you have installed the device drivers for your hardware devices properly. For information, refer to the documentation supplied with your devices.

If you are still having problems, Data Translation's Technical Support Department is available to provide technical assistance. To request technical support, go to our web site at **www.mccdaq.com/Support.aspx**.

When requesting technical support, be prepared to provide the following information:

- Your product serial number
- The hardware/software product you need help on
- The version of software that you are using
- Your contract number, if applicable

If you are located outside the USA, contact your local distributor; see our web site (www.mccdaq.com/International) for the name and telephone number of your nearest distributor.

Errors

Error Codes

Errors are returned in your program as follows:

```
–110,"Command header error"
```

The number represents the error code and the string that follows represents the error description. Note that there is no space between the comma after error code and the quotation mark before the error description.

Table 12 lists the error codes that TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments can return.

Table 12: SCPI Error Codes Returned by TEMPpoint, VOLTpoint, and MEASURpoint LXI Instruments

Error Code	Error Message	Description
0	No error	Normal operation; no error occurred.
–100	Command error	A command is missing a parameter, or the command contains too many parameters or too many dimensions.
–102	Syntax error	An unrecognized command or data type was encountered; for example, a string was received when the instrument does not accept strings.
–104	Data type error	A data element different than the one allowed was encountered; for example, numeric data was expected but string data was encountered.
–110	Command header error	The command header is invalid. See page 166 for information on troubleshooting this error.
–115	Unexpected number of parameters	The number of parameters received does not correspond to the number of parameters that were expected.
–120	Numeric data error	The value of a parameter overflowed, has the wrong dimensions, or contains an invalid value.
–131	Invalid suffix	The suffix does not follow the syntax described in IEEE 488.2, 7.7.3.2, or the suffix is inappropriate for this instrument.
–200	Execution error	A <PROGRAM DATA> element following a header was evaluated by the instrument as outside of its legal input range or is otherwise inconsistent with the instrument's capabilities. A valid program message could not be executed properly due to some condition of the instrument.
–203	Command protected	This is a password-protected command. Password protection is currently disabled. To use this command, you must enable password protection using the **SYSTem:PASSword[:CENable]** command, described on page 83.

Table 12: SCPI Error Codes Returned by TEMPpoint, VOLTpoint, and MEASURpoint LXI Instruments (cont.)

Error Code	Error Message	Description
–221	Settings conflict	The specified channels of the instrument do not support the requested operation, or an invalid current password was entered. For example, this error is returned if you try to configure a thermocouple type for channels that do not support temperature, or try to configure a voltage range that is not supported by a channel.
–222	Data out of range	A legal program data element was parsed but could not be executed because the interpreted value was outside the legal range for the instrument.
–284	Program currently running	Certain operations dealing with programs are illegal while the program is running; for example, you cannot configure/reconfigure an operation while a scan is in progress.
–350	Queue overflow	The error queue is full; subsequent errors can not be added to the queue. Use the ***CLS** command, described on page 56, to clear the error queue as well as the Status Byte register
–410	Query interrupted	The query did not complete. See page 167 for information on troubleshooting this error.

Troubleshooting Errors

This section describes how to troubleshoot the following frequently encountered errors:

- –110,"Command header error"
- –410,"Query interrupted"

Error –110 Command Header Error

This error indicates that the command you sent was not recognized by the instrument as a valid command name. Here are the most likely causes for receiving this error:

- A space is missing between the command and its parameter. At least one space (blank) must exist between the command and its parameter.

  For example, this command will not be recognized and will return error –110:

  ```
  :CONFigure:FILTerRAW                wrong
  ```

  This command, however, is correct and will not return an error:

  ```
  :CONFigure:FILTer RAW               right
  ```

- The command was specified with the improper short or long form.

  For example, you can specify **:CONF?** but not **:CON?** for the **CONFigure?** command.

  Refer to Chapter 3 starting on page 55 and Chapter 4 starting on page 65, for the correct command name.

- A space (blank) is inserted within the command name. Spaces are not permitted within the command name.

  For example, this command is incorrect and will return error -110:

  ```
  :SYST: ERR?                                 Wrong
  ```

  This command, however, is correct and will not return an error:

  ```
  :SYST:ERR?                                  Right
  ```

- The instrument did not return data. To return data from the instrument, the client must send a valid query to the instrument. For example, to return scan data, the client must issue the **:FETCh?** command once the scan has been initiated with the **INITiate** command.

- A client sent a valid query following an invalid command. This can occur when you send multiple commands or queries within one program message. When it detects an error in a program message, the instrument discards all further commands in the program message until the end of the string.

  For example, consider the following program message:

  ```
  *IDN?;*xyz;*STB?
  ```

  The **IDN?** command executes properly, but the ***xyz** command generates error –110 and the rest of the program message is aborted; therefore, the ***STB?** command is ignored even though it is a valid query.

Error –410 Query Interrupted

Usually, this error occurs when a client sends a valid query to the instrument, and then sends another command or query to the instrument before reading the response from the first query.

For example, the following sequence of commands will cause error –410 because the response from **:SYST:ERR?** is not read before the ***OPC** command is sent to the instrument:

```
:SYST:ERR?
*OPC?
```

Registers

Status Byte Register (STB)

Table 13 lists the bits of the Status Byte register.

Table 13: Status Byte Register

Bit	Name	Description
0	Unused	The value of this bit is always 0.
1	Unused	The value of this bit is always 0.
2	Error / Event Queue Summary (EAV)	During an operation, the instrument stores error conditions as they occur in an Error / Event Queue. If this bit is 1, the queue is not empty. To read the error message and empty the queue, use the **SYST:ERR?** command, described on page 78. If this bit is 0, the Error / Event Queue is empty.
3	Questionable Register Summary	TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments do not implement the Questionable Data/Signal Status Register register. Therefore, the value of this bit is always 0.
4	Message Available (MAV)	The Output Queue stores response messages until they are read. If this bit is 1, an unread message exists. The instrument places Data Byte and END messages into the Output Queue in response to query commands. These messages are removed from the Output Queue as they are read by the controller. As long as the Output Queue contains an unread message, the value of the MAV bit is 1. If this bit is 0, an unread message does not exist in the Output Queue.
5	Standard Event Status Bit (ESB) Summary	If this bit is 1, one or more bits in the Standard Event Status register, described on page 173, is set. If this bit is 0, no bits are in Standard Event Status register are set.
6	Request Service	TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments do not implement the Request Service register. Therefore, the value of this bit is always 0.
7	Operation Status Register Summary	If this bit is 1, one or more bits in the device-dependent Operation Status register, described on page 174, is set. If this bit is 0, no bits in the Operation Status register are set.

Standard Event Status Enable Register (ESE)

Figure 13 shows the relationship between the Standard Event Status Enable and Standard Event Status registers.

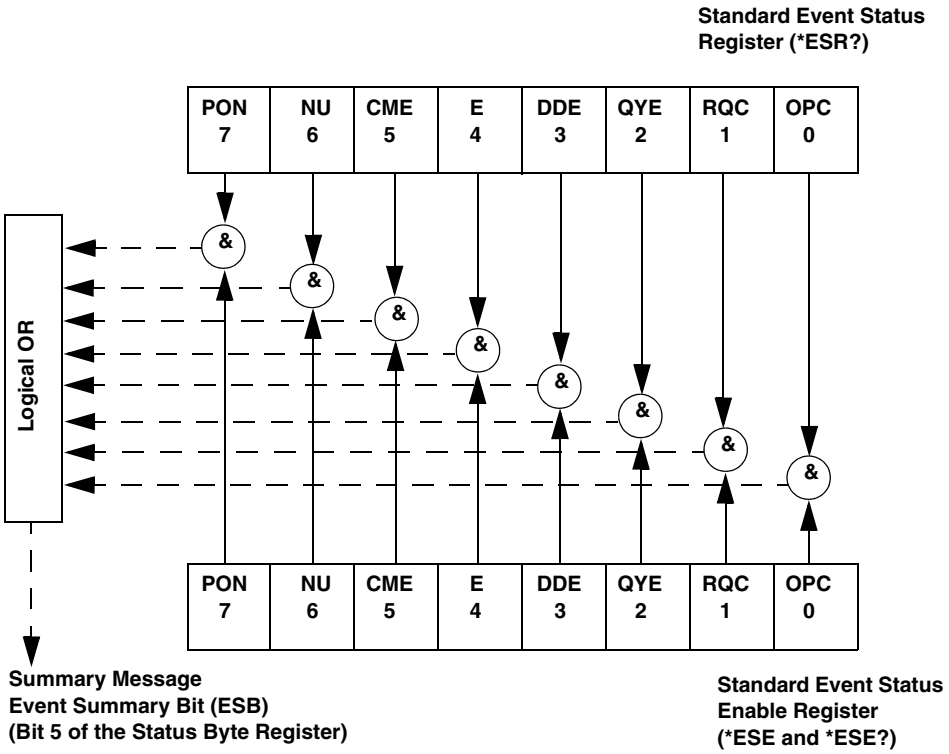


Figure 13: Standard Event Status Enable (ESE) and Standard Event Status Registers (ESR)

Table 14 lists the bits of the Standard Event Status Enable (ESE) register.

Table 14: Standard Event Status Enable (ESE) Register

Bit	Name	Description
0	Operation Complete (OPC)	This bit is always 1 on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments, since the instrument is always enabled to complete all pending overlapped commands. Overlapped commands, such as calibration and measurement commands, are executed in parallel with subsequent commands that are sent to the instrument.
1	Request Control (RQC)	This bit is always 0 on TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments since the instrument is not configured to control GPIB operation.
2	Query Error (QYE)	If this bit is set to 1, the Query Error bit (bit 2) of the Standard Event Status register is enabled. If this bit is set to 0, the Query Error bit (bit 2) of the Standard Event Status register is disabled.
3	Device Dependent Error (DDE)	If this bit is set to 1, the Device Dependent Error bit (bit 3) of the Standard Event Status register is enabled. If this bit is set to 0, the Device Dependent Error bit (bit 3) of the Standard Event Status register is disabled.
4	Execution Error (E)	If this bit is set to 1, the Execution Error bit (bit 4) of the Standard Event Status register is enabled. If this bit is set to 0, the Execution Error bit (bit 4) of the Standard Event Status register is disabled.
5	Command Error (CME)	If this bit is set to 1, the Command Error bit (bit 5) of the Standard Event Status register is enabled. If this bit is set to 0, the Command Error bit (bit 5) of the Standard Event Status register is disabled.
6	Not Used (NU)	The value of this bit is always 0.
7	Power ON (PON)	If this bit is set to 1, the Power ON bit (bit 7) of the Standard Event Status register is enabled. If this bit is set to 0, the Power ON bit (bit 7) of the Standard Event Status register is disabled.

Standard Event Status Register (ESR)

Table 15 lists the bits of the Standard Event Status register; see Figure 13 on page 171 for more information on how the Standard Event Status Enable register is used with this register.

Table 15: Standard Event Status (ESR) Register

Bit	Name	Description
0	Operation Complete (OPC)	If this bit is set to 1, all pending operations are complete. If this bit is set to 0, all pending operations have not been completed.
1	Request Control (RQC)	Not supported. TEMPpoint, VOLTpoint, and MEASURpoint LXI instruments are not configured to control GPIB operation. Therefore, the value of this bit is always 0.
2	Query Error (QYE)	If this bit is 1, a query error was detected indicating that an attempt was made to read data from the output queue when no data was present, or that data in the output queue was lost (an overflow condition occurred). If this bit is 0, a query error did not occur.
3	Device Dependent Error (DDE)	If this bit is 1, a device-dependent error was detected, indicating that the A/Ds are not synchronized when the device is streaming data. When this error is detected, streaming is stopped and the A/Ds are synchronized. If this bit is 0, the A/Ds are synchronized. Refer to Appendix A on page 164 for a list of device-dependent errors that can be returned.
4	Execution Error (E)	If this bit is 1, an Execution Error was detected indicating that a <PROGRAM DATA> element was outside the legal range or was inconsistent with the operation of the instrument, or that the instrument could not execute a valid command due to some internal condition. If this bit is 0, an Execution Error did not occur.
5	Command Error (CME)	If this bit is 1, a Command Error was detected indicating that the instrument received a command that did not follow proper syntax or was misspelled, or that the instrument received a command that was not implemented. If this bit is 0, a Command Error did not occur.
6	Not Used (NU)	The value of this bit is always 0.
7	Power ON (PON)	If this bit is 1, power to the instrument was turned OFF and then ON since the last time the Power ON register was read. If this bit is 0, power to the instrument was always ON between reads of the Power ON register.

Operation Status Register

Table 16 lists the bits of the Operation Status register.

Table 16: Operation Status Register

Bit	Name	Description
0	Unused	The value of this bit is always 0.
1	Unused	The value of this bit is always 0.
2	Unused	The value of this bit is always 0.
3	Unused	The value of this bit is always 0.
4	Scan Status	If this bit is 1 and bit 5 is 1, waiting for trigger. If this bit is 1 and bit 5 is 0, scanning is in progress. If this bit is 0 and bit 5 is 0, scanning is stopped.
5	Trigger Status	If this bit is 1 and bit 4 is 1, waiting for trigger. If this bit is 0 and bit 4 is 1, scanning is in progress. If this bit is 0 and bit 4 is 0, scanning is stopped.
6	Unused	The value of this bit is always 0.
7	Unused	The value of this bit is always 0.
8	Unused	The value of this bit is always 0.
9	Unused	The value of this bit is always 0.
10	Unused	The value of this bit is always 0.
11	Unused	The value of this bit is always 0.
12	Unused	The value of this bit is always 0.
13	Unused	The value of this bit is always 0.
14	Unused	The value of this bit is always 0.

Structures

SCAN_RECORD Structure

Description This structure stores the data from a single scan that is returned by the **FETCh?** query, described on page 145, in the circular buffer.

Structure

```
struct {
    unsigned long tmStamp;
    unsigned long tmMillisec;
    unsigned long scanNumber;
    unsigned long numValues;
    float values[];
} SCAN_RECORD;
```

Members

Name: tmStamp
Description: The time stamp of the scan record, defined as the number of seconds that have elapsed since Coordinated Universal Time (UTC).
The system time is synchronized with an SNTP server.

Name: tmMillisec
Description: The millisecond after *tmStamp* at which the sample was acquired.

Name: scanNumber
Description: The index of the scan record in the circular buffer.

Name: numValues
Description: The number of single-precision values that follow in the record.

Name: values[]
Description: A variable size array with a value from each channel that was specified in the channel list. If CJC measurements were enabled using **CONFigure:SCAn:CJC**, described on page 118, then the CJC values are paired with the corresponding channel's measurement value.

Examples

The **MeasurementSCPI** example illustrates how to use SCPI commands to program a TEMPpoint, VOLTpoint, or MEASURpoint instrument.

This example, written using Visual C# in Microsoft Visual Studio.NET 2005 and Visual C++ in Microsoft Visual Studio.NET 2003, enables three analog input channels (0, 1, and 2) for a scan, initiates the scan, and then fetches data from the circular buffer on the instrument. Note that for thermocouple measurements, the channels are configured for a J-type thermocouple. For RTD measurements, the channels are configured for a PT100 RTD type.

To open and run this example, do the following:

1. Start Microsoft Visual Studio .NET.
2. Click **File**, click **Open**, and then click **Project**.
3. If you are using Visual C# .NET, from the Windows **Start** menu, select the following: **Programs -> Data Translation, Inc -> Measurement SCPI Support ->Examples -> C# ->MeasurementSCPI 2005. sln**

   If you are using Visual C++ .NET, from the Windows **Start** menu, select the following: **Programs -> Data Translation, Inc -> Measurement SCPI Support ->Examples -> CPP ->MeasurementSCPIApp 2003. sln**
4. From the main menu of Microsoft Visual Studio .NET, click **Build**, and then click **Build Solution** to build the project.
5. To run the example, click **Debug** from the main menu, and then click **Start**.
   The example program is now running.
6. Use the capabilities of the example program to see how it operates.
7. When you are finished using the example program, click **Debug** from the main menu, then click **Stop Debugging**.
8. View the user interface of the example program by clicking the appropriate [Design] tab on the main window.
9. View the source code for the example program by clicking the appropriate tab (such as example.cs) on the main window.

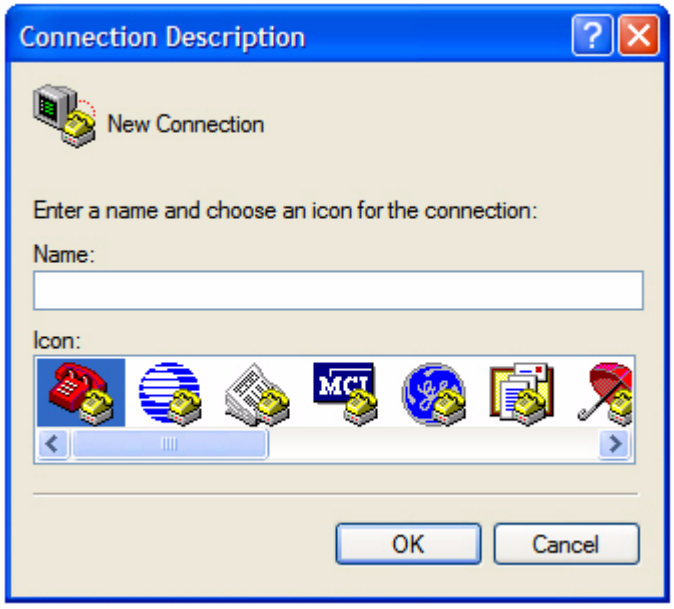
Using HyperTerminal to Send and Receive SCPI Commands

You can use the standard Windows HyperTerminal application to send and receive SCPI commands. This may be useful when debugging your application

Note: SCPI commands return measurement data in binary format. Since HyperTerminal returns data in ASCII format, you cannot use HyperTerminal to directly interpret the measurement data from TEMPpoint, VOLTpoint, or MEASURpoint instruments. The Agilent Connection Expert tool or a network protocol analyzer, such as Wireshark, may be helpful in these instances.

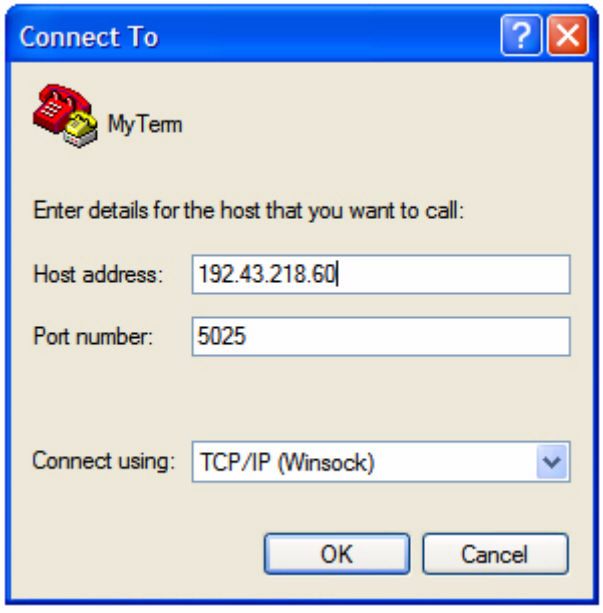
To use the standard Windows HyperTerminal application to send and receive SCPI commands, do the following:

1. From the **Start** menu, click **Programs** ->**Accessories** - > **Communications** -> **HyperTerminal**.
   The HyperTerminal application opens and the following screen appears:

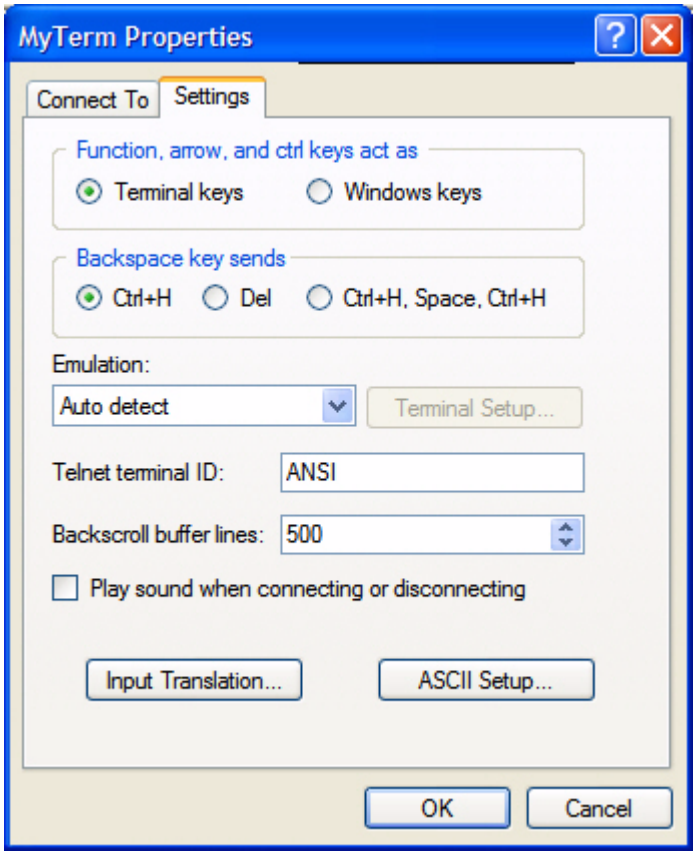


2. Enter a name for the connection, such as **MyTerm**, can click **OK**.
   The Connect To dialog appears:

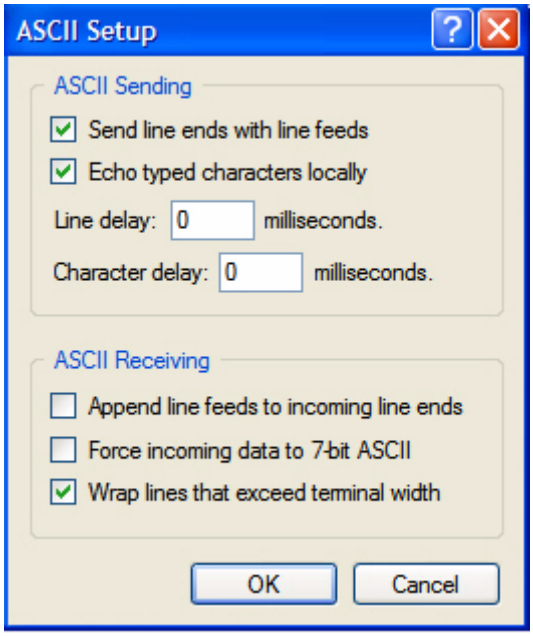
3. In the **Connect using** field, select **TCP/IP (Winsock)**. The other fields on the screen change accordingly.
4. Enter the IP address of the instrument (which you can locate using the Eureka Discovery Utility), and then enter **5025** as the port number.
   The screen should look as follows:



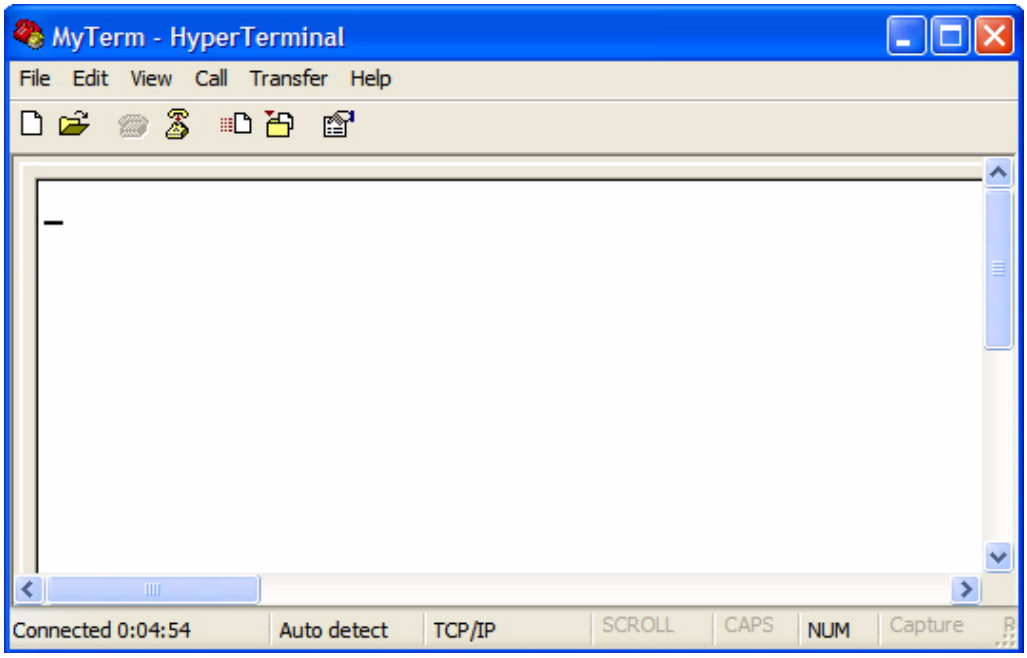
5. Click **OK**.
6. From the File menu, click **Properties**, and then click **Settings**.
   The following screen appears:



7. Click **ASCII Setup...**
8. Configure this dialog box so that the following options are checked: **Send line ends with line feeds**, **Echo typed characters locally**, and **Wrap lines that exceed terminal width**), and then click **OK**.
   The screen should look as follows:

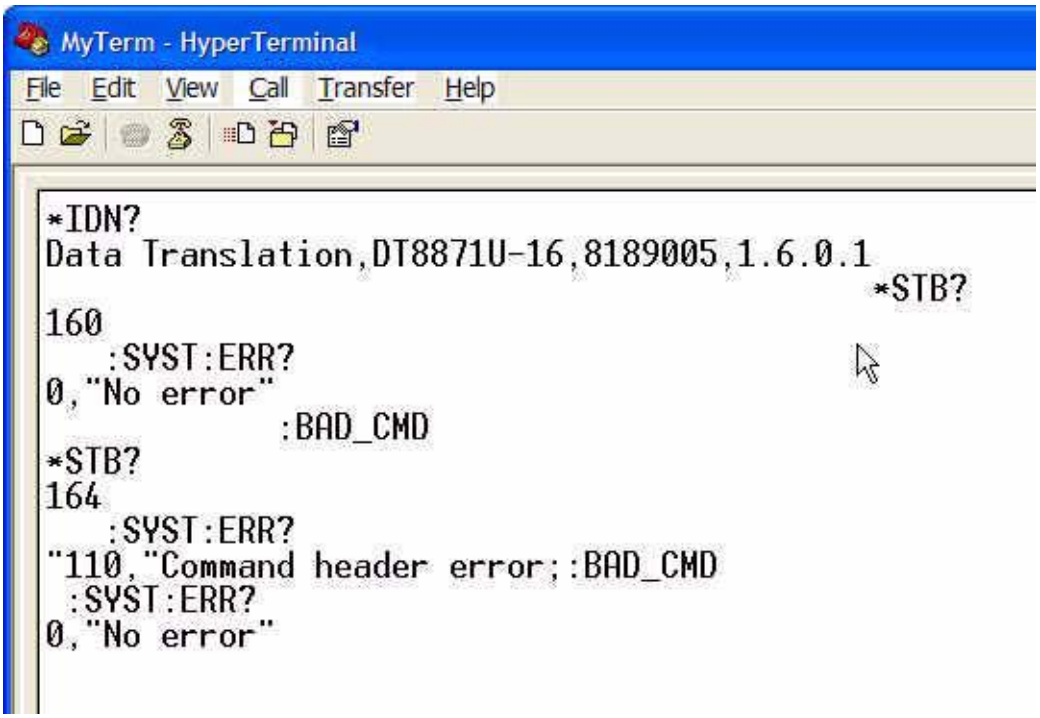


9. Click **OK** to close the Property dialog box.
The following screen appears:



10. From the **Call** menu, click **Call**.

11. Enter any of the documented SCPI commands or queries. The following screen shows an example:



12. When you are finished using the SCPI commands, select the **Call** menu, and then click **Disconnect** to terminate your connection with the instrument.

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