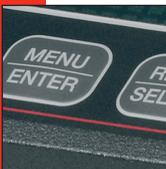


Remote Manual  
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JOFRA ASC301 & ASC321

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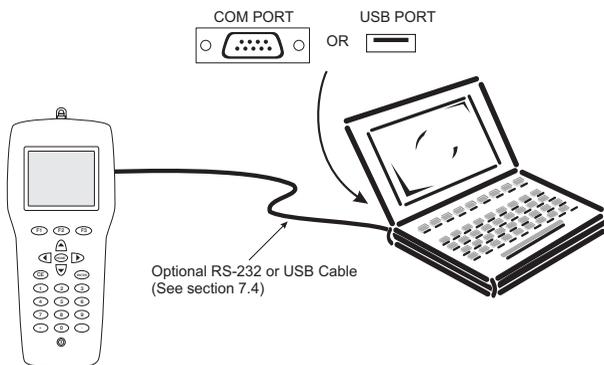
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# Remote Operation

The calibrator can be remotely controlled using a PC terminal, or by a computer program running the calibrator in an automated system. It uses an RS232 serial port connection for remote operation. With this connection the user can write programs on the PC, with Windows languages like Visual Basic to operate the calibrator, or use a Windows terminal, such as Hyper Terminal, to enter single commands. Typical RS232 remote configurations are shown in Figure 1.



**Figure 1. Calibrator-to-Computer Connection**

## 1. Setting up the RS232 Port for Remote Control

**Note:** The RS232 connection cable should not exceed 15m unless the load capacitance measured at connection points is less than 2500pF.

Serial parameter values:

9600 baud

8 data bits

1 stop bit

no parity

Xon/Xoff

EOL (End of Line) character or CR (Carriage Return) or both

To set up remote operation of the calibrator on the Windows Hyper Terminal, connected to a COM port on the PC as in Figure 1, use the following procedure:

1. Start Hyper Terminal (located in Accessories/Communications of the Windows Start menu)
2. Select New Connection.

3. For Name enter ASC301. Select the serial port that the unit is connected to.
4. Enter the above information for port settings.
5. Select ASCII setup from File/Properties/Settings and mark these choices:
  - Echo typed characters locally
  - Wrap lines that exceed terminal width
6. Select Ok
7. To see if the port works enter \*IDN?. This command will return information on the unit.

## 2. Changing Between Remote and Local Operation

There are three modes of operation of the calibrator, Local, Remote, and Remote with Lockout. Local mode is the default mode. Commands may be entered using the keypad on the unit or using a computer. In Remote mode the keypad is disabled, and commands may only be entered using a computer, but choosing [GO TO LOCAL] from the menu on the calibrator display will restore keypad operation. In Remote with Lockout, the keypad can not be used at all. To switch modes proceed as follows:

1. To enable Remote mode, type in the serial command REMOTE at the computer terminal.
2. To enable Remote with Lockout, type in REMOTE and LOCKOUT in either order.
3. To switch back to local operation enter LOCAL at the terminal. This command also turns off LOCKOUT if it was on. For more information on commands refer to the Remote Commands section.

## 3. Using Commands

### 3.1 Command types

Refer to the Section on Remote Commands for all available commands.

The calibrator may be controlled using commands and queries. All commands may be entered using upper or lower case. The commands are divided into the following categories:

#### Calibrator Commands

Only the calibrator uses these commands. For example

LOWER\_MEAS DCV

tells the calibrator to measure voltage on the lower display.

## **Common Commands**

Standard commands used by most devices. These commands always begin with an "\*". For example

```
*IDN?
```

tells the calibrator to return its identification.

## **Query Commands**

Commands that ask for information. They always end with a "?". For example:

```
FUNC?
```

Returns the current modes of the upper and lower displays.

## **Compound Commands**

Commands that contain more than one command on one line. For example:

```
LOWER_MEAS RTD; RTD_TYPE CU10
```

Sets the calibrator to measure RTD in the lower display and sets RTD type to Cu 10.

## **Overlapped Commands**

Commands that require more time to execute than normal. The command \*WAI can be used after the overlapped command to tell the calibrator to wait until the command finishes before executing the next command. For example:

```
TRIG; *WAI
```

Triggers the pulse train. Once the pulse train has been triggered, the calibrator can proceed to the next command.

## **Sequential Commands**

Commands that are executed immediately after they are entered. This type includes most of the commands.

### **3.2 Character Processing**

The data entered into the calibrator is processed as follows:

- ASCII characters are discarded if their decimal equivalent is less than 32 (space), except 10 (LF) and 13 (CR):
- Data is taken as 7-bit ASCII

- The most significant data bit is ignored.
- Upper or lower case is acceptable.

### **3.3 Response Data Types**

The data returned by the calibrator can be divided into four types:

#### **Integer**

For most computers and controllers they are decimal numbers ranging from -32768 to 32768. For example:

\*ESE 140; \*ESE? returns 140

#### **Floating**

Numbers that have up to 15 significant figures and exponents. For example:

CPRT\_COEFA? returns 3.908000E-03

#### **Character Response Data (CRD)**

Data returned as keywords. For example:

RTD\_TYPE? returns PT385\_10

#### **Indefinite ASCII (IAD)**

Any ASCII characters followed by a terminator. For example:

\*IDN? returns AMETEK, ASC301, 250, 1.00

### **3.4 Calibrator Status**

Status registers, enable registers, and queues provide status information on the calibrator. Each status register and queue has a summary bit in the Serial Poll Status Byte. Enable registers generate summary bits in the Serial Poll Status Byte. The following is a list of registers and queues along with their function.

#### **Serial Poll Status Byte (STB)**

The STB is sent when the calibrator responds to the \*STB? command. Cleared when power is reset.

#### **Service Request Enable Register (SRE)**

Enables or disables the bits of the STB. Cleared when power is reset.

Setting bits to 0 disables them in the STB. Setting the bits to 1 enables them. Bit assignments for the SRE and the STB are shown below.

7	6	5	4	3	2	1	0
0	MSS	ESB	0	EAV	0	0	0

### **MSS**

Master Summary Status. Set to 1 when ESB or EAV are 1 (enabled). Read using the \*STB? command.

### **ESB**

Set to 1 when at least one bit in ESR is 1.

### **EAV**

Error Available. An error has been entered into the error queue, and may be read using the Fault? command.

## **Event Status Register (ESR)**

A two-byte register, in which the lower bits represent conditions of the Calibrator. Cleared when read and when power is reset.

## **Event Status Enable Register (ESE)**

Enables and disables bits in the ESR. Setting a bit to 1 enables the corresponding bit in the ESR, and setting it to 0 disables the corresponding bit. Cleared at power reset. Bit assignments for the ESR and the ESE respectively are shown below.

15	14	13	12	11	10	9	8
0	0	0	0	0	0	0	0

7	6	5	4	3	2	1	0
PON	0	CME	EXE	DDE	QYE	0	OPC

### **PON**

Power On. Set to 1 if power was turned on and off before the Event Status Register was read.

**CME**

Command Error. Set to 1 when the calibrator receives an invalid command. Entering an unsupported RTD type may cause such an error.

**EXE**

Execution Error. Set to 1 when the calibrator runs into an error while executing its last command. A parameter that has too significant figures may cause such an error.

**DDE**

Device-dependent Error. Set to 1 when, for example, the output of the calibrator is overloaded.

**QYE**

Query Error.

**OPC**

Operation Complete. Set to 1 when the calibrator has finished executing all commands before the command \*OPC was entered.

**Error Queue**

If an error occurs due to invalid input or buffer overflow, its error code is sent to the error queue. The error code can be read from the queue with the command FAULT?. The error queue holds 15 error codes. When it is empty, FAULT? returns 0. The error queue is cleared when power is reset or when the clear command \*CLS is entered.

**Input Buffer**

Calibrator stores all received data in the input buffer. The buffer holds 250 characters. The characters are processed on a first in, first out basis.

## 4. Remote Commands and Error Codes

The following tables list all commands, and their descriptions, that are accepted by the calibrator.

**Table 1: Common Commands**

<b>Command</b>	<b>Description</b>
*CLS	*CLS (Clear status.) Clears the ESR, the error queue, and the RQS bit in the status byte. Terminates pending Operation Complete commands
*ESE	Loads a byte into the Event Status Enable register.
*ESE?	Returns the contents of the Event Status Enable register.
*ESR?	Returns the contents of the Event Status register and clears the register.
*IDN?	Identification query. Returns the manufacturer, model number, and firmware revision level of the Calibrator.
*OPC	Enables setting of bit 0 (OPC for "Operation Complete") in the Event Status Register to 1 when all pending device operations are complete.
*OPC?	Returns a 1 after all pending operations are complete. This command causes program execution to pause until all operations are complete.
*RST	Resets the state of the instrument to the power-up state. This command holds off execution of subsequent commands until it is complete.
*SRE	Loads a byte into the Service Request Enable register.
*SRE?	Returns the byte from the Service Request Enable register.
*STB?	Returns the status byte.
*WAI	Prevents further remote commands from being executed until all previous remote commands have been executed.

**Table 2: Calibrator Commands**

<b>Command</b>	<b>Description</b>
CAL_START	Puts the calibrator in calibration mode
CJC_STATE	Turns CJC on or off.
CJC_STATE?	Returns the state of the CJC
CPRT_COEFA	Sets the custom RTD coefficient A
CPRT_COEFA?	Returns the custom RTD coefficient A
CPRT_COEFB	Sets the custom RTD coefficient B
CPRT_COEFB?	Returns the custom RTD coefficient B
CPRT_COEFC	Sets the custom RTD coefficient C

CPRT_COEFC?	Returns the custom RTD coefficient C
CPRT_MIN_T	Sets the custom RTD minimum temperature
CPRT_MIN_T?	Returns the custom RTD minimum temperature
CPRT_MAX_T	Sets the custom RTD maximum temperature
CPRT_MAX_T?	Returns the custom RTD maximum temperature
CPRT_R0	Sets the custom RTD R0 resistance
CPRT_R0?	Returns the custom RTD R0 resistance
FAULT?	Returns the error code of an error that has occurred
FREQ_LEVEL	Sets the frequency and pulse amplitude
FREQ_LEVEL?	Returns the frequency and pulse amplitude
FREQ_TYPE	Set the frequency output to continuous (frequency) or pulse.
FREQ_TYPE?	Returns frequency output type, continuous or pulse
FREQ_UNIT	Sets the unit for frequency and pulse
FREQ_UNIT?	Returns the unit for frequency and pulse
FUNC?	Returns the current mode of the upper and lower display
HART_ON	Turns the HART resistor on
HART_OFF	Turns the HART resistor off
HART?	Returns the state of the HART resistor
LOCAL	Returns user to manual operation of the calibrator
LOCKOUT	Locks out the keypad of the calibrator, and allows for remote operation only
LOOP_PWR_OFF	Turns 24V loop power off.
LOOP_PWR_ON	Turns 24V loop power on.
LOOP_PWR?	Returns the state of 24V loop power.
LOWER_MEAS	Sets the mode for measuring on the lower display.
LT_START	Begin a leak test
LT_STOP	Stop a leak test
LT_INITIAL?	Returns the initial leak test value
LT_FINAL?	Returns the final leak test value
LT_RATE?	Returns the leak rate
L_PRES_UNIT	Sets the pressure unit on the lower display
OUT	Sets the output of the calibrator
OUT?	Returns the output of the calibrator
PRES?	Returns the model and serial number of the attached pressure module
PRES_UNIT?	Returns the pressure unit for the upper and lower display

PULSE_CNT	Sets the number of pulses for the pulse train
PULSE_CNT?	Returns the number of pulses in the pulse train
REMOTE	Puts the calibrator in remote mode
RTD_TYPE	Sets the RTD type
RTD_TYPE?	Returns the RTD type
RTD_WIRE	Sets the number of wires used by the RTD mode.
RTD_WIRE?	Returns the wire number setting used in the RTD mode
SCALE_FUNC	Sets the scaling function to volts or mA
SCALE_FUNC?	Returns the scaling function
SCL_MA_HI	Sets 100% value for mA scaling
SCL_MA_HI?	Returns 100% value for mA scaling
SCL_MA_LO	Sets 0% value for mA scaling
SCL_MA_LO?	Returns 0% value for mA scaling
SCL_V_HI	Sets 100% value for volts scaling
SCL_V_HI?	Returns 100% value for volt scaling
SCL_V_LO	Sets 0% value for volts scaling
SCL_V_LO?	Returns 0% value for volt scaling
SCL_ERR_HI	Sets 100% value for scaling and %error
SCL_ERR_HI?	Returns 100% value for scaling and %error
SCL_ERR_LO	Sets 0% value for scaling and %error
SCL_ERR_LO?	Returns 0% value scaling and %error
SIM	Sets the output for mA simulation
SIM?	Returns the output of the mA simulation
ST_START	Starts a new switch test if the unit is in switch test mode
ST_CLOSE?	Returns the value at which the switch closed
ST_OPEN?	Returns the value at which the switch opened
ST_DEAD?	Returns the value of the dead band of the switch
TC_TYPE	Sets the thermocouple type
TC_TYPE?	Returns the thermocouple type
TEMP_UNIT	Sets input/output temperature unit for RTD and TC
TEMP_UNIT?	Returns the temperature unit for RTD and TC
TRIG	Starts and stops the pulse train in pulse mode
TRIG?	Returns TRIGGERED when a pulse train is on. Returns UNTRIGGERED when the pulse train is off.
TSENS_TYPE	Sets temperature sensor type.
TSENS_TYPE?	Returns temperature sensor type

UPPER_MEAS	Sets the measuring mode for the upper display.
U_PRES_UNIT	Sets the upper pressure unit
VAL?	Returns the measured values
ZERO_MEAS	Zeros the pressure module
ZERO_MEAS?	Returns the zero offset of the pressure module

**Table 3: Parameter units**

<b>Units</b>	<b>Meaning</b>
MA	milliamps of current
MV	Voltage in millivolts
V	Voltage in volts
CPM	Frequency in cycles per minute
Hz	Frequency in Hertz
KHz	Frequency in kiloHertz
Ohms	Resistance in Ohms
Cel	Temperature in Celsius
Far	Temperature in Fahrenheit
Psi	Pressure in pounds per square-inch
InH2O4C	Pressure in inches of water at 4°C
InH2O20C	Pressure in inches of water at 20°C
CmH2O4C	Pressure in centimeters of water at 4°C
CmH2O20C	Pressure in centimeters of water at 20°C
Bar	Pressure in bars
Mbar	Pressure in millibars
KPaI	Pressure in kiloPascals
InHg	Pressure in inches of mercury at 0°C
MmHg	Pressure in millimeters of mercury at 0°C
Kg/cm2	Pressure in kilograms per square-centimeter

**Table 4: Error codes**

<b>Error Number</b>	<b>Error Description</b>
100	A non-numeric entry was received where it should be a numeric entry
101	Too many significant digits entered
102	Invalid units or parameter value received

103	Entry is above the upper limit of the allowable range
104	Entry is below the lower limit of the allowable range
105	A required command parameter was missing
106	An invalid pressure unit was received
107	An invalid CJC_STATE was received
108	An invalid TSENS_TYPE was received
109	Pressure module not connected
110	An unknown command was received
111	An invalid RTD or TC parameter value was received
112	The serial input buffer overflowed
113	Too many entries in the command line
114	The serial output buffer overflowed
115	Output is overloaded
116	Calibrator not in pulse train mode when TRIG was received
117	An invalid FREQ_TYPE was received

## 5. Entering Commands

Commands for the calibrator may be entered in upper or lower case. There is at least one space required between the command and parameter, all other spaces are optional. Almost all commands for the calibrator are sequential, any overlapped commands will be indicated as such. This section will briefly explain each of the commands and describe their general use, which will include any parameters that may be entered with the command as well as what the output of the command is.

### 5.1 Common Commands

#### **\*CLS**

Clears the ESR, the error queue and the RQS bit. Also terminates all pending operations. When writing programs, use before each procedure to avoid buffer overflow.

#### **\*ESE**

Loads a byte into the Event Status Enable register. The command is entered with a decimal number that, when converted to binary, enables the right bits in the Event Status Register. For example:

\*ESE 133

When 133 is converted to binary it is 10000101. Bits 7, 2, and 0 will be enabled.

### **\*ESE?**

Returns the contents of the Event Status Enable register. The value returned is a decimal. For example, if the register has the following settings:

10000101      than the value returned will be 133.

### **\*ESR?**

Returns the contents of the Event Status Register in decimal form. For example:

If the ESR contains 10111001, \*ESR? will return 185.

### **\*IDN?**

Returns the manufacturer, model number, and firmware revision of the Calibrator. For example:

\*IDN? will return AMETEK, ASC301, 250, 1.00

### **\*OPC**

Enables the Operation Complete setting in the ESR. This setting makes it possible to check if an operations is complete after it has been initialized.

For example this operation could be used with the command TRIG.

### **\*OPC?**

Returns 1 when all operations are complete, and causes program execution to pause until all the operations are complete. For example:

TRIG ; \*OPC? will return a 1 when the pulse train initiated by TRIG is complete.

### **\*RST**

Resets the state of calibrator to the power-up state. All subsequent commands are held off until the execution of the command is complete.

### **\*SRE**

Loads a byte into the Service Request Enable register. A decimal number must be entered, which when converted to binary, corresponds to the correct settings.

For example:

\*SRE 8 enters the binary number 00001000 to the SRE. This enables bit 3. Bit 6 is not used.

### **\*SRE?**

Returns a byte from the SRE. The byte is returned in decimal format. For example:

If 40 is returned, bits 5 and 3 are enabled.

### **\*STB**

Returns the status byte in decimal form from the Serial Poll Status Byte. For example;

If 72 is returned, bits 6 and 3 are enabled.

### **\*WAI**

Prevents further remote commands from being executed until all previous commands are executed. For example:

OUT 10 MA ; \*WAI ; OUT 5 V will output 10mA and wait until output settles, then volts command will be processed.

## ***5.2 Calibrator Commands***

### **CAL\_START**

Puts the calibrator in calibration mode. The main display will say CALIBRATION MODE and a calibration menu will be displayed on the terminal.

### **CJC\_STATE**

Turns Cold Junction Compensation (CJC) on or off, when the calibrator is in thermocouple (TC) mode. The command is used by adding ON or OFF after it.

For example:

CJC\_STATE OFF      turns CJC off.

### **CJC\_STATE?**

Tells whether the Cold Junction Compensation in thermocouple mode is turned on or turned off. The calibrator returns OFF if CJC is off, and ON if CJC is on.

### **CPRT\_COEFA**

This command is used for entering a custom RTD into the calibrator. The numeric value entered after the command will be set as the first coefficient of the polynomial used by the custom RTD.

For example:

CPRT\_COEFA 3.9083E-3 enters 3.9083E-3 as coefficient A.

### **CPRT\_COEFA?**

Returns the number which was entered for the first coefficient of the polynomial used in the custom RTD. Using the example above CPRT\_COEFA? Would return:

3.9083E-3

### **CPRT\_COEFB**

This command is used for entering a custom RTD into the calibrator. The numeric value entered after the command will be set as the second coefficient of the polynomial used by the custom RTD.

For example:

CPRT\_COEFB -5.775x10-7 enters -5.775x10-7 as coefficient B.

### **CPRT\_COEFB?**

Returns the number, which was entered for the first coefficient of the polynomial used in the custom RTD. Using the example above, CPRT\_COEFB? Would return:

-5.775x10-7

### **CPRT\_COEFC**

This command is used for entering a custom RTD into the calibrator. The numeric value entered after the command will be set as the first coefficient of the polynomial used by the custom RTD.

For example:

CPRT\_COEFC -4.183x10-12 enters -4.183x10-12 as coefficient C.

### **CPRT\_COEFC?**

Returns the number which was entered for the first coefficient of the polynomial used in the custom RTD. Using the example above CPRT\_COEFC? Would return:

-4.183x10-12

### **CPRT\_MIN\_T**

Sets the minimum temperature of the custom RTD range. The temperature value must be entered with a degrees label, CEL for Celsius and FAR for Fahrenheit.

For example:

CPRT\_MIN\_T -260 CEL enters -260°C as the minimum temperature.

### **CPRT\_MIN\_T?**

Returns the value entered for minimum temperature in the range for a custom RTD. Note that the Calibrator always returns numbers in scientific notation. The above example would return:

-2.600000E+02, CEL

### **CPRT\_MAX\_T**

Sets the maximum temperature of the custom RTD range. The temperature value must be entered with a degrees label, CEL for Celsius and FAR for Fahrenheit.

For example:

CPRT\_MAX\_T 0.0 CEL enters 0.0°C as the maximum temperature.

### **CPRT\_MIN\_T?**

Returns the value entered for minimum temperature in the range for a custom RTD. The above example would return:

0.000000E+00, CEL

## **CPRT\_R0**

Sets the 0° resistance, R0, in the custom RTD. The value must be entered with a units label. Refer to the Parameter Units table for assistance.

For example:

CPRT\_R0 100 OHM sets R0 to 100 ohms.

CPRT\_R0?

Returns the value for the resistance in custom RTD. The above example would return:

1.000000E+02, OHM

## **FAULT?**

Returns the error code number of an error that has occurred. The command may be entered when the previous command did not do what it was meant to do.

For example, if a value for current output is entered that is bigger than the supported range (0-24mA) FAULT? Would return:

103 which is the code number for an entry over range.

Refer to the Error Codes table for more information on error code numbers.

## **FREQ\_LEVEL**

Sets the amplitude of the wave used in the Frequency Out and Pulse modes. The range for amplitude entered may be found in the Specifications section.

For example:

FREQ\_LEVEL 5 V sets the amplitude at 5Vpp.

## **FREQ\_LEVEL?**

Returns the amplitude of the wave used in Frequency Out and Pulse modes.

FREQ\_LEVEL? with the above example would return:

5.000000E+00, V

## **FREQ\_TYPE**

When in frequency mode, sets the calibrator to output a continuous wave (Frequency Out), or a pulse train. To set the calibrator to continuous wave enter CONT after the command. To set the calibrator to pulse enter PULSE after the command. For example:

FREQ\_TYPE CONT will set the calibrator to FREQ OUT.

**Note:** This command does not put the calibrator in frequency mode. Use the OUT command to put the calibrator in frequency mode.

### **FREQ\_TYPE?**

Tells whether calibrator is sourcing a pulse or a continuous wave. The command will return CONT if the calibrator is in FREQ OUT mode, and PULSE if the calibrator is in PULSE mode.

### **FREQ\_UNIT**

Sets the unit for frequency. There are three ranges of frequencies for frequency and pulse modes, CPM (cycles per minute), Hz, and kHz. Use this command to select the right range. For example:

FREQ\_UNIT HZ sets the frequency to Hz range

### **FREQ\_UNIT?**

Returns the frequency unit currently being used by the frequency and pulse modes.

### **FUNC?**

Returns the current mode of the upper and lower displays. For example if the calibrator is set to volts on the upper display, and pressure on the lower display, FUNC? Would return:

DCV, PRESSURE

### **HART\_ON**

Puts a 250 $\Omega$  Hart resistor in series with the mA source circuit and the isolated mA read with loop power circuit.

### **HART\_OFF**

Removes the 250 $\Omega$  Hart resistor from the mA source circuit and the isolated mA read with loop power circuit.

### **HART?**

Returns the state of the Hart resistors.

## **LOCAL**

Restores the calibrator to local operation if it was in remote mode. Also clears LOCKOUT if the unit was in lockout mode.

## **LOOP\_PWR\_OFF**

Turns 24V loop power off for isolated mA read functions including %Error and Scaled mA.

## **LOOP\_PWR\_ON**

Turns 24V loop power on for isolated mA read functions including %Error and Scaled mA.

## **LOOP\_PWR?**

Returns the state of the 24V loop power supply for isolated mA read functions including %Error and Scaled mA, either ON or OFF.

## **LOWER\_MEAS**

Sets the lower display to measure mode. The command is followed by any of the parameters except for pulse and mA sim, which are source only. Enter DCI for mA, DCV for volts, TC for thermocouple, RTD for RTD, FREQUENCY for frequency, and PRESSURE for pressure. For example:

LOWER\_MEAS DCV sets the lower display mode to VOLTS IN

## **LT\_START**

Starts a leak test if you are in leak test mode.

## **LT\_STOP**

Stops the leak test timer and puts the unit in leak test recall mode.

## **LT\_INITIAL?**

If the unit is in leak test recall mode the query returns the pressure at the start of the leak test.

## **LT\_FINAL?**

If the unit is in leak test recall mode the query returns the pressure at the end of the leak test.

## **LT\_RATE?**

If the unit is in leak test recall mode the query returns the leak rate.

## **L\_PRES\_UNIT**

Sets the unit for measuring pressure on the lower display. Add the unit after the command. The available pressure units and their syntax are shown in the Table 7. (Parameter Units).

For example:

L\_PRES\_UNIT KPAL sets the pressure unit to kiloPascals

## **OUT**

Sets the output of the calibrator. This command may be used to output mA, volts, frequency, temperature, and ohms. Frequency output, which is set by the command `FREQ_TYPE`, is either continuous or pulse. The calibrator is automatically set to source mode when `OUT` is entered. A number and its unit must follow the command. See Table 7. (Parameter Units) for a list of available units. For example:

OUT 10 MA sets the calibrator to mA OUT mode and sets the output to 10mA.

## **OUT?**

Returns the output of the calibrator. Using the above example, `OUT?` Would return:

1.000000E-02, A

## **PRES?**

Returns the model and serial number of the attached pressure unit. Returns NONE if no pressure unit is attached. For example:

PRES? Will return AMETEK,001PNS,3,0

## **PRES\_UNIT?**

Returns the pressure units of both the upper and the lower display. For example if the unit on the upper display is bars, and on the lower it is psi, the command will return:

BAR, PSI

## **PULSE\_CNT**

Sets the number of pulses the calibrator will produce when it is triggered while in pulse mode. For example;

PULSE\_CNT 3000 will set the number of pulses to 3000.

## **PULSE\_CNT?**

Returns the number of pulses in the pulse train. Using the above example, the returned value would be:

3000

## **REMOTE**

Puts the calibrator in remote mode. From the remote mode the user can still use the keypad to get back to local unless the command LOCKOUT was entered before REMOTE. Then the keypad is totally locked out, and the user has to send the LOCAL command to get back to local operation.

## **RTD\_TYPE**

Sets the RTD type. The following is a list of RTD types they way they should be entered after the command:

P10(90)385	P50(90) 385	P100(90)385
P200(90)385	P400(90)385	P500(90)385
P1K(90)385	P50(90)391	P100(90)391
P100(90)392	M10(90)427	M50(90)428
M100(90)428	H120(90)672	P100(90)JIS
YSI(90)400	OHMS	CUSTOM

For example:

RTD\_TYPE P10(90)385 sets RTD type to Pt385-10

## **RTD\_TYPE?**

Returns the RTD type.

## **RTD\_WIRE**

Sets the number of wires used for connection in measuring RTDs. The calibrator measures RTDs using 2-, 3-, and 4-wire connections. After the command, enter 2W for 2- wire, 3W for 3-wire, and 4W for 4-wire. For example:

RTD\_WIRE 4W sets the connection to 4-wire

**RTD\_WIRE?**

Returns the number of wires used in the RTD connection.

**SCALE\_FUNC**

Sets the scaling function to volts or mA.

**SCALE\_FUNC?**

Returns the scaling function.

**SCL\_MA\_HI**

Sets 100% value for mA scaling calculation. E.g. SCL\_MA\_HI 20 mA

**SCL\_MA\_HI?**

Returns 100% value for mA scaling

**SCL\_MA\_LO**

Sets 0% value for mA scaling calculation. E.g. SCL\_MA\_LO 4 mA

**SCL\_MA\_LO?**

Returns 0% value for mA scaling calculation.

**SCL\_V\_HI**

Sets 100% value for volts scaling calculation. E.g. SCL\_V\_HI 10 V

**SCL\_V\_HI?**

Returns 100% value for volt scaling

**SCL\_V\_LO**

Sets 0% value for volts scaling calculation. E.g. SCL\_V\_HI 10 V

**SCL\_V\_LO?**

Returns 0% value for volt scaling calculation.

### **SCL\_ERR\_HI**

Sets 100% value for scaling and %error calculation. E.g. SCL\_ERR\_HI 100 CEL

### **SCL\_ERR\_HI?**

Returns 100% value for scaling and %error calculation.

### **SCL\_ERR\_LO**

Sets 0% value for scaling and %error calculation. E.g. SCL\_ERR\_LO 0 CEL

### **SCL\_ERR\_LO?**

Returns 0% value scaling and %error calculation.

### **SIM**

Sets the output for current simulation. This command also switches the calibrator into mA simulation mode. A number and a unit must be entered after the command. For example:

SIM 5 MA sets the current simulation at 5 mA

### **SIM?**

Returns the output of the current simulation. With the example above, the output would be:

5.000000E-03, A

### **ST\_START**

Starts a new switch test if the unit is in switch test mode.

### **ST\_CLOSE?**

In switch test recall mode this command returns the value at which the switch closed.

### **ST\_OPEN?**

In switch test recall mode this command returns the value at which the switch opened.

## **ST\_DEAD?**

In switch test recall mode this command returns the dead band of the switch.

## **TC\_TYPE**

Sets the type of the thermocouple. All available types are shown in the TC Types table in Section 8. (Specifications). For example:

TC\_TYPE B sets thermocouple type to B

## **TC\_TYPE?**

Returns the type of thermocouple the calibrator is set to.

## **TEMP\_UNIT**

Sets the temperature unit for sourcing and measuring RTD and TC. Add CEL after the command for Celsius, and FAR for Fahrenheit. For example:

TEMP\_UNIT CEL sets the temperature to be measured or sourced to Celsius.

## **TEMP\_UNIT?**

Returns the temperature unit that is currently used for measuring and sourcing RTD and TC.

## **TRIG**

Starts and stops the pulse train when the calibrator is in pulse mode. The parameters of the pulse train are set by commands PULSE\_CNT, and FREQ\_LEVEL. Entering TRIG initializes the train. Entering the command while the pulse train is running stops it.

## **TRIG?**

Returns TRIGGERED if the pulse train is running, and returns UNTRIGGERED when the pulse train is not running. Returns NONE when the calibrator is not in pulse mode.

## **TSENS\_TYPE**

Sets the temperature sensor type to thermocouple, or to RTD for temperature measurement. After the command add TC for thermocouple, or RTD for RTDs. For example:

TSENS\_TYPE TC sets the sensor type to thermocouple

## **TSENS\_TYPE?**

Returns the type of sensor that is currently set to measure temperature, either TC or RTD.

## **UPPER\_MEAS**

Sets the measuring mode for the upper display. After the command enter DCI for mA, DCI\_LOOP for mA with loop power, DCV for volts, and PRESSURE for pressure. For example:

UPPER\_MEAS DCV sets the upper display to measure volts

## **U\_PRES\_UNIT**

Sets the unit for measuring pressure on the upper display. Add the unit after the command. The available pressure units and their syntax are shown in Table 7. (Parameter Units). For example:

U\_PRES\_UNIT MMHG sets the pressure unit to millimeters of mercury at 0°C

## **VAL?**

Returns the value of any measurement taking place on the upper and lower display. For example, if the upper display is measuring 5mA, and the lower display is measuring 10V, then VAL? will return:

5.000000E-03, A, 1.000000E+01, V

## **ZERO\_MEAS**

Zeroes the attached pressure module. Enter the zeroing value in PSI after the command when zeroing an absolute pressure module.

## **ZERO\_MEAS?**

Returns the zero offset or the reference value for absolute pressure modules.



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