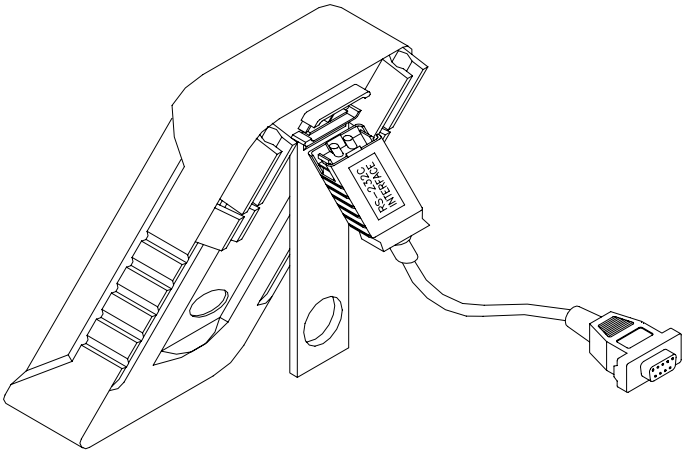**User Guide**

EXTECH
INSTRUMENTS

PC Interface Protocol Manual

Model CMM-17

Warranty

*EXTECH INSTRUMENTS CORPORATION warrants this instrument to be free of defects in parts and workmanship for **one year** from date of shipment (a six month limited warranty applies to sensors and cables). If it should become necessary to return the instrument for service during or beyond the warranty period, contact the Customer Service Department at (781) 890-7440 ext. 210 for authorization or visit our website www.extech.com for contact information. A Return Authorization (RA) number must be issued before any product is returned to Extech. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. Extech specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. Extech's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.*

Introduction

Congratulations on your purchase of the Extech CMM-17 PC Interface kit. This manual covers the interface command sets and the software protocol. For instructions on operating the meter and running the Windows™ software, refer to the separate User Guides supplied with the meter and the software.

Figure 1, below, illustrates the optical cable connection for the meter and a host computer. A USB and a DB-9 style cable are available. The DB-9 cable is connected to a D-type 9-pin male connector on the host computer. The USB cable is connected to a USB port on a host computer. The computer is added a virtual RS-232 COM port when the user plugs the USB type cable and installs the USB driver.

The PC interface is a serial binary data interchange, which operates from 2400 to 19200 baud. The meter's communication port is full duplex, rendering the meter's datalogging capabilities more reliable and efficient.

FIGURE 1 – Connecting the Communications Cable to the CMM-17
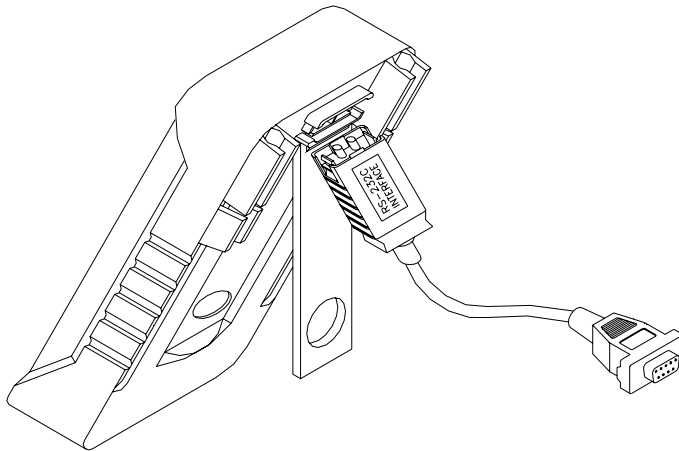
PC Interface Configuration Parameters

In order to operate the meter via a host personal computer, the meter's interface parameters must match the PCs serial interface parameters. The following procedures will guide the user in setting up the meter's interface parameters in order to comply with the interface parameters of the host PC. The meter's factory default settings are 9600-baud rate, non-parity, 8 data bits, and 1 stop bit (9600, n, 8, 1). Table 1, below, lists the factory settings; these settings can be changed by the user.

Table 1 – Interface Parameters

Item	Parameter	Factory Setting	Parameter Selections
1	Baud rate	9600	2400, 4800, 9600, 19200
2	Parity	None	None, Odd, or Even
3	Data bits	8	7 or 8
4	Echo	OFF	ON or OFF
5	Print-only	OFF	ON or OFF

Echo

With ECHO ON, the meter echoes (returns) all the characters it receives.

Print-Only

The meter's remote indicator flashes when the meter is set to Print-Only ON. With Print-Only ON, the meter will print the measured data after the measurement cycle. The meter automatically sends the newest data to the PC. Note that the meter does not accept commands while in the Print-Only mode.

Commands Summary

Overview of the Command Types and Formats

Note: All commands must be entered in upper case.

There are two command types: IEEE 488 common commands and Standard Commands for Programmable Instruments (SCPI). The SCPI commands used are in conformance with the SCPI standard (version 1999.0).

IEEE-488 Common Command Format

The IEEE 488 standard defines the common commands as commands that perform functions, i.e. Reset and System Query. Common commands are usually accompanied by an asterisk "*" character, and may include parameters. Some examples of common commands: *IDN, *RST, and *CLS

SCPI Command Format and Query Format

The SCPI commands control instrument functions. A subsystem command has a hierarchical structure that usually consists of a top-level (or root) keyword, (one or more) lower level keywords, and parameters. The following example shows a command and its associated query:

A. CONFigure:VOLTage:DC 0.5; Set the primary display to the DC voltage measurement, and select the 500mV range.

B. CONFigure:RANGe?; Returns the range of the primary display measurement.

CONFigure is a root level keyword with the second level keyword, VOLTage, and 0.5 is the command parameter. The query command ends with a question mark "?".

Note: SCPI stems from IEEE 488.1 and IEEE 488.2. Although the IEEE 488.2 standard addressed some instrument measurements, it principally dealt with common commands and syntax or data formats. Please refer to the IEEE 488.2 and SCPI reference manual for more information.

Terminators

A terminator is a character sent by a host identifying the end of a command string. A valid terminator consists of two-bytes of data:

> **<CR> (Carriage Return, ASC(&H0D))** and
>
> **<LF> (Line Feed, ASC(&H0A))**

Response Messages

After the meter executes a query command, the response will be in the following format:

<Result> + <CR> <LF>

If the meter is in the print-only mode, the meter will print the measured data when the measurement cycle is completed (primary display only). The printed data will appear as follows:

<Measurement Data> + <CR> <LF>

On the meter warning the return of the prompt will be in the following format (except with Xon and Xoff):

<Prompt> + <CR> <LF>

Data Types

Returned messages are ASCII strings. A query is a command followed by a question mark. Table 2 details the data types.

Table 2 - Data Types for Response Messages and Parameters

Data Type	Explanation	Example
<NR1>	An integer	+10000, -10000, 123, -100
<NR2>	This numeric representation has an explicit radix point	+13.234, -.00002, 3.4567
<NR3>	This representation has an explicit radix point and an exponent	-1.20000000E+02, +9.90000000E+37*
<NRf>	Flexible numeric representation (only positive integers)	100, 255, 16
<Boolean>	Single ASCII-encoded byte (returned after setting query)	0 or 1,OFF or ON
<Literal>	ASCII-encoded bytes corresponding to the short form of the literal used as the command parameter	DCV, ACA
Note*:+9.90000000E+37 indicates positive overload, -9.90000000E+37 indicates negative overload.		

Prompts

When the meter comes up with system warnings, the meter sends a prompt string to the host through the remote interface. The meter returns one of the prompts listed in Table 3.

Table 3 - Return Prompts

Prompts	Description
·S	Into setup mode
·L	Into local mode
·C	Into calibration mode
* E	Remote command's error warning
* B	Battery low warning
* I	Input warning
* O	Output warning
* 0	Rotary position: Voltage input & Pulse output
* 1	Rotary position: Voltage input & Current output
* 2	Rotary position: Voltage input & Voltage output
* 3	Rotary position: mV input & Voltage output
* 4	Rotary position: Resistance input & Voltage output
* 5	Rotary position: Diode input & Current output
* 6	Rotary position: Current input & Voltage output
* 7	Rotary position: Current input & Current output
* 8	Rotary position: Current input & Pulse output
ASC(&H11)	Xon: The meter is available
ASC(&H13)	Xoff: The meter is busy

IEEE 488 Common Commands

*CLS

Description:	Clear the System Error Queue.

*IDN?

Description:	Query the Meter identification.
Response:	Returns instrument model number, serial number and firmware version.

*RST

Description:	Put the meter to power-on-reset state, but no affect the Output Queue and interface parameter.
Note:	The reset operation is executed for 3 seconds at least. Be sure to execute other commands then.

LLO

Description:	Put the meter into the local lockout state when in remote control. This means no local key operation at the front panel is allowed during remote control.

GTL

Description:	Put the meter into the local state, clearing the remote state and front panel lockout.

SCPI Commands

This subsection describes the SCPI subsystem commands for the meter. The meter only accepts the upper case part of command. It is unnecessary to send complete command characters. All commands set or query the state of the primary display of the meter only.

Table 4 - Some SCPI Symbol Conventions

Text Symbol	Meaning
[ ]	Optional; can be omitted
|	Exclusive OR
< >	Defined element
( )	Comment
?	Question mark
:	SCPI command start
;	Compound commands

CONFigure Subsystem:

CONFigure

```
[:SCALar]
   :CURRent
      :DC      [<range>]
      :AC      [<range>]
      :ACDC    [<range>]
      :DCAC    [<range>]
```

Description:	Set to DC, AC or AC+DC current measurement.
Parameter:	If parameter is omitted, the meter is set to auto range.
	<range>: Measurement range is A unit.
	Rotary switch is set to CURRENT measuring: 0.05, 50mA, 0.5, 500mA.
Example:	CONF:CURR:DC ; Set to DC current.
	CONF:CURR:AC 500mA ; Set to AC current and 500mA range.

CONFigure[:SCALar]:CPERcent < 0-20mA | 4-20mA >

Description:	Set to the DCmA percent measurement.
	The rotary switch must be at mA measuring.
Parameter:	0-20mA – 0 mA (0 %) ~ 20 mA (100 %);
	4-20mA – 4 mA (0 %) ~ 20 mA (100 %).
Example:	CONF:CPER 4-20mA

CONFigure

```
[:SCALar]
   :VOLTage
      :DC    [<range>]
      :AC    [<range>]
      :ACDC  [<range>]
      :DCAC  [<range>]
```

Description:	Set to DC, AC or AC+DC voltage measurement.
Parameter:	If parameter is omitted, the meter is set to the auto range mode.
	<range>: Measurement range is V units.
	The rotary switch is set to mV measuring: 0.05, 50mV, 0.5, 500mV, 1.
	The rotary switch is set to V measuring: 5, 50, 500, 1000 (DC only), 750 (except DC).
Example:	CONF:VOLT:DC ; Set to DC voltage.
	CONF:VOLT:ACDC 0.5 ; Set to AC+DC voltage and 500mV range.

CONFigure[:SCALar]:FREQuency [<range>]

Description:	Set to frequency measurement.
Parameter:	If parameter is omitted, the meter is set to the auto range mode.
	<range>: Measuring range is Hz units.
	Rotary switch is set to the voltage & current measurement position:
	100, 1000, 1KHz, 10KHz, 100KHz, 200KHz.
Example:	CONF:FREQ ;Set to frequency measuring.

CONFigure

[:SCALar]
   :PULSe
      :PWIDth   **[<range>]**
      :NWIDth   **[<range>]**
      :PDUTycycle
      :NDUTycycle

Description:	Set to pulse measurement.
Parameter:	If a parameter is omitted, the meter is set to the auto range mode.
	<range>: Measuring range is second units.
	Rotary switch is set to voltage & current measuring: 0.5, 500ms, 5.
Example:	CONF:PULS:PWID ; Set to positive pulse width measuring.
	CONF:PULS:NDUT ; Set to negative pulse duty measuring.

CONFigure[:SCALar]:RESistance [<range>]

Description:	Set to 2-wire resistance measurement.
Parameter:	If parameter is omitted, the meter is set to the auto range mode.
	<range>: Measuring range is ohm units.
	The rotary switch is set to resistance measuring:
	500, 5000, 5Kohm, 50Kohm, 500Kohm, 5Mohm, 50Mohm.
Example:	CONF:RES 50Kohm ; Set to resistance measuring and 50kΩ range.

CONFigure[:SCALar]:CONTinuity [<range>]

Description:	Set to 2-wire resistance measurement with continuity test.
Parameter:	If parameter is omitted, the meter is set to the auto range mode.
	<range>: Measuring range is ohm units.
	The rotary switch is set to resistance:
	500, 5000, 5Kohm, 50Kohm, 500Kohm, 5Mohm, 50Mohm.
Example:	CONF: CONT 500; Set to resistance measuring with the continuity test (500Ω range).

CONFigure[:SCALar]:DIODe

Description:	Set to diode measurement mode with continuity test.
	The rotary switch must be set to the diode position.

CONFigure[:SCALar]:TEMPerature [TCouple[,K[,< CEL | FAR >]]]

Description:	Set to temperature measurement.
	The rotary switch must be set to the mV position.
Parameter:	If parameters are omitted, the meter is set to K-type thermocouple and Celsius units.
Example:	CONF:TEMP TC,K,CEL ; Set to temperature measurement, thermocouple K type and Celsius units.

CONFigure?

Description:	Query the function of the primary display.			
Response:	Return <"function range, resolution"> format string, the examples are as follows:			

Example	Function	Range	Resolution
VOLT +5.000000E-02,+1.000000E-06	DCV	50mV	0.001mV
VOLT:ACDC +5.000000E-00,+1.000000E-04	AC+DCV	5V	0.0001V
CURR:AC +5.000000E-01,+1.000000E-05	ACA	500mA	0.01mA
CPER:0-20mA	Current percent: 0-20mA		
FREQ +1.000000E+03,+1.000000E-01	Frequency	1KHz	0.1Hz
PULS:PWID +1.000000E+00,+1.000000E-04	Pulse width (Positive)	1000ms	0.1ms
PULS:NDUT	Pulse duty (Negative)		
RES +5.000000E+04,+1.000000E+00	Resistance	50KΩ	1Ω
CONT +5.000000E+02,+1.000000E-02	Continuous	500Ω	0.01Ω
DIOD	Diode		
TEMP:K CEL	Temperature	Celsius	

Formatted: Bullets and Numbering

● **CALCulate Subsystem:**

CALCulate:STATe <Boolean>

Description:	Enable or disable the calculation function.
Parameter:	<Boolean>: ON, 1; OFF, 0.
Note:	Only the NULL function can be enabled on the trigger mode.

CALCulate:STATe?

Description:	Query the state of the calculation function.
Response:	Return 0 (OFF) or 1 (ON).

CALCulate:FUNCtion < AVERage | PEAKhold | NULL >[,OFF]

Description:	Set the function of the calculation.
Parameter:	AVER – average (record) function;
	PEAK – peak-hold function;
	NULL – null (relative) function.
Example:	CALC:FUNC AVER
Note:	The NULL function is power-on default. The meter doesn't allow disabling of the calculation function. When the state of the calculation function is OFF, setting calculation function would not change the state of the calculation function to ON. User can combine the calculation functions, but the AVERage function and the PEAKhold function cannot be applied together. Use care when combining the calculation functions. Set the lower priority function and then set the higher priority function, the lower priority function could be canceled.
	The priority order of the calculation function is shown as following:
	1. AVERage and PEAKhold
	2. NULL

CALCulate:FUNCtion?

Description:	Query the function of the calculation function.
Response:	Return <Literal> format string: AVER, PEAK or NULL.
Example:	Returning AVER, NULL indicates that the record function and the relative function are being enabled.

CALCulate:NULL:OFFSet?

Description:	Query the offset value of the null (relative) function.
Response:	Return <NR3> format string.

CALCulate

:AVERage
   :MAXimum?
   :MINimum?
   :AVERage?
   :PRESent?
   :COUNt?

Description:	Query the value of the dynamic recording function.
Response:	Return <NR3> format string.
Example:	CALC:AVER:MAX? ; Query the maximum measuring value.
	CALC:AVER:MIN?; ; Query the minimum measuring value.
	CALC:AVER:AVER? ; Query the average measuring value.
	CALC:AVER:PRES? ; Query the present measuring value.
	CALC:AVER:COUN? ; Query the count value of the average mode.

:PEAKhold
    :MAXimum?
    :MINimum?

Description:	Query the value of the peak-hold function.
Response:	Return <NR3> format string.
Example:	CALC:PEAK:MAX? ; Query the maximum peak-hold value.
	CALC:PEAK:MIN? ; Query the minimum peak-hold value.

- ● **TRIGger Subsystem:**

TRIGger:SOURce < BUS | REFreshhold | IMMediate >

Description:	Select the source of the start trigger signal.
Parameter:	BUS – select a bus command and enter the trigger (hold) mode;
	REF – select a refresh-hold trigger source and enter the trigger mode;
	IMM – select the internal trigger source and escape the trigger mode.
Example:	TRIG:SOUR BUS
Note:	The calculation function is disabled when entering the trigger mode.

TRIGger:SOURce?

Description:	Query the type of the trigger source.
Response:	Return <Literal> format string: BUS, REF or IMM.

TRIGger:REFreshhold:COUNt <numeric>

Description:	Set the count of the refresh-hold mode.
Parameter:	<numeric>: 0, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000.
	The other numeric would be rounded down to valid value.
Note:	The EEPROM value is affected.

TRIGger:REFreshhold:COUNt?

Description:	Query the count of the refresh-hold mode.
Response:	Return <NRf> format string: 0 ~ 1000.

ABORt

Description:	The command resets the trigger system and places all trigger sequences in the idle state. This command is an event and has no associated *RST condition or query form.

INITiate[:IMMediate]

Description:	The command causes all sequences to exit the idle state and the trigger system to initiate and complete one full trigger cycle, returning to idle on completion. If the device is not in idle or if the source of the trigger is set to immediate, the command has no effect on the trigger system and an error -213 is generated.
	INITiate:IMMediate is an event and cannot be queried as there is no state associated with it.

● **Measuring Subsystem:**

FETCh?

Description:	Retrieves the measurements taken by the INITiate command and places them into the device's output buffer. The query will return data any time that the last reading is valid. Data becomes invalid under the following conditions: When *RST is excuted. When an INITiate is executed. When there is any reconfiguration of signal routing, measurement function, signal generation and/or trigger blocks. When the sensor begins acquisition of a new reading. If data is invalid, the command shall not be complete until all data is valid. The exceptions to this are, if the meter is in the trigger idle state and the data is invalid, or the instrument has been reconfigured as defined above and no new measurement has been initiated. In such cases, the meter generates an error -230 and no result is returned. A common cause for this error is receiving a FETCh? after a *RST. Return the primary display value of output buffer.
Response:	Return <NR3> format string.
Example:	FETC? ; Return the value, e.g. +1.23450000E+00

READ?

Description:	The command provides a method of performing a FETCh? operation on fresh data. The query command is identical to: ABORt; INITiate; FETCh? Return the primary display value of output buffer after the next triggered measurement is complete.
Response:	Return <NR3> format string.

● **SOURce Subsystem:**

[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude] <level>

Description:	Set the amplitude of the voltage output.
Parameter:	<level>: format s#.#### for range -1.5000 ~ +1.5000 V or
	format s##.### for range -15.000 ~ +15.000 V.
Example:	VOLT +01.000

[SOURce:]VOLTage[:LEVel][:IMMediate][:AMPLitude]?

Description:	Query the amplitude of the voltage output.
Response:	Return <NR3> format string.

[SOURce:]VOLTage:RANGe < 1.5 | 15 >

Description:	Set the range of the voltage output.
Parameter:	1.5 – range -1.5000 ~ +1.5000 V;
	15 – range -15.000 ~ +15.000 V.
Example:	VOLT:RANG 1.5

[SOURce:]VOLTage:RANGe?

Description:	Query the range of the voltage output.
Response:	Return <Literal> format string: 1.5 or 15.

[SOURce:]VOLTage:RAMP:STARt <level>,<resolution>

Description:	Set the start position of the voltage RAMP function.
Parameter:	<level>: format s#.#### for range -1.5000 ~ +1.5000 V or
	format s##.### for range -15.000 ~ +15.000 V;
	<resolution>: 1 ~ 999.
Example:	VOLT:RAMP:STAR -1.0000,100 ; start from -1V (range 1.5V),
	100 step resolution.
Note:	The EEPROM value is affected.

[SOURce:]VOLTage:RAMP:STOP <level>,<resolution>

Description:	Set the stop position of the voltage RAMP function.
Parameter:	<level>: format s#.#### for range -1.5000 ~ +1.5000 V or
	format s##.### for range -15.000 ~ +15.000 V;
	<resolution>: 1 ~ 999.
Example:	VOLT:RAMP:STOP -1.0000,100 ; stop to -1V (range 1.5V),
	100 step resolution.
Note:	The EEPROM value is affected.

[SOURce:]VOLTage:RAMP:ONCE <boolean>

Description:	Set the cycle mode of the voltage RAMP function.
Parameter:	<Boolean>: ON, 1 (one cycle); OFF, 0 (continuous).

[SOURce:]VOLTage:RAMP:ONCE?

Description:	Query the cycle mode of the voltage RAMP function.
Response:	Return 0 (continuous) or 1 (one cycle).

[SOURce:]VOLTage:SCAN[:TABLe] \<step\>,\<level\>,\<second\>

Description:	Set the table of the voltage SCAN function.
Parameter:	\<step\>: 1 ~ 16;
	\<level\>: format s#.#### for range -1.5000 ~ +1.5000 V or
	format s##.### for range -15.000 ~ +15.000 V;
	\<second\>: 0 ~ 99.
Example:	VOLT:SCAN 6,+02.000,5 ; step 6, +2V(range 15V), 5 seconds.
Note:	The EEPROM value is affected.

[SOURce:]VOLTage:SCAN:STEP < 1 ~ 16 | +1 | -1 >

Description:	Set the step value of the voltage SCAN function.
Parameter:	1 ~ 16 – fixed step;
	+1 – next step;
	-1 – previous step.
Example:	VOLT:SCAN:STEP 8 ; set to the step 8 of the voltage SCAN function.

[SOURce:]VOLTage:SCAN:STEP?

Description:	Query the step value of the voltage SCAN function.
Response:	Return \<NRf\> format string: 1 ~ 16.

[SOURce:]VOLTage:SCAN:ONCE \<Boolean\>

Description:	Set the cycle mode of the voltage SCAN function.
Parameter:	\<Boolean\>: ON, 1 (one cycle); OFF, 0 (continuous).

[SOURce:]VOLTage:SCAN:ONCE?

Description:	Query the cycle mode of the voltage SCAN function.
Response:	Return 0 (continuous) or 1 (one cycle).

[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude] <level>

Description:	Set the amplitude of the current output.
Parameter:	<level>: format s##.### for range -25.000 ~ +25.000 mA.
Example:	CURR +01.000

[SOURce:]CURRent[:LEVel][:IMMediate][:AMPLitude]?

Description:	Query the amplitude of the current output.
Response:	Return <NR3> format string.

[SOURce:]CURRent:RANGe < 0.025 | 25mA >

Description:	Set the range of the current output.
Parameter:	0.025 – range -25.000 ~ +25.000 mA;
	25mA – range -25.000 ~ +25.000 mA.
Example:	CURR:RANG 0.025

[SOURce:]CURRent:RANGe?

Description:	Query the range of the current output.
Response:	Return <Literal> format string: 0.025.

[SOURce:]CURRent:RAMP:STARt <level>,<resolution>

Description:	Set the start position of the current RAMP function.
Parameter:	<level>: format s##.### for range -25.000 ~ +25.000 mA;
	<resolution>: 1 ~ 999.
Example:	CURR:RAMP:STAR -10.000,100 ; start from –10mA (range 25mA),
	100 step resolution.
Note:	The EEPROM value is affected.

[SOURce:]CURRent:RAMP:STOP <level>,<resolution>

Description:	Set the stop position of the current RAMP function.
Parameter:	<level>: format s##.### for range -25.000 ~ +25.000 mA;
	<resolution>: 1 ~ 999.
Example:	CURR:RAMP:STOP -10.000,100 ; stop to –10mA (range 25mA),
	100 step resolution.
Note:	The EEPROM value is affected.

[SOURce:]CURRent:RAMP:ONCE <boolean>

Description:	Set the cycle mode of the current RAMP function.
Parameter:	<Boolean>: ON, 1 (one cycle); OFF, 0 (continuous).

[SOURce:]CURRent:RAMP:ONCE?

Description:	Query the cycle mode of the current RAMP function.
Response:	Return 0 (continuous) or 1 (one cycle).

[SOURce:]CURRent:SCAN[:TABLe] <step>,<level>,<second>

Description:	Set the table of the current SCAN function.
Parameter:	<step>: 1 ~ 16;
	<level>: format s##.### for range -25.000 ~ +25.000 mA;
	<second>: 0 ~ 99.
Example:	CURR:SCAN 6,+02.000,5 ; step 6, +2mA(range 25mA), 5 seconds.
Note:	The EEPROM value is affected.

[SOURce:]CURRent:SCAN:STEP < 1 ~ 16 | +1 | -1 >

Description:	Set the step value of the current SCAN function.
Parameter:	1 ~ 16 – fixed step;
	+1 – next step;
	-1 – previous step.
Example:	CURR:SCAN:STEP 8 ; set to the step 8 of the current SCAN function.

[SOURce:]CURRent:SCAN:STEP?

Description:	Query the step value of the current SCAN function.
Response:	Return <NRf> format string: 1 ~ 16.

[SOURce:]CURRent:SCAN:ONCE <Boolean>

Description:	Set the cycle mode of the current SCAN function.
Parameter:	<Boolean>: ON, 1 (one cycle); OFF, 0 (continuous).

[SOURce:]CURRent:SCAN:ONCE?

Description:	Query the cycle mode of the current SCAN function.
Response:	Return 0 (continuous) or 1 (one cycle).

[SOURce:]SQUare:DCYCle:DECimal <numeric>

Description:	Set the duty cycle of the square wave.
	Duty cycle = numeric / 256
Parameter:	<numeric>: 1 ~ 255.
Example:	SQU:PWID:DEC 64 ; The duty cycle is 25%.

[SOURce:] SQUare:DCYCle?

Description:	Query the duty cycle of the square wave.
Response:	Return <NRf> format string: 1 ~ 255.

[SOURce:]SQUare:PWIDth:DECimal <numeric>

Description:	Set the pulse width of the square wave.
	Pulse width = numeric / (frequency x 0.256)
Parameter:	<numeric>: 1 ~ 255.
Example:	SQU:PWID:DEC 64 ; The pulse width is approx 0.42ms at 600Hz

[SOURce:] SQUare:PWIDth?

Description:	Query the pulse width of the square wave.
Response:	Return <NRf> format string: 1 ~ 255.

[SOURce:]SQUare:FREQuency <numeric>

Description:	Set the frequency of the square wave.
Parameter:	<numeric>: 0.5, 1, 2, 5, 10, 15, 20, 25, 30, 40, 50, 60, 75, 80, 100, 120, 150, 200, 240, 300, 400, 480, 600, 800, 1200, 1600, 2400, 4800. The other numeric is invalid value.
Example:	SQU:FREQ 600

[SOURce:] SQUare:FREQuency?

Description:	Query the frequency of the square wave.
Response:	Return <NR2> or <NRf> format string: 0.5 ~ 4800.

[SOURce:]SQUare:AMPLitude < +5V | 10V | +12V | 24V >

Description:	Set the amplitude of the square wave.
Parameter:	+5V – 0V ~ +5V;
	10V – -5V ~ +5V;
	+12V – 0V ~ +12V;
	24V – -12V ~ +12V.
Example:	SQU:AMPL +12V

[SOURce:] SQUare:AMPLitude?

Description:	Query the amplitude of the square wave.
Response:	Return <Literal> format string: +5V, 10V, +12V or 24V.

SOURce?

Description:	Query the output function.			
Response:	Return <"function amplitude[,frequency,percentage]"> format string, the examples are as following:			
	Example	Function	Amplitude	Frequency,%
	VOLT –1.000000E+00	Voltage	-1V	
	VOLT:RAMP +2.000000E-01	Voltage: RAMP	0.2V	
	CURR:SCAN +0.000000E+00	Current: SCAN	0mA	
	SQU +1.000000E+01 ,+1.200000E+03,5.000000E+01	Square wave	10V	1200Hz,50%

OUTPut[:STATe] <Boolean>

Description:	Activate or stand-by the output.
Parameter:	<Boolean>: ON, 1 (activate); OFF, 0 (stand-by).

OUTPut[:STATe]?

Description:	Query the state of the output.
Response:	Return 0 (stand-by) or 1 (activate).

- **SYSTem Subsystem:**

DISPlay:TEXT <"string">

Description:	Set the text of the primary display.
Parameter:	The five characters in front are valid. Extra characters would be rounded off. Missing characters would be replaced by space characters. Accepts any numeral or capital letter. Undefined characters would be displayed as spaces.
Example:	DISP:TEXT "DONE"

DISPlay:TEXT:CLEar

Description:	Clear the text of the primary display and revert to the original display mode.

DISPlay:TEXT?

Description:	Query the text of the primary display.
Response:	Return a string with the double quotation marks.

SYSTem:BEEPer [< CONTinous | STOP | TONE >]

Description:	Set the action of the beeper. Ignore the original state of the beeper.
Parameter:	If parameter is omitted, the meter is set to tone. CONT – beep continuously; STOP –stop to beep; TONE –beep one tone.
Example:	SYST:BEEP

SYSTem:BEEPer[:STATe] <Boolean>

Description:	Enable or disable the beeper.
Parameter:	<Boolean>: ON, 1; OFF, 0.

SYSTem:BEEPer[:STATe]?

Description:	Query the state of the beeper.
Response:	Return 0 (OFF) or 1 (ON).

SYSTem:BLIT[:STATe] <Boolean>

Description:	Enable or disable the display backlight.
Parameter:	<Boolean>: ON, 1; OFF, 0.

SYSTem:BLIT[:STATe]?

Description:	Query the state of the display backlight.
Response:	Return 0 (OFF) or 1 (ON).

SYSTem:BLIT:TIME <second>

Description:	Set the time of the backlight ON period.
Parameter:	<second>: 0 ~ 99.
Note:	The EEPROM value is affected.

SYSTem:BLIT:TIME?

Description:	Query the time of the display backlight.
Response:	Return <NRf> format string: 0 ~ 99.

SYSTem:AOFF[:STATe] <Boolean>

Description:	Enable or disable the auto power off function.
Parameter:	<Boolean>: ON, 1; OFF, 0.

SYSTem:AOFF[:STATe]?

Description:	Query the state of the auto power off function.
Response:	Return 0 (OFF) or 1 (ON).

SYSTem:AOFF:TIME <minute>

Description:	Set the interval time of the auto power off function.
Parameter:	<minute>: 0 ~ 99.
Note:	The EEPROM value is affected.

SYSTem:AOFF:TIME?

Description:	Query the interval time of the auto power off function.
Response:	Return <NRf> format string: 0 ~ 99.

SYSTem:TCOMpensated[:STATe] <Boolean>

Description:	Enable or disable the temperature compensation.
Parameter:	<Boolean>: ON, 1; OFF, 0.

SYSTem: TCOMpensated [:STATe]?

Description:	Query the state of the temperature compensation.
Response:	Return 0 (OFF) or 1 (ON).

SYSTem:DEFAult

Description:	Set the EEPROM to default value but don't affect the calibration data.

SYSTem:VERSion?

Description:	Query the version of the SCPI.
Response:	Return 1999.0 string.

SYSTem:ERRor?

Description:	Query the error message.
Response:	Return <Number,"Error String"> format string. Table 5 is a list of SCPI error messages that might occur during operation.
Note:	The buffer size of the system error queue is one.

Table 5 - SCPI Error Message

Number	Error String	Number	Error String
+0	No error	-109	Missing parameter
-102	Syntax error	-200	Execution error
-103	Invalid separator	-213	Init ignored
-104	Data type error	-222	Data out of range
-108	Parameter not allowed	-230	Data stale

● STATus Subsystem:

STATus?

Description:	Query the status of the meter.
Response:	Return <"ABCDEFGHIJKLMNOPQRSTU"> format string.
	Each character is defined below:

	Item	Explanation
A	Average function	0:off, 1:on
B	Null function	0:off, 1:on
C	Unused	always 0
D	Unused	always 0
E	Peak-hold function	0:off, 1:on
F	Unused	always 0
G	Trigger mode	I:IMM, B:BUS, R:REF
H	Slide switch position	0:meter/source, 1:meter only
I	Ambient temperature compensation	0:off, 1:on
J	Beep	0:off, 1:1KHz, 2:2KHz, 4:4KHz, F:600Hz
K	Auto Power Off	0:off, 1:on
L	Back lit	0:off, 1:on
M	Meter mode	L:local, S:setup, C:Calibration
N	Input warning	0:normal, 1:warming
O	Output warning	0:normal, 1:warning
P	Rotary position	0: voltage input & pulse output 1: voltage input & current output 2: voltage input & voltage output 3: mV input & voltage output 4: resistance input & voltage output 5: diode input & current output 6: current input & voltage output 7: current input & current output 8: current input & pulse output
Q	Output status	0:stand-by, 1:operation
R	Rate	4:50000 counts
S	Battery	0:normal, 1:low
T	Power jack	0:pull out, 1:plug in
U	Auto 1	0:off, 1:on

Summary of SCPI Commands

Command	Parameter	Explanation
CONFigure?		Query the function of the primary display.
CONFigure[:SCALar]		Configure the meter to perform specified measurement.
:VOLTage :AC	[<range>]	Set the voltage measurement.
:ACDC	[<range>]	
:DCAC	[<range>]	
:DC	[<range>]	
:CURRent :AC :ACDC :DCAC :DC	[<range>] [<range>] [<range>] [<range>]	Set the current measurement.
:CPERcent	[<0-20mA|4-20mA>]	Set the DCmA percent measurement.
:FREQuency	[<range>]	Set the meter to frequency measurement.
:PULSe :PWIDth :NWIDth :PDUTycycle :NDUTycycle	[<range>] [<range>]	Set the pulse measurement. Positive pulse width Negative pulse width Positive pulse duty Negative pulse duty
:RESistance	[<range>]	Set the resistance measurement.
:CONTinuity	[<range>]	Set the resistance measurement with the continuity test.
:DIODe		Set the diode measurement.
:TEMPerature	[TC[,K[,<CEL|FAR>]]]	Set the temperature measurement.

Command	Parameter	Explanation
TRIGger		Trigger function
:SOURce?		Query the trigger source type.
:SOURce	<BUS|REF|IMM>	Select a trigger source.
:REF:COUNt?		Query the count of the refresh-hold mode.
:REF:COUNt	<numeric>: 0 ~ 1000	Set the count of the refresh-hold mode.
ABORt		Reset the trigger system of the meter.
INITiate[:IMMediate]		Initiate the trigger system of the meter.
FETCh?		Return the data any time that the last reading is valid.
READ?		Return the primary display value when the new measurement is valid.
CALCulate		
:STATe?		Query the state of the calculation function.
:STATe	<Boolean>	Enable or disable the calculation function.
:FUNCtion?		Query the calculation function.
:FUNCtion	<function>[,OFF]	Set the calculation function.
:NULL:OFFSet?		Query the offset value of the relative function.
:AVERage :MAXimum? :MINimum? :AVERage? :PRESent? :COUNt?		Query the value of the dynamic recording function
:PEAKhold :MAXimum? :MINimum?		Query the value of the peak-hold function.

Command	Parameter	Explanation
OUTPut		
[:STATe]?		Query the state of the output function.
[:STATe]	<Boolean>	Activate or stand-by the output.
SOURce?		Query the output function.
[SOURce:]VOLTage		Output voltage.
[:LEV][:IMM][AMPL]?		Query the amplitude of the output.
[:LEV][:IMM][AMPL]	<level>	Set the amplitude of the output.
:RANGe?		Query the range of the output.
:RANGe	<1.5|15>	Set the range of the output.
:SCAN		SCAN function.
[:TABLe]	<step>,<level>,<second>	Set the table of the SCAN function.
:STEP?		Query the step value of the SCAN function.
:STEP	<01~16|+1|-1>	Set the step value of the SCAN function.
:ONCE?		Query the cycle mode of the SCAN function.
:ONCE	<Boolean>	Set the cycle mode of the SCAN function.
:RAMP		RAMP function.
:STARt	<level>,<resolution>	Set the start point of the RAMP function.
:STOP	<level>,<resolution>	Set the stop point of the RAMP function.
:ONCE?		Query the cycle mode of the SCAN function.
:ONCE	<Boolean>	Set the cycle mode of the SCAN function.
[SOURce:]CURRent		Output current.
[:LEV][:IMM][AMPL]?		Query the amplitude of the output.
[:LEV][:IMM][AMPL]	<level>	Set the amplitude of the output.
:RANGe?		Query the range of the output.
:RANGe	<0.025|25mA>	Set the range of the output.
:SCAN		SCAN function.
[:TABLe]	<step>,<level>,<second>	Set the table of the SCAN function.
:STEP?		Query the step value of the SCAN function.
:STEP	<01~16|+1|-1>	Set the step value of the SCAN function..
:ONCE?		Query the cycle mode of the SCAN function.
:ONCE	<Boolean>	Set the cycle mode of the SCAN function.
:RAMP		RAMP function.
:STARt	<level>,<resolution>	Set the start position of the RAMP function.
:STOP	<level>,<resolution>	Set the stop position of the RAMP function.
:ONCE?		Query the cycle mode of the SCAN function.
:ONCE	<Boolean>	Set the cycle mode of the SCAN function.

Command	Parameter	Explanation
[SOURce:]SQUare		Output square wave.
:DCYCle?		Query the duty cycle of the square wave.
:DCYCle:DECimal	<numeric>: 1 ~ 255	Set the duty cycle of the square wave.
:PWIDth?		Query the pulse width of the square wave.
:PWIDth:DECimal	<numeric>: 1 ~ 255	Set the pulse width of the square wave.
:FREQuency?		Query the frequency of the square wave.
:FREQuency	<numeric>	Set the frequency of the square wave.
:AMPLitude?		Query the amplitude of the square wave.
:AMPLitude	<+5V|10V|+12V|24V>	Set the amplitude of the square wave.
DISPlay		
:TEXT?		Query the text of the primary display.
:TEXT	<string>	Set the text of the primary display.
:TEXT:CLEar		Clear the text of the primary display.
SYSTem		
:AOFF		
[:STATe]?		Query the state of the auto power off function.
[:STATe]	<Boolean>	Enable or disable the auto power off function.
:TIME?		Query the time of the auto power off function.
:TIME	<minute>: 0 ~ 99	Set the time of the auto power off function.
:BEEPer	[<CONT|STOP|TONE>]	Set the action of the beeper.
[:STATe]?		Query the state of the beeper.
[:STATe]	<Boolean>	Enable or disable the beeper.
:BLIT		
[:STATe]?		Query the state of the back lit.
[:STATe]	<Boolean>	Enable or disable the back lit.
:TIME?		Query the time of the back lit.
:TIME	<second>: 0 ~ 99	Set the time of the back lit.
:TCOM		
[:STATe]?		Query the state of the temperature compensated.
[:STATe]	<Boolean>	Enable or disable the temperature compensated.
:DEFAult		Set the EEPROM to default value.
:ERRor?		Query the error message.
:VERSion?		Query the version of the SCPI.
STATus?		Query the status of the meter.