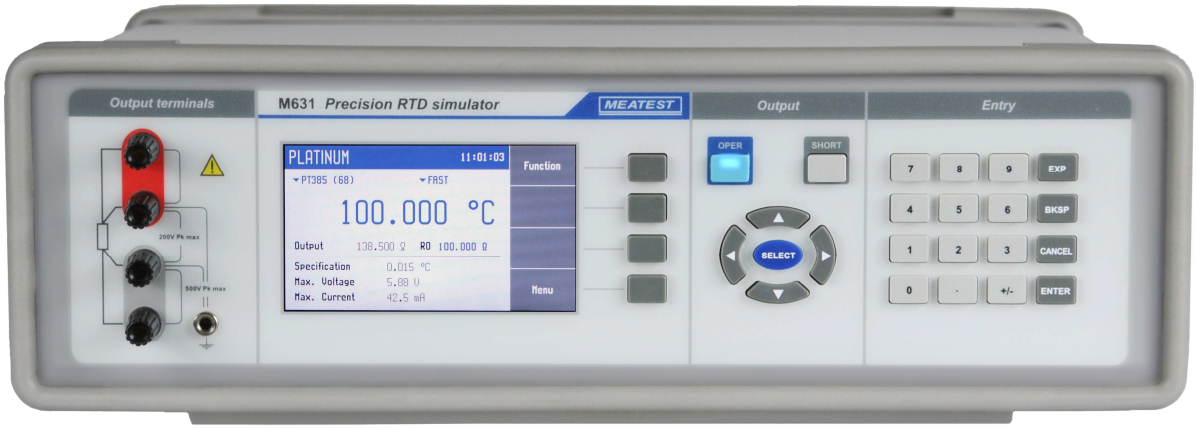
MC631

Precision RTD Simulator

Operation manual



Content

Figures

Tables

1. Basic information

Precision RTD Simulator MC631 is suitable for automated simulation of different resistance sensors (temperature, pressure, position, force …). Internal design eliminates "zero resistance effect" which is typical for most resistance decades.

Resistance value is created via appropriate combination of physical resistors. RTD simulator is equipped with built-in function of direct simulation of most frequent temperature Pt and Ni sensors. Low thermal voltage relays and stable resistors are used as main parts of the RTD Simulator. Actual set values are displayed high resolution TFT display. MC631 is sophisticated instrument with its own re-calibration procedure. The procedure enables to correct any deviation in resistance without any mechanical adjusting.

Instrument is especially suitable for automatic testing procedures. RS232 line (optionally IEEE488, USB and Ethernet bus) is used for connecting RTD simulator to the computer.

2. Preparation for use

2.1. Inspecting package contents, selecting the installation location

Basic package includes the following items:

- RTD Simulator MC631
- RS232 cable
- CD with demo program
- User's manual
- Test report

The instrument must be powered by 230/115 V – 50/60 Hz mains. Before powering on the instruments, place it on a level surface. If the instrument was stored out of range of reference temperatures, let it stabilize for one hour.

2.2. Power on

- Before connecting the instrument to the mains, check the position of the mains voltage selector located at the rear panel.
- Plug one end of the power cord into the connector located at the rear panel and connect the other end of the power cord into a wall outlet.

- Switch on the mains switch located at the rear panel. Display is lit.

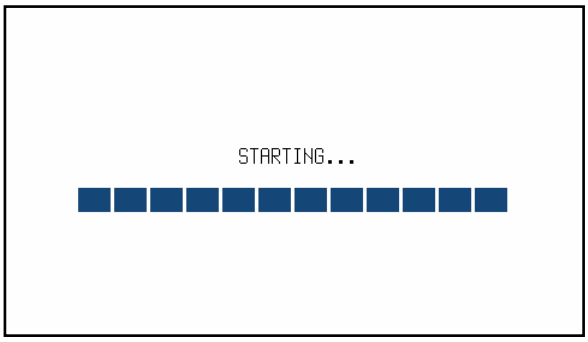


Figure 1 Starting Screen

- The instrument performs internal hardware checks for app. 5 seconds.
- After the tests conclude, the instrument resets to its reference state, i.e. the following parameters are set:

Function	Resistance
Set value	100.00 Ω
Output terminals	OFF

2.3. Warm-up time

The instrument works after it is switched on and the initial checks complete. Specified parameters are only guaranteed after the instrument warms up for 10 minutes.

2.4. Safety precautions

The instrument has been designed according to EN 61010-1:2011. Safety is ensured by the design and by the use of specific component types.

The manufacturer is not liable for the damage caused by modification of the construction or replacement of parts with non-original ones.

Safety symbols used on the equipment

Warning, reference to the documentation

4. Operation

4.1. Connection and disconnection of output terminals

Set value is connected (disconnected) to the output terminals after pressing OPER key. Connected output terminals are indicated by the lit LED in the key.

Disconnected output terminals can be used for “Open terminals” simulation. “Short circuit” is simulated after pressing SHORT key. Active SHORT key (LED in the key is ON) replaces the main value with the short circuit. Also the short circuit must be connected to the output terminals by the OPER key.

4.2. Wires connection

Output resistance is available on R output terminals. Available is 2, 3 and 4-wire connection. Both sides (red and grey) are floating up to 500Vpk against the case (PE).

Ground terminal is connected to the metal case and to the protective earth (PE).

4.3. Setting the function

Function can be changed after pressing „Function“ softkey. New function is selected using cursor keys ▲,▼ or display softkeys. Selection must be confirmed by pressing SELECT key or „OK“ softkey.

Device supports following functions:

Resistance
Offers direct setting of exact resistance value.

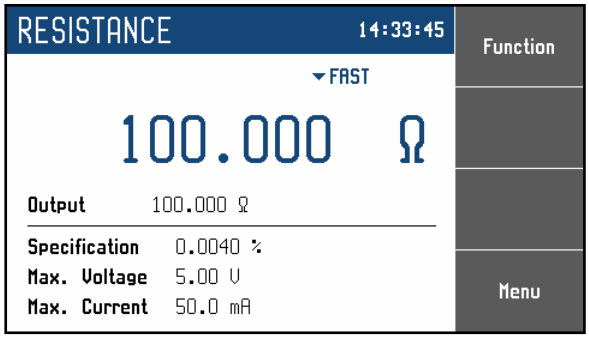


Figure 5 Resistance screen

Editable parameters:
Resistance value: 16 Ω … 400 kΩ
Switching mode: FAST, SMOOTH, VIA OPEN, VIA SHORT

Platinum
Offers direct setting of temperature of simulated platinum thermometer.

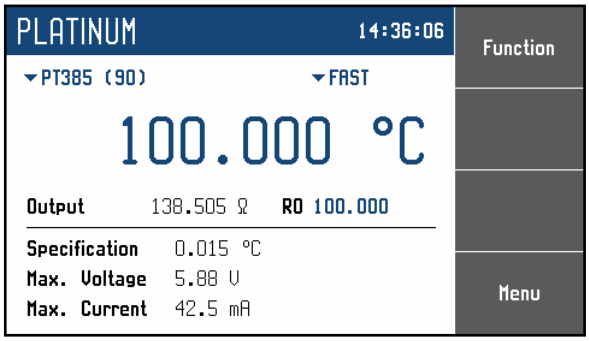


Figure 6 Platinum screen

Editable parameters:
Temperature: -200 °C … +850 °C (-328 °F … 1562 °F)
R0 value: 100 Ω … 1 kΩ
Temperature standard: PT385 (68), PT385 (90), PT3916, PT3926, PT User
Switching mode: FAST, SMOOTH, VIA OPEN, VIA SHORT

Nickel
Offers direct setting of temperature of simulated nickel thermometer.

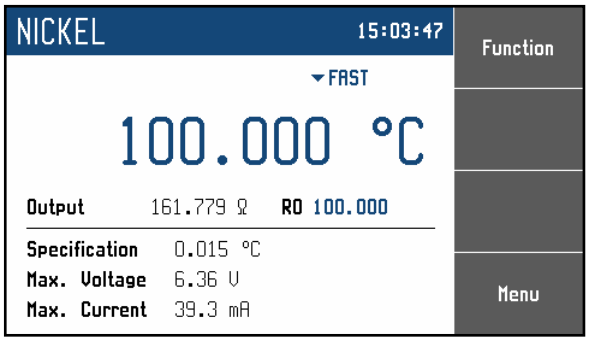


Figure 7 Nickel screen

Editable parameters:
Temperature: -60 °C … +300 °C (-76 °F … 572 °F)
R0 value: 100 Ω … 1 kΩ
Switching mode: FAST, SMOOTH, VIA OPEN, VIA SHORT

User function

Offers simulation of conversion curve defined by a table. User can define more conversion curves. Values between defined points are linearly interpolated.

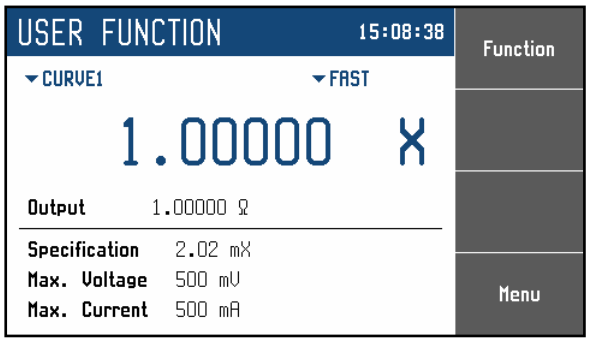


Figure 8 User function screen

Editable parameters:

Main value:	according to the function
User function:	curves defined by the user
Switching mode:	FAST, SMOOTH, VIA OPEN, VIA SHORT

Function is defined by table of user values and corresponding resistance values. This table is called „Curve“ and is editable. Maximum number of tables is 10 with each table having up to 8 values but the fewer tables are defined the more values within can be set. For instance one table can have up to 120 values, 3 tables can have up to 36 values and so on. Tables can be defined via remote control as well. Manual table setup can be done in *Menu → Device → User function curve*:

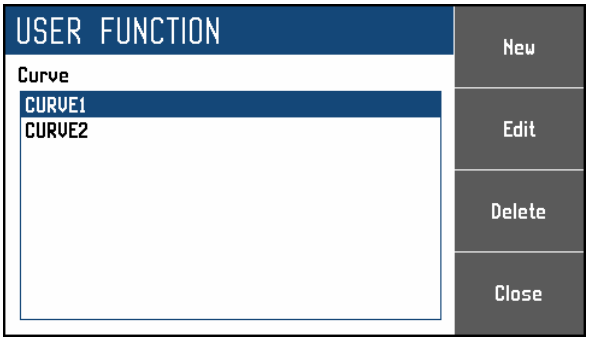


Figure 9 User function list

Menu shows a list of all previously defined tables (curves). Screen above shows two tables named „CURVE1“ and „CURVE2“ but number of tables and their names can be different due to local settings. Softkeys on the right hand side of the panel have these functions:

New – create a plain table (curve).

Edit – edit selected table. Table can be selected using ▲,▼ cursor keys.

Delete – delete selected table.

Close – close the menu and return to *Menu → Device*.

Creating a new table

Pressing the *New* softkey opens this submenu:

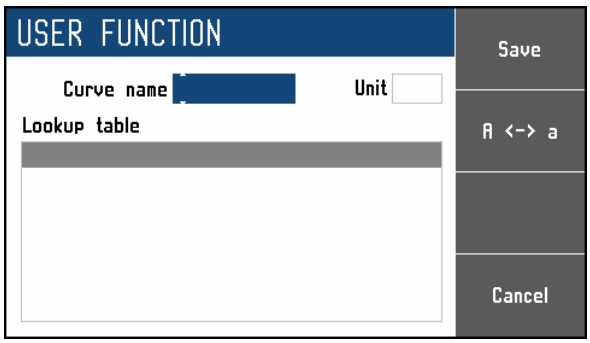


Figure 10 New user function

Curve name – table name is set using ▲,▼ (character selection) and ◄, ► (position) cursor keys. Name may be 8 characters long at most. Softkey „*A <-> a*“ switches between uppercase and lowercase of selected character. Table name has to be set before proceeding to the next step using SELECT key.

Unit – user function unit abbreviation is set in the same way as table name only it can be just up to two characters long. Unit abbreviation has to be set before proceeding to the next step using the SELECT key.

Lookup table – a place where you define user function using values in Ω. Table must contain at least two “user function value → Ω value” points so that a slope of the function can be calculated. Range in user function mode is given by actual resistance range of the simulator. Browsing through the table is done by ▲,▼ cursor keys. Editing is done using these contextual softkeys:

Add – create a new point.

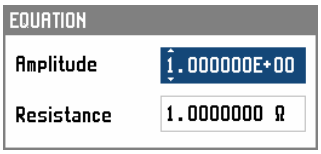


Figure 11 User function point editing

Amplitude – user function value in user units. Press the SELECT key to proceed.

Resistance – corresponding Ω value. Range is restricted to actual resistance range of the simulator.

Edit – edit selected point.

Delete – delete selected point.

Save – closes the table and saves current settings.

Cancel – closes the table and does not save current settings.

Editing an existing table

Existing table can be edited in the same way as it can be created. Editable entries (Curve name, Unit, Lookup table points) are selected using the SELECT key.

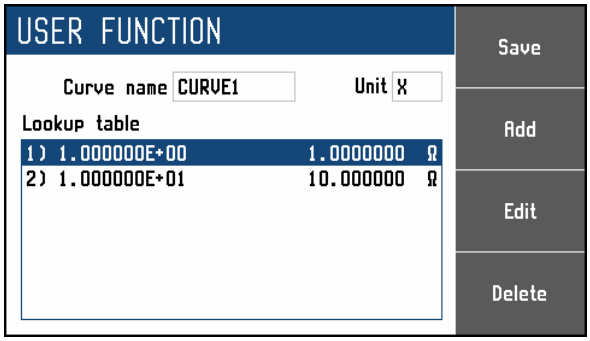


Figure 12 User function edit

Timing

Offers simulation of time-varying resistance defined by a table. User can define more time curves.

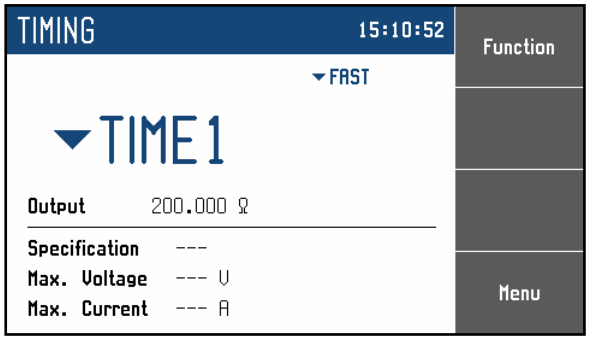


Figure 13 Timing screen

Editable parameters:

Timing table: table defined by the user
Switching mode: FAST, SMOOTH, VIA OPEN, VIA SHORT

Sequence is defined by table of time intervals and corresponding resistance values. This table is called „Preset“ and is editable. Maximum number of tables is 10 with each table having up to 4 time intervals but the fewer tables are defined the more time intervals within can be set. For instance one table can have up to 60 intervals, 3 tables can have up to 18 intervals and so on. Tables can be defined via remote control as well. Manual table setup can be done in *Menu → Device → Timings:*

Figure 14 Time sequence list

Menu shows a list of all previously defined tables (presets). Screen above shows three tables named „TIMING A“, „TIMING B“ a „TIMING C“ but number of tables and their names can be different due to local settings. Softkeys on the right hand side of the panel have these functions:

New – create a plain table (Preset).

Edit – edit selected table. Table can be selected using ▲,▼ cursor keys.

Delete – delete selected table.

Close – close the menu and return to *Menu → Device*.

Creating a new table

Pressing the *New* softkey opens this submenu:

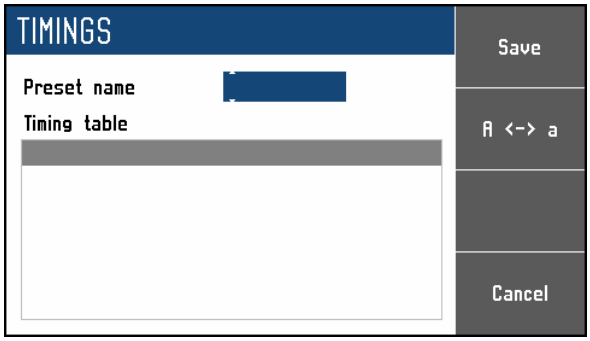


Figure 15 New sequence

Preset name – table name is set using ▲,▼ (character selection) and ◄, ► (position) cursor keys. Name may be 8 characters long at most. Softkey „*A <-> a*“ switches between uppercase and lowercase of selected character. Table name has to be set before proceeding to the next step using SELECT key.

Timing table – a list of values in Ω and their durations in seconds. Browsing through the table is done by ▲,▼ cursor keys. Editing is done using these contextual softkeys:

Add – create a new point.

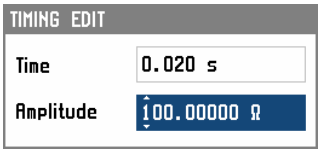


Figure 16 Timing sequence point editing

Time – duration of selected resistance (from 2 ms to 60 s).

Amplitude – corresponding Ω value. Range is restricted to actual resistance range of the simulator.

Edit – edit selected point.

Delete – delete selected point.

Save – closes the table and saves current settings.

Cancel – closes the table and does not save current settings.

Editing an existing table

Existing table can be edited in the same way as it can be created. Editable entries (Preset name, Timing table points) are selected using the SELECT key.

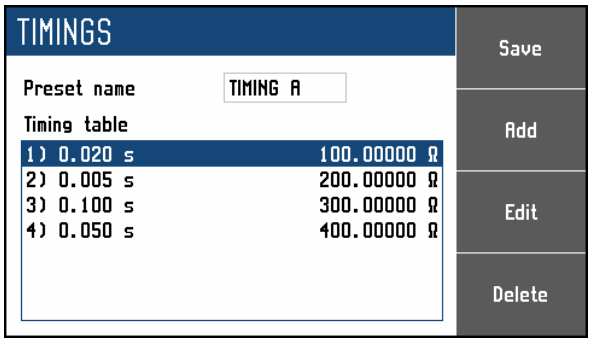


Figure 17 Timing sequence edit

4.4. Setting the value of output signal

Edit mode

Parameters of output signal can be changed in Edit mode. Only parameters displayed in blue color can be changed. Display can be switched to edit mode in different ways:

- Pressing numeric button
- Pressing „Sel“ button (in the middle of cursors buttons)
- Pressing cursor button

In edit mode is edited value highlighted by blue backgournd. Pressing the SELECT button you can change among editable (blue) parameters. Edit mode is finished by pressing CANCEL key.

Entry of the value using numeric keyboard

- Use the numeric keyboard to set the desired value. After the first digit is entered, input box is displayed. In the upper row of the input box is the name of edited parameter. Using softkeys you can enter the new value in different units.

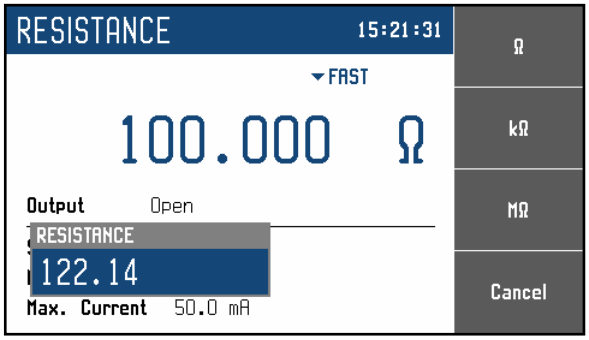


Figure 18 Numeric value entry

- Enter desired value.
- After the entry is complete press softkey with requested unit or press ENTER key. ENTER key inputs the value in basic units (Ω, °C, …).
- Instrument sets the new value.
- The value is copied to the appropriate field in the screen and the input box disappears.

Entry of the value using cursor keys

- Press ◄, ►, ▲ or ▼ key. The display now includes cursor marks which points to the active digit.
- ▲,▼ keys can be used to change the value. ◄, ► keys can be used to change the position of active digit.
- To get to the default screen, press CANCEL key.

Note:

- All parameters have limits (high and low). If the entered value is outside these limits warning message is displayed („Value too high (low)“) and new value is not accepted.

4.5. Setup Menu

Setup Menu is displayed after pressing „Menu“ softkey. Setup menu permits setting device’s parameters. New parameters are saved into the non-volatile memory.

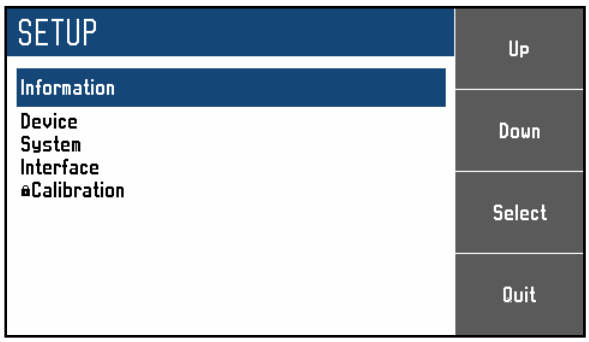


Figure 19 Setup menu

Required menu item is highlighted using cursor keys ▲,▼ or display softkeys. Highlighted menu is selected by pressing SELECT key or „OK“ softkey.

Information
This menu displays information about the device. Items can’t be changed by the user.

Manufacturer
Model
Seial number
Software version
Hardware version

Device
This menu permits setting operational parameters of device.

Temperature unit
Temperature functions can be expressed in different units. Available units are °C (Celsius), °F (Fahrenheit) and K (Kelvin).

Switching
Item defines the way how resistance value is changed. Value R1 is changed to value R2 in the time interval T. Resistance connected to the output terminals can have different values during the time interval T.

FAST	Fastest possible switching method. T is typically 400us. Resistance during T is undefined. It can be higher or lower than R1 (R2).
SMOOTH	Method with smalest possible resistance change. T is typically 1ms. Resistance during T can’t be higher than max (R1, R2) and can be lower than min (R1, R2).
VIA OPEN	2 steps switching method. R1 is switched to OPEN and than to R2. T is typically 1ms.

VIA SHORT	2 steps switching method. R1 is switched to SHORT and than to R2. T is typically 1ms. SHORT value is lower than min (R1, R2).

Platinum standard
Platinum thermometers can be simulated according to the different standards. Available standards are:

PT385 (68)	DIN, standard EN60751, temperature scale IPTS68 (A=3.90802e-3, B=-5.80195e-7, C=-4.2735e-12)
PT385 (90)	DIN, standard EN60751, temperature scale ITS90 (A=3.9083e-3, B=-5.775e-7, C=-4.18301e-12)
PT3916	Pt3916 temperature curve (A=3.9692e-3, B=-5.8495e-7, C=-4.2325e-12)
PT3926	Pt3926 temperature curve (A=3.9848e-3, B=-5.870e-7, C=-4.0e-12)
PT User	user defined temperature curve (A=3.9083e-3, B=-5.775e-7, C=-4.18301e-12) – values can be changed

Platinum user coefficients
This menu permits A, B and C coefficients definition of the PT User platinum standard (see above).

Timings
This menu permits definition of different time dependent resistance curves. Each curve is defined by the Timing table. Each row in the table contains information about resistance value and time for which is this value applied. If the timing function is activated all rows are sequentially executed. User can define more timing tables with different names. Number of rows is limited to 50.

User function curve
This menu permits definition of different conversion curves. Each curve is defined by the Lookup table. Each row in the table contains information about value of simulated function and appropriate resistance value. User can define more lookup tables with different names. Typical application is definition table for simulation of non-standard resistance thermometers. Number of rows is limited to 100.

System
This menu permits setting system parameters of device.

Language
Language setting.

Backlight
Display backlight level setting.

Beeper volume
Beeper volume level setting.

Keyboard beep
Enables / Disables keyboard beep.

Time
Internal time setting.

Date
Internal date setting

Interface
This menu permits setting parameters of remote control interfaces.

Active bus
Active bus setting. Only active bus can be used for remote control.

RS232 Baudrate
RS232 communication baudrate setting. The same baudrate must be used in the controller.

GPIB Address
GPIB address setting. Each instrument connected to the GPIB bus must have a unique address.

LAN Settings
Ethernet parameters setting. Device use Telnet protocol. Default setting is:

DHCP	ON	
IP Address	192.168.001.100	only valid if DHCP is OFF
Subnet mask	255.255.255.000	only valid if DHCP is OFF
Default gateway	255.255.255.255	only valid if DHCP is OFF
Port number	23	
Host name	MC631_SN6200 31	only valid if DHCP is ON

4.6. Calibration mode

In this mode resistance elements of the RTD simulator can be recalibrated. Access to the calibration mode is from the setup Menu.

Correct password must be entered before calibration. Without correct password the access to the calibration mode is refused. Default factory set calibration code is “2”. Return to standard mode is possible after pushing the key ESC.

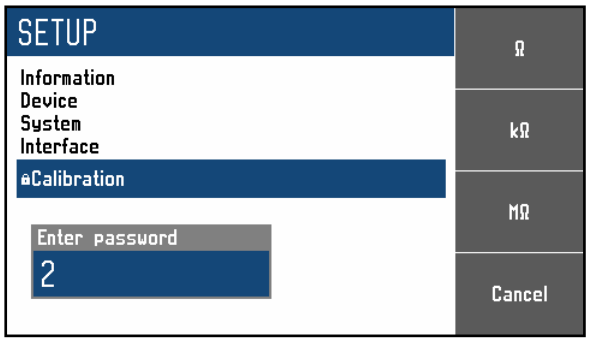


Figure 20 Password entry

Recalibration procedure consists of measuring of 24 basic resistance values and entering their actually measured data. Calibration point can be changes using display softkeys “Previous” and “Next”. Calibration value of selected resistance can be change using cursor keys ▲,▼, ◄, ►.

Following table describes nominal values of calibration points and requested recalibration accuracy:

Calibration points MC631

Standard	Nominal value	Requested Accuracy
R1	30,5 Ω	1 mΩ
R2	60,4 Ω	1 mΩ
R3	120 Ω	2 mΩ
R4	237 Ω	3 mΩ
R5	464 Ω	6 mΩ
R6	909 Ω	15 mΩ
R7	1,78 kΩ	30 mΩ
R8	3,48 kΩ	100 mΩ
R9	6,87 Ω	250 mΩ
R10	13,5 kΩ	500 mΩ
R11	26,6 kΩ	1 Ω
R12	52,2 kΩ	5 Ω
R13	103 kΩ	10 Ω
R14	202 kΩ	20 Ω
R15	396 kΩ	40 Ω
R16	778 kΩ	80 Ω
R17	1,54 MΩ	200 Ω
R18	3,03 MΩ	400 Ω
R19	6,0 MΩ	1 kΩ
R20	12 MΩ	5 kΩ
R21	23 MΩ	50 kΩ
R22	48 MΩ	200 kΩ
R22	100 MΩ	500 kΩ
R23	200 MΩ	1 MΩ

Table 1 MC631 Calibration points

Process of calibration consists of measuring partial resistances and writting their actual values into the RTD simulator:

- Set the first calibration point (resistance element). Use display softkeys “Previous” and “Next” to select the element.
- Measure resistance of the selected element. Use ohm-meter with appropriate accuracy in 4-wire connection mode.

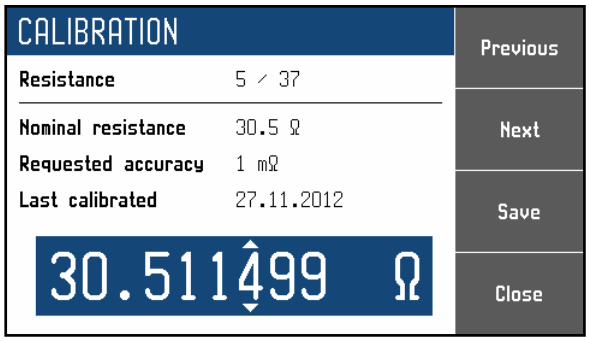


Figure 21 Calibration point screen

- Using cursor keys ▲,▼, ◄, ► adjust resistance value in MC631 according to the ohm meter.
- Confirm new calibration value by pressing “Save” softkey.
- Repeat above described procedure for all resistance elements.

5. Performance verification test

Parameter verification procedure is described in the chapter. Verification procedure is based on measuring resistance on the simulator output terminals with standard multimeter in recommended points.

Required equippment

- Ohm-meter nominal accuracy 0.001% in range 1 Ω to 1.2 MΩ (type Fluke 8508A or similar)

RTD simulator setting

Switch RTD simulator to the resistance function. Connect standard multimeter to the simulator output terminals. Use four-wire connection technique.

Procedure

Use following procedure to perform parameter verification test:

1. Switch both instruments on and let them for 1 hour stabilise in the laboratory with ambient temperature 23 ± 3 °C. Connect simulator terminals R4W to the standard ohm-meter (multimeter).
2. Case of the simulator should be grounded or connected to the Lo terminal of multimeter.
3. Check resistance value in points according to Table I.

Maximal absolute deviations MC631

Nominal value	**MC631** max. deviation
16 Ω	2.2 mΩ
20 Ω	2.4 mΩ
50 Ω	3.0 mΩ
100 Ω	4.0 mΩ
200 Ω	6.0 mΩ
500 Ω	15 mΩ
1 kΩ	30 mΩ
2 kΩ	100 mΩ
5 kΩ	750 mΩ
10 kΩ	1.5 Ω
20 kΩ	6.0 Ω
50 kΩ	50 Ω
100 kΩ	100 Ω
200 kΩ	800 Ω
400 kΩ	1.6 kΩ

Table 2 Verification - allowed deviations

6. Remote control

RTD simulator can be controled via RS232, GPIB, LAN and USB interface. The simulator can be only controlled by one of interfaces at a time. It is therefore necessary to select ans set-up one of the interfaces using the system menu. All interfaces shares the same commands except following commands, which are intended only for use with RS232, LAN and USB interface:

SYSTem:LOCal

This command places simulator in the "LOCAL" mode.

SYSTem:REMote

This command places simulator in the "REMOTE" mode.

SYSTem:RWLock

This command places the simulator in the "REMOTE" mode and locks all keys (including LOCAL key) on front panel.

NOTE: If device is not in REMOTE mode all other commands are ignored by simulator (for RS232, LAN and USB interface). With the exception of Compatible commands which are processed each time. GPIB interface places device in the "REMOTE" mode automatically by opening the GPIB interface and therefore these commands are not intended for this interface.

6.1. RS232 Interface

The simulator can be controled via standard RS232 interface.

Following equipment is required:

- MC631 RTD simulator
- Personal Computer (or other controling device) with RS232 port (USB-to-RS232 converter is also possible)
- 9-pin D-SUB, 3-wire direct (1:1) male/female RS232 cable

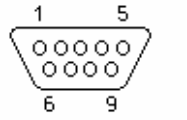
The RS232 interface must be selected from simulator system menu to be in operation (*SETUP->Interface->Active bus*). There is only one RS232 setting accesible from the simulator system menu under *SETUP->Interface* path:

RS232 Baudrate	1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200

Other RS232 parameters are fixed to the following settings:

Number of data bits	8
Number of stop bits	1
Parity	None
Handshake (XON/XOFF)	Off

RS232 connection



Pin	Label	I/O	Description
2	TXD	output	Transmitter
3	RXD	input	Receiver
5	GND	-	Ground

Figure 22 RS232 9 pin D-SUB MALE connector

Cable between simulator and computer description (configuration 1:1)

Computer	D-Sub 1	D-Sub 2	MC631
Receiver	2	2	Transmitter
Transmitter	3	3	Receiver
Ground	5	5	Ground

Table 3 RS232 cable connection

6.2. GPIB Interface (option)

The simulator can be controled via GPIB (General Purpose Interface Bus) interface.

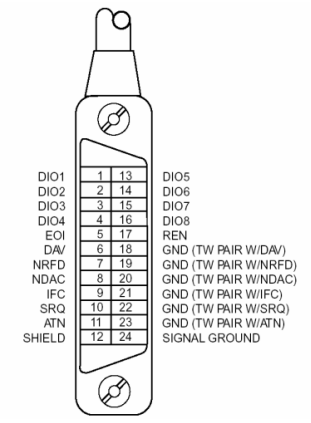
Following equipment is required:

- MC631 RTD simulator with LAN, USB, IEEE488 bus option
- Personal Computer (or other controling device) with GPIB interface
- GPIB cable

The GPIB interface must be selected from simulator system menu to be in operation (*SETUP->Interface->Active bus*). There is only one GPIB setting accesible from the simulator system menu under *SETUP->Interface* path:

GPIB Address 1 to 31

The instrument performs the following functions based on IEEE488 bus commands:



SH1, AH1, T5, L3, RL1, DC1

The instrument also recognizes the following general commands:
DCL Device Clear - resets the instrument to its basic state
SDC Selected Device Clear - resets the instrument to its basic state
GTL Go To Local - switches the remote control off
LLO Local Lock Out - switches the local control off, the instrument cannot be controlled from the front panel

Commands are identical to the commands for RS-232 interface. Detailed description is shown in chapter 8.2.

Figure 23 IEEE488 connector

6.3. LAN Interface (option)

LAN Interface allows communication with RTD simulator using Telnet protocol. A propper setting must be established.

Following equipment is required:

- MC631 RTD simulator with LAN, USB, IEEE488 bus option
- Personal Computer (or other controling device) with LAN interface
- LAN cable

The LAN interface must be selected from simulator system menu to be in operation (*SETUP->Interface->Active bus*). There are folowing LAN settings accesible from simulator system menu under *SETUP->Interface->LAN Settings* path (values are default ones):

DHCP	ON	
IP Address	192.168.001.100	only valid if DHCP is OFF
Subnet mask	255.255.255.000	only valid if DHCP is OFF
Default gateway	255.255.255.255	only valid if DHCP is OFF
Port number	23	
Host name	MC631_SN620031	only valid if DHCP is ON

If DHCP (Dynamic Host Configuration Protocol) is enabled, the IP Address and all necessary settings are done automatically and connection in Telnet protocol is done via “Host name” and “Port number”. Otherwise the IP address, Subnest mask and Default gateway should be properly set. In this case connection is done via “IP Address” and “Port number”.

Connection to simulator using Microsoft Telnet terminal with DHCP option enabled:

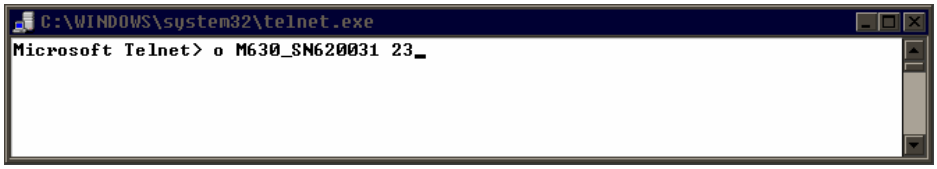


Figure 24 LAN connection 1

If connection is succesful following screen will appear:

Figure 25 LAN connection 2

6.4. USB Interface (option)

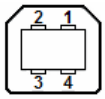
The RTD simulator can be controled via USB (Universal Serial Bus) interface.

Following equipment is required:

- MC631 RTD simulator with LAN, USB, IEEE488 bus option
- Personal Computer (or other controling device) with USB interface (USB type A connector)
- Standard USB A-B cable

The USB interface must be selected from simulator system menu to be in operation (*SETUP->Interface->Active bus*). There is no USB setting in the simulator.

RTD simulator is equiped with USB type B connector.



Pin	Label	Description
1	+5V	Power supply
2	DATA-	Data signal -
3	DATA+	Data signal +
4	GND	Ground

Figure 26 USB connector

Communication from user control program is performed via standard RS232 interface. Following settings should be set on your PC for propper operation:

Baudrate	9600 Bd
Data bits	8
Stop bits	1
Parity	None

Also proper COM port must be selected. After connecting simulator to your PC, virtual COM port should appear in System Control panel of Microsoft Windows OS. This COM port is labeled “USB Serial Port (COMxx)”.

6.5. Command syntax

The commands described in this chapter can be issued through all buses (RS232/GPIB/LAN/USB).

All commands listed in this chapter are explained in two columns:

KEYWORD and PARAMETERS.

KEYWORD column includes the name of the command. Each command includes one or more keywords. If a keyword is in brackets ([ ]), it is not mandatory. Non-mandatory commands are used only to achieve compatibility with language standard SCPI.

Capitals designate the abbreviated form of the commands; extended form is written in lowercase.

Command parameters are in brackets (<>); each parameter is separated using a comma. Parameters in brackets ([ ]) are not mandatory. Line (|) means “or” and is used to separate several alternative parameters.

Semicolon ‘;’ is used to separate more commands written on one line.

E.g. :RES 100;:OUTP ON

Terminators:

For GPIB interface each command line must end with <lf>. Response from the device also returns <lf>. For non GPIB interfaces <cr>, <lf> or <crlf> can be used as terminator. The device returns <crlf> in this case. The device performs all commands written on one line of the program after it receives terminator. Without terminator, the program line is not executed.

Description of abbreviations

<DNPD> = Decimal Numeric Program Data, this format is used to express decimal number with or without the exponent.

<CPD> = Character Program Data. Usually, it represents a group of alternative character parameters. E.g. {SERial|GPIB|USB|LAN}.

<SPD> = String Program Data (quoted string). This type of parameter is similar to CPD, but allows transmission of more ISO characters.

<BOOL> = Boolean Program Data. This type of parameter has only two states 0 and 1. Parameter can take form of integer value (0 or 1), or character alias (ON or OFF). Device always returns integer value (0 or 1).

<UNIT> = unit parameter works in conjunction with DNPD parameter and specifies unit of DNPD (numeric) value. Unit must be selected from predefined ones. If UNIT part is omitted, default one is used. Query always returns actual unit.

? = A flag indicating a request for the value of the parameter specified by the command. No other parameter than the question mark can be used.

(?) = A flag indicating a request for the parameter specified by the command. This command permits a value to be set as well as requested.

<cr> = carriage return. ASCII code 13. This code executes the program line.

<lf> = line feed. ASCII code 10. This code executes the program line.

6.6. SCPI Command Tree

This chapter sumarizes all public SCPI commands supported by device in alphabetic order. Detailed description follows in next chapter.

```
:CALibration
        :RESistance
                :AMPLitude(?) <DNPD>
                :SELect(?) <DNPD>
        :SECure
                :PASSword(?) <DNPD>
                :EXIT
:DISPlay
        :ANNotation
                :CLOCk
                        :DATE
                                :FORMat(?) {MDYS|MDYA|DMYS|DMYO|DMYA|YMDS|YMDO}
                        [:STATe](?) {ON|OFF|1|0}
        :BRIGhtness(?) <DNPD>
        :LANGuage(?) {ENGLish|DEUTsch|FRENch|RUSSian|SPANish|CZECh}
:OUTPut
        :SHORt(?) {ON|OFF|1|0}
        [:STATe](?) {ON|OFF|1|0}
        :SWITching(?) {FAST|SMOoth|OPEN|SHORt}
[:SOURce]
        :NICKel
                [:AMPLitude](?) <DNPD>[{CEL|FAR|K}]
                :ZRESistance(?) <DNPD>[OHM]
        :PLATinum
                [:AMPLitude](?) <DNPD>[{CEL|FAR|K}]
                :COEFficient(?) <DNPD>,<DNPD>,<DNPD>
                :STANdard(?) {PT385A|PT385B|PT3916|PT3926|USER}
                :ZRESistance(?) <DNPD>[OHM]
        :RESistance
                [:AMPLitude](?) <DNPD>[OHM]
        :TIMing
                :PAPPend <SPD>
                :PCOunt? <DNPD>
                :PRESet<IND_PRESET>
                        :NAME(?) <SPD>
                        :PDELete
                        :RAPPend <SPD>
                        :RCOunt? <DNPD>
                        :ROW<IND_ROW>
                                :AMPLitude(?) <SPD>
                                :RDELete
                :SELect(?) <DNPD>
        :UFUNction
                [:AMPLitude](?) <DNPD>
                :CURVe
                        :SELect(?) <DNPD>
                        :PAPPend <SPD>
```

```
                    :PCOunt? <DNPD>
                    :PRESet<IND_PRESET>
                        :NAME(?) <SPD>
                        :PDELete
                        :RAPPend <SPD>
                        :RCOunt? <DNPD>
                        :ROW<IND_ROW>
                            :AMPLitude(?) <SPD>
                            :RDELete
                        :UNIT(?) <SPD>
:STATus
    :OPERation
        :CONDition(?) <DNPD>
        :ENABle(?) <DNPD>
        [:EVENt]? <DNPD>
        :NTRansition(?) <DNPD>
        :PTRansition(?) <DNPD>
    :QUEStionable
        :CONDition(?) <DNPD>
        :ENABle(?) <DNPD>
        [:EVENt]? <DNPD>
        :NTRansition(?) <DNPD>
        :PTRansition(?) <DNPD>
:SYSTem
    :BEEPer
        :STATe(?) {ON|OFF|1|0}
        :VOLume(?) <DNPD>
    :COMMunicate
        :BUS(?) {SERial|GPIB|USB|LAN}
        :GPIB
            :ADDRess(?) <DNPD>
        :LAN
            :ADDRess(?) <CPD>
            :MASK(?) <CPD>
            :GATE(?) <CPD>
            :PORT(?) <DNPD>
            :HOST(?) <CPD>
            :DHCP(?) {ON|OFF|1|0}
        :RESTart
        :SERial
            :BAUD(?) {1200|2400|4800|9600|19200|38400|57600|115200}
    :DATE(?) <DNPD>,<DNPD>,<DNPD>
    :ERRor
        [:NEXT]? <CPD>
    :KEY(?) <DNPD>
    :LOCal
    :PRESet
    :REMote
    :RWLock
    :TIME(?) <DNPD>,<DNPD>,<DNPD>
    :VERSion? <CPD>
:UNIT
    :TEMPerature(?) {CEL|FAR|K}
*CLS
*ESE(?)
```

*ESR?
*IDN?
*OPC(?)
*OPT?
*RST
*SRE(?)
*STB?
*TST?
*WAI

6.7. Standard Status Data Structures

RTD simulator meets standard protocol according to the standard IEEE488.2. The protocol can be used for checking of error and status behavior of the device. It enables single-wire transmitting of SRQ command. The conditions on which SRQ signal (local control request) is sent can be set with parameters *STB?, *SRE?, *SRE, *ESR?, *ESE?, *ESE a *CLS.

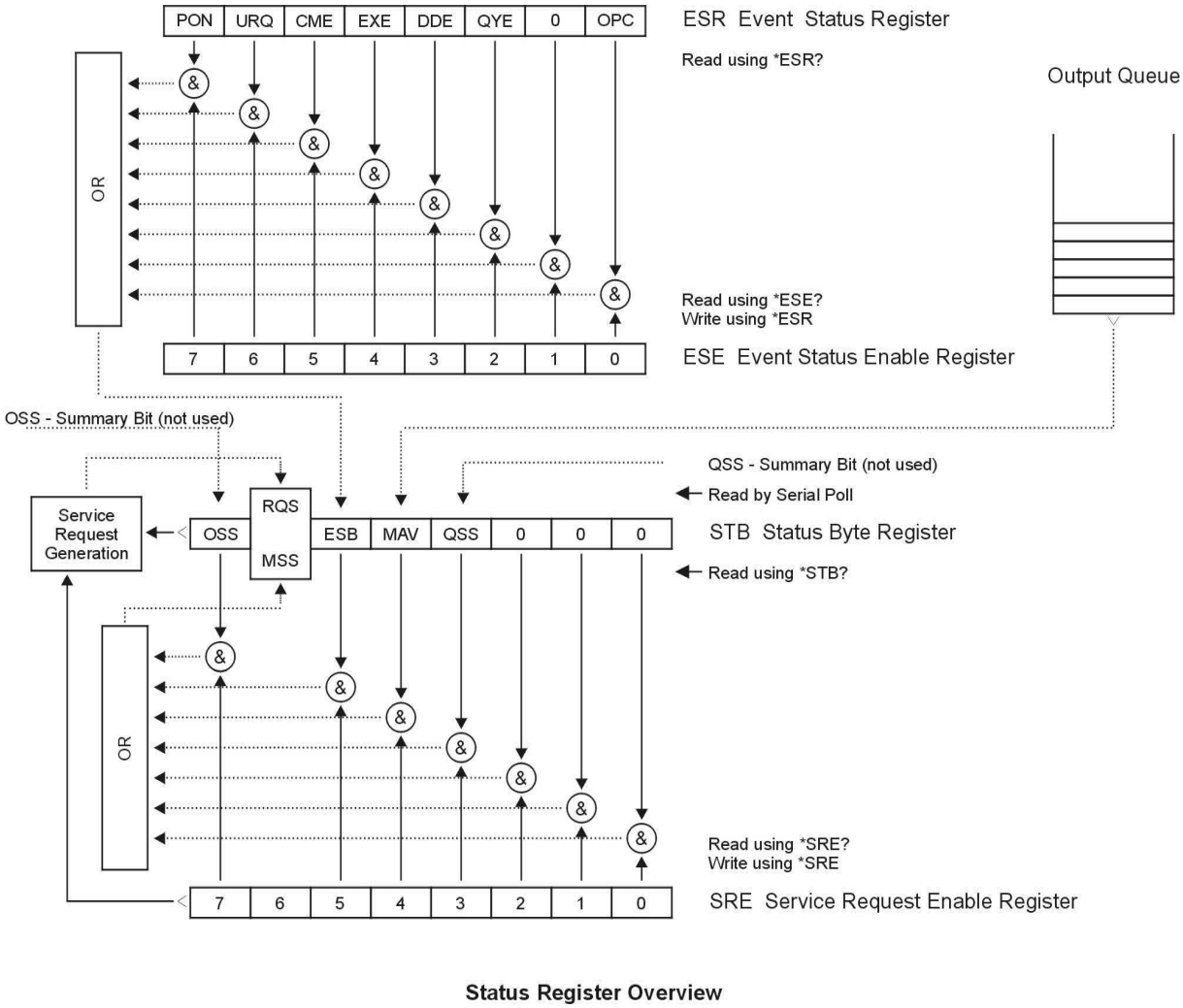


Figure 27 Status register overview

Status data structure contains following registers:

STB – Status Byte Register
SRE – Service Request Enable Register
ESR – Event Status Register
ESE – Event Status Enable Register
Output Queue

STB Status Byte Register

STB is main register where information from other status registers and from output queue is collected. Value of STB register is reset after switching on the device or after sending command *CLS. This command reset the STB register except bit MAV, which remains set if the output queue is not empty. STB register value can be read via serial message or through general query *STB?.

Bit configuration of Status Byte Register:

OSS Operation Summary Status, bit 7. SCPI-defined. The OSS bit is set to 1 when the data in the OSR (Operation Status Register) contains one or more enabled bits which are true.
RQS Request Service, bit 6. The bit is read as a part of status byte only when serial message is sent.
MSS Master Summary Status, bit 6. The MSS bit is set to 1 whenever bits ESB or MAV are 1 and enabled (1) in the SRE. This bit can be read using the *STB? command. Its value is derived from STB and SRE status.
ESB Event Summary Bit, bit 5. His value is derived from STB and SRE status. The ESB bit is set to 1 when one or more enabled ESR bits are set to 1.
MAV Message Available, bit 4. The MAV bit is set to 1 whenever data is available in the IEEE488 Output Queue (the response on query is ready).
QSS Questionable Summary Status, bit 3. SCPI-defined. The QSS bit is set to 1 when the data in the QSR (Questionable Status Register) contains one or more enabled bits which are true.

SRE Service Request Enable Register

The Service Request Enable Register suppresses or allows the STB bits. “0” value of a SRE bit means, that the bit does not influence value of MSS bit. Value of any unmasked STB bit results in setting of the MSS bit to the level “1” . SRE bit 6 is not influenced and its value is “0”. The SRE register value can be set via the command *SRE followed by mask register value (0 – 191). The register can be read with the command *SRE?. The register is automatically resets after switching the simulator on. The register is not reset by the command *CLS.

ESR Event Status Register

Every bit of the EventStatusRegister corresponds to one event. Bit is set when the event is changed and it remains set also when the event passed. The ESR is cleared when the power is turned on (except bit PON which is set), and every time it is read via command *ESR? Or cleared with *CLS.

Bit configuration of Event Status Register:

PON Power On, bit 7. This event bit indicates that an off-to-on transition has occurred in the device’s power supply.
URQ User Request, bit 6. Bit is not used and it is always “0”.
CME Command Error, bit 5. This event bit indicates that an incorrectly formed command or query has been detected by the instrument.
EXE Execution Error, bit 4. This event bit indicates that the received command cannot be executed, owing to the device state or the command parameter being out of limits.
DDE Device Dependent Error, bit 3. This event bit indicates that an error has occurred which is neither a Command Error, a Query Error, nor an Execution Error. A Device-specific Error is any executed device operation that did not properly complete due to some condition, such as overload.
QYE Query Error, bit 2. The bit is set if the simulator is addressed as talker and output queue is empty or if control unit did not pick up response before sending next query.

OPC Operation Complete, bit 0. This event bit is generated in response to the *OPC command. It indicates that the device has completed all selected pending operations.

ESE Event Status Enable Register

The Event Status Enable Register allows one or more events in the Event Status Register to be reflected in the ESB summary-message bit. This register is defined for 8 bits, each corresponding to the bits in the Event Status Register. The Event Status Enable Register is read with the common query *ESE?. Data is returned as a binary-weighted value. The Event Status Enable Register is written to by the common command, *ESE. Sending the *ESE common command followed by a zero clears the ESE. The Event Status Enable Register is cleared upon power-on.
It suppresses or allows bits in ESR register. Value „0“ of a bit of ESE register suppresses influence of appropriate bit of ESR register on value of sum bit of ESB status register. Setting of any unmask bit of ESR register results in setting of ESB status register. ESE register value can be modified by command *ESE followed by value of mask register (integer in range 0 –255). Reading of the register can be performed with command *ESE?. The register is automatically reset after switching on. The register is not reset with *CLS command.

Operation Status Register

Not used in the simulator.

Questionable Status Register

Not used in the simulator.

Output Queue

The Output Queue stores response messages until they are read from control unit. If there is at minimum one sign in the output queue, MAV register (message available) is set. The Output Queue is cleared upon power-on and after reading all signs from output queue.

Error Queue

The Error Queue stores error messages. They are placed in a “first in, first out” queue.
The queue is read destructively using the query command “SYSTem:ERRor?” to obtain a code number and errro message. The query “SYSTem:ERRor?” can be used to read errors in the queue until it is empty, when the message “0, No Error” will be returned.

6.8. SCPI Standard Commands

This chapter describes standard SCPI commands.

***IDN?**

Syntax:

*IDN?

Description:

This command returns the identification of the manufacturer, model, serial number and firmware revision.

Parameters:

<CPD> manufacturer
<CPD> model
<DNPD> serial number
<DNPD> frimware version

Remarks:

Overlapped command

Example:

*IDN? Response: Powertek,M631,620151,1.00

***OPC**

Syntax:

*OPC

Description:

This command sets the OPC bit in the ESR (Event Status Register) when all pending operations are complete.

Parameters:

None

Remarks:

Overlapped command

Example:

*OPC

***OPC?**

Syntax:

*OPC?

Description:

This command returns "1" to the output queue after all pending operations inside simulator are complete.

Parameters:

<DNPD> always returns 1

Remarks:

Sequential command

Example:

*OPC? Response: 1

***OPT?**

Syntax:

*OPT?

Description:

This command return the instrument's hardware fitment. The only parameter returns presence of GPIB/LAN/USB interface.

Parameters:

<DNPD> 0 – extended interface not present, 1 – extended interface present

Remarks:

Overlapped command

Example:

*OPT? Response: 1

***WAI**

Syntax:

*WAI

Description:

Prevents the instrument from executing any further commands or queries until all previous remote commands have been executed.

Parameters:

None

Remarks:

Sequential command

Example:

*WAI

***RST**

Syntax:

*RST

Description:

This command resets the device to its initial status.

Parameters:

None

Remarks:

Sequential command

Example:

*RST

***TST?**

Syntax:

*TST?

Description:

This command launches internal self-test and returns result.

Parameters:

<DNPD> 0 – test passed, 1 – test failed

Remarks:

Sequential command

Example:

*TST? Response: 0

***STB?**

Syntax:

*STB?

Description:

This query returns content of register STB, which carries the MSS bit status.

Parameters:

<DNPD> Status byte register, Range 0 … 255

Remarks:

Overlapped command

Example:

*STB? Response: 0

***SRE**

Syntax:

*SRE

*SRE?

Description:

This command allows set condition of the Service Request Enable register. Since bit 6 is not used, the maximum value is 191.

Parameters:

<DNPD> Service Request Enable register

Remarks:

Overlapped command

Example:

*SRE 2

*SRE? Response: 2

***ESR?**

Syntax:

*ESR?

Description:

This query returns the contents of the Event Status Register and clears the register.

Parameters:

<DNPD> Event Status Register

Remarks:

Overlapped command

Example:

*ESR? Response: 0

***ESE**

Syntax:

*ESE

*ESE?

Description:

This command programs the Event Status Enable register bits.

Parameters:

<DNPD> Event Status Enable register, Range 0 … 255

Remarks:

Overlapped command

Example:

*ESE 2

*ESE? Response: 2

***CLS**

Syntax:

*CLS

Description:

This command clears all status data structures in the device i.e. Event Status Register, Status Byte Register except the MAV bit, Operation Status Register, Questionable Status Register. Also error queue is cleared. Output queue is unaffected.

Parameters:

None

Remarks:

Overlapped command

Example:

*CLS

6.9. SCPI Commands

This chapters describes all public SCPI commands in detailed form. The commands here are in alphabetic order.

:CALibration:RESistance:AMPLitude

Syntax:

:CALibration:RESistance:AMPLitude <DNPD>
:CALibration:RESistance:AMPLitude?

Description:

This command sets calibration value of particular internal resistance standard at output terminals including all parasitic resistances inside simulator.

Parameters:

<DNPD>	Standard resistance value in Ohms. Ranges and default values varies in accordance to selected resistance etalon (see table “Calibration points MC631”).

Remarks:

This command requires "Calibration" access
Overlapped command
Value is not affected by reset

Example:

CAL:RES:AMPL 1.944
CAL:RES:AMPL? Response: 1.944000E+00

:CALibration:RESistance:SELect

Syntax:

:CALibration:RESistance:SELect <DNPD>
:CALibration:RESistance:SELect?

Description:

This command enters calibration mode and selects internal resistance standard for calibration. Output terminals are automatically switched-on.

Parameters:

<DNPD>	Range 1 ... Max. Resistance Count, one based index of resistance standard

Remarks:

This command requires "Calibration" access
Overlapped command

Example:

CAL:RES:SEL 1
CAL:RES:SEL? Response: 1

:CALibration:SECure:PASSword

Syntax:

:CALibration:SECure:PASSword <DNPD>

Description:

This command validates entered password and enables calibration access if verification is successful. Acces is invalidated after reset or if CAL:SEC:EXIT command is issued. Calibration password can be changed from simulator system menu *SETUP->Calibration->Change password.*

Parameters:

<DNPD>	Range 0 ... 4294967295 (default 0)

Remarks:

Overlapped command

Example:
CAL:SEC:PASS 0

:CALibration:SECure:EXIT

Syntax:
:CALibration:SECure:EXIT
Description:
This command exits calibration mode and access.
Parameters:
None
Remarks:
Overlapped command
Example:
CAL:SEC:EXIT

:DISPlay:ANNotation:CLOCk:DATE:FORMat

Syntax:
:DISPlay:ANNotation:CLOCk:DATE:FORMat <CPD>
:DISPlay:ANNotation:CLOCk:DATE:FORMat?
Description:
This command sets format of date displayed on device screen.
Parameters:
<CPD> {MDYS|MDYA|DMYS|DMYO|DMYA|YMDS|YMDO} (default MDYS)
·MDYS M/D/Y format (M-month, D-day, Y-year)
·MDYA M-D-Y format
·DMYS D/M/Y format
·DMYO D.M.Y format
·DMYA D-M-Y format
·YMDS Y/M/D format
·YMDO Y.M.D format
Remarks:
Overlapped command
Value is not affected by reset
Example:
DISP:ANN:CLOC:DATE:FORM MDYS
DISP:ANN:CLOC:DATE:FORM? Response: MDYS

:DISPlay:ANNotation:CLOCk[:STATe]

Syntax:
:DISPlay:ANNotation:CLOCk[:STATe] <BOOL>
:DISPlay:ANNotation:CLOCk[:STATe]?
Description:
This command enables/disables showing actual time in title on device screen
Parameters:
<BOOL> {ON|OFF|1|0} (default 1)
·ON actual time is shown
·OFF actual time is hidden
·1 same as ON
·0 same as OFF
Remarks:
Overlapped command
Value is not affected by reset
Example:
DISP:ANN:CLOC ON
DISP:ANN:CLOC? Response: 1

:DISPlay:BRIGhtness

Syntax:

:DISPlay:BRIGhtness <DNPD>

:DISPlay:BRIGhtness?

Description:

This command sets brightness of device display.

Parameters:

<DNPD> Range 0.0 ... 1.0 (default 1.0), 0.0 – Min, 1.0 – Max brightness

Remarks:

Overlapped command

Value is not affected by reset

Example:

DISP:BRIG 1.0

DISP:BRIG? Response: 1.000000E+00

:DISPlay:LANGuage

Syntax:

:DISPlay:LANGuage <CPD>

:DISPlay:LANGuage?

Description:

This command sets language that is used on device display.

Parameters:

<CPD> {ENGLish|DEUTsch|FRENch|RUSSian|SPANish|CZECh} (default ENGL)

- ·ENGLish english version
- ·DEUTsch deutsch version
- ·FRENch french version
- ·RUSSian russian version
- ·SPANish spanish version
- ·CZECh czech version

Remarks:

Overlapped command

Value is not affected by reset

Example:

DISP:LANG ENGL

DISP:LANG? Response: ENGL

:OUTPut:SHORt

Syntax:

:OUTPut:SHORt <BOOL>

:OUTPut:SHORt?

Description:

This command turns on short function. “Short” is activated only if output terminals are switched on (see OUTP:STAT command).

Parameters:

<BOOL> {ON|OFF|1|0} (default 0)

- ·ON short is set if output is on
- ·OFF resistance is set if output is on
- ·1 same as ON
- ·0 same as OFF

Remarks:

Overlapped command

Value is set to default after reset

Example:

OUTP:SHOR ON
OUTP ON
OUTP:SHOR? Response: 1

:OUTPut[:STATe]

Syntax:

:OUTPut[:STATe] <BOOL>
:OUTPut[:STATe]?

Description:

This command switches ON/OFF output terminals. This command operates in conjunction with OUTP:SHOR command:

OUTP:STAT	*OUTP:SHOR*	*Output terminals*
OFF	OFF	Open
OFF	ON	Open
ON	OFF	Resistance
ON	ON	Short

Table 4 OUTPut command structure

Parameters:

<BOOL> {ON|OFF|1|0} (default 0)
·ON output terminals are switched on
·OFF output terminals are switched off
·1 same as ON
·0 same as OFF

Remarks:

Overlapped command
Value is set to default after reset

Example:

OUTP ON
OUTP? Response: 1

:OUTPut:SWITching

Syntax:

:OUTPut:SWITching <CPD>
:OUTPut:SWITching?

Description:

If output amplitude is changed and output terminals are already switched on, some glitches appear at output terminals. This setting allows selecting a method how new resistance at output terminals is achieved.

Parameters:

<CPD> {FAST|SMOoth|OPEN|SHORt} (default FAST)
·FAST new resistance is set as fast as possible
·SMOoth new resistance is set with minimal ouput changes
·OPEN open function is activated before new resistance is set
·SHORt short function is activated before new resistance is set

Remarks:

Overlapped command
Value is not affected by reset

Example:

OUTP:SWIT FAST
OUTP:SWIT? Response: FAST

[:SOURce]:NICKel[:AMPLitude]

Syntax:

[:SOURce]:NICKel[:AMPLitude] <DNPD>[<UNIT>]
[:SOURce]:NICKel[:AMPLitude]?

Description:

This command sets temperature in Nickel mode. Node SOUR:NICK also selects "NICKEL" function if not already selected. If unit parameter is part of temperature, new unit is set.

Parameters:

<DNPD> temperature at Nickel function. Default value is 100.0 °C.
<UNIT> {CEL|FAR|K}
·CEL degrees of Celsius
·FAR degrees of Fahrenheit
·K Kelvin

Remarks:

Overlapped command
Value is set to default after reset

Example:

NICK 100.0
NICK? Response: 1.000000E+02 CEL

[:SOURce]:NICKel:ZRESistance

Syntax:

[:SOURce]:NICKel:ZRESistance <DNPD>[<UNIT>]
[:SOURce]:NICKel:ZRESistance?

Description:

This command sets resistance at 0 °C for Nickel function.

Parameters:

<DNPD> Range 100.0 ... 1000.0 (default 100.0).
<UNIT> {OHM}
·OHM

Remarks:

Overlapped command
Value is not affected by reset

Example:

NICK:ZRES 100.0
NICK:ZRES? Response: 1.000000E+02 OHM

[:SOURce]:PLATinum[:AMPLitude]

Syntax:

[:SOURce]:PLATinum[:AMPLitude] <DNPD>[<UNIT>]
[:SOURce]:PLATinum[:AMPLitude]?

Description:

This command sets temperature in Platinum mode. Node SOUR:PLAT also selects "PLATINUM" function if not already selected. If unit parameter is part of temperature, new unit is set.

Parameters:

<DNPD> temperature at Platinum function. Default value is 100.0 °C.
<UNIT> {CEL|FAR|K}
·CEL degrees of Celsius
·FAR degrees of Fahrenheit
·K Kelvin

Remarks:

Overlapped command
Value is set to default after reset

Example:

PLAT 100.0

PLAT? Response: 1.000000E+02 CEL

[:SOURce]:PLATinum:COEFficient

Syntax:

[:SOURce]:PLATinum:COEFficient <DNPD>,<DNPD>,<DNPD>

[:SOURce]:PLATinum:COEFficient?

Description:

This command allows to define Coefficients (A, B, C) used for "User" Platinum standard scale.

Parameters:

<DNPD> Range 3.0e-3 ... 5.0e-3 (default 3.9083e-3), Coefficient A

<DNPD> Range -7.0e-7 ... -5.0e-7 (default -5.775e-7), Coefficient B

<DNPD> Range -5.0e-12 ... -3.0e-12 (default -4.18301e-12), Coefficient C

Remarks:

Overlapped command

Value is not affected by reset

Example:

PLAT:COEF 3.9083e-3,-5.775e-7,-4.18301e-12

PLAT:COEF? Response: 3.908300E-03,-5.775000E-07,-4.183010E-12

[:SOURce]:PLATinum:STANdard

Syntax:

[:SOURce]:PLATinum:STANdard <CPD>

[:SOURce]:PLATinum:STANdard?

Description:

This command selects Platinum temperature standard.

Parameters:

<CPD> {PT385A|PT385B|PT3916|PT3926|USER} (default PT385A)

- ·PT385A Pt385 (68) standard
- ·PT385B Pt385 (90) standard
- ·PT3916 Pt3916 standard
- ·PT3926 Pt3926 standard
- ·USER User (see PLAT:COEF command)

Remarks:

Overlapped command

Value is not affected by reset

Example:

PLAT:STAN PT385A

PLAT:STAN? Response: PT385A

[:SOURce]:PLATinum:ZRESistance

Syntax:

[:SOURce]:PLATinum:ZRESistance <DNPD>[<UNIT>]

[:SOURce]:PLATinum:ZRESistance?

Description:

This command sets resistance at 0 °C for Platinum function.

Parameters:

<DNPD> Range 100.0 ... 1000.0 (default 100.0).

<UNIT> {OHM}

- ·OHM

Remarks:

Overlapped command

Value is not affected by reset

Example:

PLAT:ZRES 100.0

PLAT:ZRES? Response: 1.000000E+02 OHM

[:SOURce]:RESistance[:AMPLitude]

Syntax:

[:SOURce]:RESistance[:AMPLitude] <DNPD>[<UNIT>]

[:SOURce]:RESistance[:AMPLitude]?

Description:

This command sets amplitude in Resistance mode. Node SOUR:RES also selects "RESISTANCE" function if not already selected. Optionaly unit can be enclosed.

Parameters:

<DNPD> Range 16.0 … 400.0e3, default 100.0

<UNIT> {OHM}

·OHM

Remarks:

Overlapped command

Value is set to default after reset

Example:

RES 100.0

RES? Response: 1.000000E+02 OHM

[:SOURce]:TIMing:PAPPend

Syntax:

[:SOURce]:TIMing:PAPPend <SPD>

Description:

This command appends new preset into timing function. The new appended preset has empty timing table and new records should be also appended (see TIM:PRES<index>:RAPP). The new preset has its own index and can be obtained by TIM:PCO command.

Parameters:

<SPD> Quoted preset name. Upper alpha, lower alpha, digits and spaces are allowable. Maximum string size is 10 characters.

Remarks:

Overlapped command

Example:

TIM:PAPP "TIME2"

[:SOURce]:TIMing:PCOunt?

Syntax:

[:SOURce]:TIMing:PCOunt?

Description:

This command retreives actual number of timing presets. This number represents maximum index used in preset commands.

Parameters:

<DNPD> Integer value representing preset count

Remarks:

Overlapped command

Example:

TIM:PCO? Response: 1

[:SOURce]:TIMing:PRESet<IND_PRESET>:NAME

Syntax:

[:SOURce]:TIMing:PRESet<IND_PRESET>:NAME <SPD>

[:SOURce]:TIMing:PRESet<IND_PRESET>:NAME?

Description:

This command allows reading and changing preset name. The preset must exist before its name is changed or read.

Parameters:

<IND_PRESET> Range 1 ... Preset count (1 - if omitted)

<SPD> Quoted preset name. Upper alpha, lower alpha, digits and spaces are allowable. Maximum string size is 10 characters.

Remarks:

Overlapped command

Example:

TIM:PRES2:NAME "TIME 1s"

TIM:PRES2:NAME? Response: "TIME 1s"

[:SOURce]:TIMing:PRESet<IND_PRESET>:PDELete

Syntax:

[:SOURce]:TIMing:PRESet<IND_PRESET>:PDELete

Description:

This command allows deleting existing preset. The preset will be deleted including particular timing table.

Parameters:

<IND_PRESET> Range 1 ... Preset count (1 - if omitted)

Remarks:

Overlapped command

Example:

TIM:PRES1:PDEL

[:SOURce]:TIMing:PRESet<IND_PRESET>:RAPPend

Syntax:

[:SOURce]:TIMing:PRESet<IND_PRESET>:RAPPend <SPD>

Description:

This command appends new record at the end of timing table.

Parameters:

<IND_PRESET> Range 1 ... 255 (1 - if omitted)

<SPD> Quoted string representing amplitude. The amplitude consists of two float numeric fields separated by comma. The first one represents timing interval in seconds and the second one amplitude in Ohms.

Remarks:

Overlapped command

Example:

TIM:PRES1:RAPP "0.5,220.0"

[:SOURce]:TIMing:PRESet<IND_PRESET>:RCOunt?

Syntax:

[:SOURce]:TIMing:PRESet<IND_PRESET>:RCOunt?

Description:

This commands returns actual number of records in timing table.

Parameters:

<IND_PRESET> Range 1 ... Preset count (1 - if omitted)

<DNPD> Integer value representing number of records

Remarks:

Overlapped command

Example:

TIM:PRES1:RCO? Response: 6

[:SOURce]:TIMing:PRESet<IND_PRESET>:ROW<IND_ROW>:AMPLitude

Syntax:

[:SOURce]:TIMing:PRESet<IND_PRESET>:ROW<IND_ROW>:AMPLitude <SPD>
[:SOURce]:TIMing:PRESet<IND_PRESET>:ROW<IND_ROW>:AMPLitude?

Description:

This command sets / retreives selected row in timing table.

Parameters:

<IND_PRESET>	Range 1 ... Preset count (1 - if omitted)
<IND_ROW>	Range 1 ... Row count (1 - if omitted)
<SPD>	Quoted string representing amplitude. The amplitude consists of two float numeric fields separated by comma. The first one represents timing interval in seconds and the second one amplitude in Ohms.

Remarks:

Overlapped command

Example:

TIM:PRES2:ROW1:AMPL "0.5,220.0"
TIM:PRES2:ROW1:AMPL? Response: " 5.000000E-01,2.200000E+02"

[:SOURce]:TIMing:PRESet<IND_PRESET>:ROW<IND_ROW>:RDELete

Syntax:

[:SOURce]:TIMing:PRESet<IND_PRESET>:ROW<IND_ROW>:RDELete

Description:

This command deletes row from timing table.

Parameters:

<IND_PRESET>	Range 1 ... Preset count (1 - if omitted)
<IND_ROW>	Range 1 ... Row count (1 - if omitted)

Remarks:

Overlapped command

Example:

TIM:PRES2:ROW1:RDEL

[:SOURce]:TIMing:SELect

Syntax:

[:SOURce]:TIMing:SELect <DNPD>
[:SOURce]:TIMing:SELect?

Description:

This command selects timing preset. Selected preset is the preset that is shown on device display and has no effect on other SOUR:TIM commands.

Parameters:

<DNPD>	Range 1 ... Preset count (default 1), one based index of preset

Remarks:

Overlapped command
Value is not affected by reset

Example:

TIM:SEL 1
TIM:SEL? Response: 1

[:SOURce]:UFUNction[:AMPLitude]

Syntax:

[:SOURce]:UFUNction[:AMPLitude] <DNPD>
[:SOURce]:UFUNction[:AMPLitude]?

Description:

This command sets amplitude in USER FUNCTION mode. Node SOUR:UFUN also selects “USER FUNCTION” function if not already selected.

Parameters:

<DNPD> Range depends on translation curve, default value is 1.0 or minimal value that can be set

Remarks:

Overlapped command

Value is set to default after reset

Example:

UFUN 1.0

UFUN? Response: 1.000000E+00

[:SOURce]:UFUNction:CURVe:SELect

Syntax:

[:SOURce]:UFUNction:CURVe:SELect <DNPD>

[:SOURce]:UFUNction:CURVe:SELect?

Description:

This command selects curve preset in User function mode.

Parameters:

<DNPD> Range 1 ... Curve preset count (default 1), one based index of preset

Remarks:

Overlapped command

Value is not affected by reset

Example:

UFUN:CURV:SEL 1

UFUN:CURV:SEL? Response: 1

[:SOURce]:UFUNction:CURVe:PAPPend

Syntax:

[:SOURce]:UFUNction:CURVe:PAPPend <SPD>

Description:

This command appends new curve preset into User function. The new appended preset has empty curve table and new records should be also appended (see UFUN:CURV:PRES<index>:RAPP). The new preset has its own index and can be obtained by UFUN:CURV:PCO command.

Parameters:

<SPD> Quoted curve preset name. Upper alpha, lower alpha, digits and spaces are allowable. Maximum string size is 10 characters.

Remarks:

Overlapped command

Example:

UFUN:CURV:PAPP "CURVE 2"

[:SOURce]:UFUNction:CURVe:PCOunt?

Syntax:

[:SOURce]:UFUNction:CURVe:PCOunt?

Description:

This command retreives actual number of user function presets. This number represents maximum index used in preset commands.

Parameters:

<DNPD> Integer value representing number of preset count

Remarks:

Overlapped command

Example:

UFUN:CURV:PCO? Response: 1

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:NAME

Syntax:

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:NAME <SPD>

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:NAME?

Description:

This command allows reading and changing preset name. The preset must exist before its name is changed or read.

Parameters:

<IND_PRESET>	Range 1 ... Curve preset count (1 - if omitted)
<SPD>	Quoted preset name. Upper alpha, lower alpha, digits and spaces are allowable. Maximum string size is 10 characters.

Remarks:

Overlapped command

Example:

UFUN:CURV:PRES2:NAME "CURVE 2"

UFUN:CURV:PRES2:NAME? Response: "CURVE 2"

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:PDELete

Syntax:

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:PDELete

Description:

This command allows deleting existing preset. The preset will be deleted including particular curve table.

Parameters:

<IND_PRESET>	Range 1 ... Curve preset count (1 - if omitted)

Remarks:

Overlapped command

Example:

UFUN:CURV:PRES1:PDEL

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:RAPPend

Syntax:

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:RAPPend <SPD>

Description:

Parameters:

<IND_PRESET>	Range 1 ... Curve preset count (1 - if omitted)
<SPD>	Quoted string representing amplitude. The amplitude consists of two float numeric fields separated by comma. The first one represents amplitude in “User Function” units and the second one amplitude in Ohms.

Remarks:

Overlapped command

Example:

UFUN:CURV:PRES1:RAPP "10.6,220.0"

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:RCOunt?

Syntax:

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:RCOunt?

Description:

This commands returns actual number of records in curve table.

Parameters:

<IND_PRESET>	Range 1 ... Curve preset count (1 - if omitted)
<DNPD>	Integer value representing number of records for particular curve table

Remarks:

Overlapped command

Example:

UFUN:CURV:PRES1:RCO? Response: 2

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:ROW<IND_ROW>:AMPLitude

Syntax:

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:ROW<IND_ROW>:AMPLitude <SPD>

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:ROW<IND_ROW>:AMPLitude?

Description:

This command sets / retreives selected row in curve table.

Parameters:

<IND_PRESET>	Range 1 ... 255 (1 - if omitted)
<IND_ROW>	Range 1 ... 255 (1 - if omitted)
<SPD>	Quoted string representing amplitude. The amplitude consists of two float numeric fields separated by comma. The first one represents amplitude in “User Function” units and the second one amplitude in Ohms.

Remarks:

Overlapped command

Example:

UFUN:CURV:PRES1:ROW1:AMPL "10.6,220.0"

UFUN:CURV:PRES1:ROW1:AMPL? Response: "1.060000E+01,2.200000E+2"

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:ROW<IND_ROW>:RDELete

Syntax:

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:ROW<IND_ROW>:RDELete

Description:

This command deletes row from curve table.

Parameters:

<IND_PRESET>	Range 1 ... Curve preset count (1 - if omitted)
<IND_ROW>	Range 1 ... Row count (1 - if omitted)

Remarks:

Overlapped command

Example:

UFUN:CURV:PRES1:ROW1:RDEL

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:UNIT

Syntax:

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:UNIT <SPD>

[:SOURce]:UFUNction:CURVe:PRESet<IND_PRESET>:UNIT?

Description:

Parameters:

<IND_PRESET>	Range 1 ... Curve presetcount (1 - if omitted)
<SPD>	Quoted user function unit. Upper alpha, lower alpha, digits and spaces are allowable. Maximum string size is 4 characters.

Remarks:

Overlapped command

Example:

UFUN:CURV:PRES1:UNIT "N"

UFUN:CURV:PRES1:UNIT? Response: "N"

:STATus:OPERation:CONDition

Syntax:

:STATus:OPERation:CONDition?

Description:

This query returns the content of Operational Condition register. It is a decimal value which corresponds to the binary-weighted sum of all bits in the register. Register is not cleared after this query. The response to the query therefore represents an instantaneous 'Snapshot' of the register state, at the time that the query was accepted.

Parameters:

<DNPD> Operational Condition register

Remarks:

Overlapped command

Example:

STAT:OPER:COND? Response: 2

:STATus:OPERation:ENABle

Syntax:

:STATus:OPERation:ENABle <DNPD>

:STATus:OPERation:ENABle?

Description:

This command enables bits in the Operational Data Enable register. Selected bits are summarized at bit 7 (OSS) of the IEEE488.2 Status Byte register.

Parameters:

<DNPD> Operational Data Enable register

Remarks:

Overlapped command

Example:

STAT:OPER:ENAB 2

STAT:OPER:ENAB? Response: 2

:STATus:OPERation[:EVENt]?

Syntax:

:STATus:OPERation[:EVENt]?

Description:

This query returns the content of Operational Data Event register. It is a decimal value which corresponds to the binary-weighted sum of all bits set in the register. Register is cleared after this query.

Parameters:

<DNPD> Operational Data Event register

Remarks:

Overlapped command

Example:

STAT:OPER? Response: 0

:STATus:OPERation:NTRansition

Syntax:

:STATus:OPERation:NTRansition <DNPD>

:STATus:OPERation:NTRansition?

Description:

This comman allows set Operation Negative Transition Register. It is a decimal value which corresponds to the binary-weighted sum of all bits set in the register. Setting a bit in the negative transition filter shall cause a 1 to 0 transition in the corresponding bit of the associated condition register to cause a 1 to be written in the associated bit of the corresponding event register.

Parameters:

<DNPD> Operation Negative Transition Register, Range 0… 32767

Remarks:

Overlapped command

Example:

STAT:OPER:NTR 2

STAT:OPER:NTR? Response: 2

:STATus:OPERation:PTRansition

Syntax:

:STATus:OPERation:PTRansition <DNPD>

:STATus:OPERation:PTRansition?

Description:

This comman allows set Operation Positive Transition Register. It is a decimal value which corresponds to the binary-weighted sum of all bits set in the register. Setting a bit in the positive transition filter shall cause a 0 to 1 transition in the corresponding bit of the associated condition register to cause a 1 to be written in the associated bit of the corresponding event register.

Parameters:

<DNPD> Operation Positive Transition Register, Range 0 … 32767

Remarks:

Overlapped command

Example:

STAT:OPER:PTR 1.0

STAT:OPER:PTR? Response: 1.000000E+00

:STATus:QUEStionable:CONDition

Syntax:

:STATus:QUEStionable:CONDition?

Description:

This query returns the content of Questionable Condition register. It is a decimal value which corresponds to the binary-weighted sum of all bits in the register. Register is not cleared after this query. The response to the query therefore represents an instantaneous 'Snapshot' of the register state, at the time that the query was accepted.

Parameters:

<DNPD> Questionable Condition register

Remarks:

Overlapped command

Example:

STAT:QUES:COND? Response: 2

:STATus:QUEStionable:ENABle

Syntax:

:STATus:QUEStionable:ENABle <DNPD>

:STATus:QUEStionable:ENABle?

Description:

This command enables bits in the Questionable Data Enable register. Selected bits are summarized at bit 3 (QSS) of the IEEE488.2 Status Byte register.

Parameters:

<DNPD> Questionable Data Enable register

Remarks:

Overlapped command

Example:

STAT:QUES:ENAB 2

STAT:QUES:ENAB? Response: 2

:STATus:QUEStionable[:EVENt]?

Syntax:

:STATus:QUEStionable[:EVENt]?

Description:

This query returns the content of Questionable Data Event register. It is a decimal value which corresponds to the binary-weighted sum of all bits set in the register. Register is cleared after this query.

Parameters:

<DNPD> Questionable Data Event register

Remarks:

Overlapped command

Example:

STAT:QUES? Response: 0

:STATus:QUEStionable:NTRansition

Syntax:

:STATus:QUEStionable:NTRansition <DNPD>

:STATus:QUEStionable:NTRansition?

Description:

This comman allows set Questionable Negative Transition Register. It is a decimal value which corresponds to the binary-weighted sum of all bits set in the register. Setting a bit in the negative transition filter shall cause a 1 to 0 transition in the corresponding bit of the associated condition register to cause a 1 to be written in the associated bit of the corresponding event register.

Parameters:

<DNPD> Questionable Negative Transition Register, Range 0… 32767

Remarks:

Overlapped command

Example:

STAT:QUES:NTR 2

STAT:QUES:NTR? Response: 2

:STATus:QUEStionable:PTRansition

Syntax:

:STATus:QUEStionable:PTRansition <DNPD>

:STATus:QUEStionable:PTRansition?

Description:

This comman allows set Questionable Positive Transition Register. It is a decimal value which corresponds to the binary-weighted sum of all bits set in the register. Setting a bit in the positive transition filter shall cause a 0 to 1 transition in the corresponding bit of the associated condition register to cause a 1 to be written in the associated bit of the corresponding event register.

Parameters:

<DNPD> Questionable Positive Transition Register, Range 0… 32767

Remarks:

Overlapped command

Example:

STAT:QUES:PTR 2

STAT:QUES:PTR? Response: 2

:SYSTem:BEEPer:STATe

Syntax:

:SYSTem:BEEPer:STATe <BOOL>

:SYSTem:BEEPer:STATe?

Description:

This command sets state of device beeper.

Parameters:

<BOOL> {ON|OFF|1|0} (default 1)

·ON device system beeper is enabled

·OFF device system beeper is disabled

·1 same as ON

·0 same as OFF

Remarks:

Overlapped command

Value is not affected by reset

Example:

SYST:BEEP:STAT ON

SYST:BEEP:STAT? Response: 1

:SYSTem:BEEPer:VOLume

Syntax:

:SYSTem:BEEPer:VOLume <DNPD>

:SYSTem:BEEPer:VOLume?

Description:

This command sets the system device beeper volume.

Parameters:

<DNPD> Range 0.0 ... 1.0 (Max. volume) (default 0.2)

Remarks:

Overlapped command

Value is not affected by reset

Example:

SYST:BEEP:VOL 0.2

SYST:BEEP:VOL? Response: 2.000000E-01

:SYSTem:COMMunicate:BUS

Syntax:

:SYSTem:COMMunicate:BUS <CPD>

:SYSTem:COMMunicate:BUS?

Description:

This command selects communication interface.

Parameters:

<CPD> {SERial|GPIB|USB|LAN} (default SER)

·SERial RS232 interface

·GPIB GPIB interface

·USB USB interface

·LAN LAN interface

Remarks:

Sequential command

Value is not affected by reset

Example:

SYST:COMM:BUS SER

SYST:COMM:BUS? Response: SER

:SYSTem:COMMunicate:GPIB:ADDRess

Syntax:

:SYSTem:COMMunicate:GPIB:ADDRess <DNPD>

:SYSTem:COMMunicate:GPIB:ADDRess?

Description:

This commands allows set communication GPIB address

Parameters:

<DNPD> Range 1 ... 31 (default 2)

Remarks:

Overlapped command

Value is not affected by reset

Example:

SYST:COMM:GPIB:ADDR 2

SYST:COMM:GPIB:ADDR? Response: 2

:SYSTem:COMMunicate:LAN:ADDRess

Syntax:

:SYSTem:COMMunicate:LAN:ADDRess <CPD>

:SYSTem:COMMunicate:LAN:ADDRess?

Description:

This command allows to change IP address if DHCP is switched off. Interface must be restarted to take effect (see SYST:COMM:REST command).

Parameters:

<CPD> Range 000.000.000.000 ... 255.255.255.255 (default 192.168.001.100)

Remarks:

Overlapped command

Value is not affected by reset

Example:

SYST:COMM:LAN:ADDR 192.168.001.100

SYST:COMM:LAN:ADDR? Response: 192.168.001.100

:SYSTem:COMMunicate:LAN:MASK

Syntax:

:SYSTem:COMMunicate:LAN:MASK <CPD>

:SYSTem:COMMunicate:LAN:MASK?

Description:

This command allows to change subnet mask if DHCP is switched off. Interface must be restarted to take effect (see SYST:COMM:REST command).

Parameters:

<CPD> Range 000.000.000.000 ... 255.255.255.255 (default 255.255.255.000)

Remarks:

Overlapped command

Value is not affected by reset

Example:

SYST:COMM:LAN:MASK 255.255.255.000

SYST:COMM:LAN:MASK? Response: 255.255.255.000

:SYSTem:COMMunicate:LAN:GATE

Syntax:

:SYSTem:COMMunicate:LAN:GATE <CPD>

:SYSTem:COMMunicate:LAN:GATE?

Description:

This command allows to change default gateway if DHCP is switched off. Interface must be restarted to take effect (see SYST:COMM:REST command).

Parameters:

<CPD> Range 000.000.000.000 ... 255.255.255.255 (default 255.255.255.255)

Remarks:

Overlapped command

Value is not affected by reset

Example:

SYST:COMM:LAN:GATE 255.255.255.255
SYST:COMM:LAN:GATE? Response: 255.255.255.255

:SYSTem:COMMunicate:LAN:PORT

Syntax:

:SYSTem:COMMunicate:LAN:PORT <DNPD>
:SYSTem:COMMunicate:LAN:PORT?

Description:

This command allows to change port number. Interface must be restarted to take effect (see SYST:COMM:REST command).

Parameters:

<DNPD> Range 0 ... 9999 (default 23)

Remarks:

Overlapped command
Value is not affected by reset

Example:

SYST:COMM:LAN:PORT 23
SYST:COMM:LAN:PORT? Response: 23

:SYSTem:COMMunicate:LAN:HOST

Syntax:

:SYSTem:COMMunicate:LAN:HOST <CPD>
:SYSTem:COMMunicate:LAN:HOST?

Description:

This command allows to change host name if DHCP is switched on. Interface must be restarted to take effect (see SYST:COMM:REST command).

Parameters:

<CPD> Upper alpha, lower alpha, digits, underscores and spaces are allowable. Maximum string size is 14 characters.

Remarks:

Overlapped command
Value is not affected by reset

Example:

SYST:COMM:LAN:HOST M631_SNXXXXXX
SYST:COMM:LAN:HOST? Response: M631_SNXXXXXX

:SYSTem:COMMunicate:LAN:DHCP

Syntax:

:SYSTem:COMMunicate:LAN:DHCP <BOOL>
:SYSTem:COMMunicate:LAN:DHCP?

Description:

This command allows switch On/Off DHCP.

Parameters:

<BOOL> {ON|OFF|1|0} (default 1)
- ·ON DHCP is On
- ·OFF DHCP is Off
- ·1 same as ON
- ·0 same as OFF

Remarks:

Overlapped command
Value is not affected by reset

Example:

SYST:COMM:LAN:DHCP ON
SYST:COMM:LAN:DHCP? Response: 1

:SYSTem:COMMunicate:RESTart

Syntax:

:SYSTem:COMMunicate:RESTart

Description:

This command will restart communication interface. It will take several seconds. During this period device will not respond to any commands. Restart is needed for all LAN setting changes.

Parameters:

None

Remarks:

Overlapped command

Example:

SYST:COMM:REST

:SYSTem:COMMunicate:SERial:BAUD

Syntax:

:SYSTem:COMMunicate:SERial:BAUD <CPD>

:SYSTem:COMMunicate:SERial:BAUD?

Description:

This command allows changing RS232 transfer rate.

Parameters:

<CPD> {1200|2400|4800|9600|19200|38400|57600|115200} (default 9600)

- ·1200 1200 Bd
- ·2400 2400 Bd
- ·4800 4800 Bd
- ·9600 9600 Bd
- ·19200 19200 Bd
- ·38400 38400 Bd
- ·57600 57600 Bd
- ·115200 115200 Bd

Remarks:

Overlapped command

Value is not affected by reset

Example:

SYST:COMM:SER:BAUD 9600

SYST:COMM:SER:BAUD? Response: 9600

:SYSTem:DATE

Syntax:

:SYSTem:DATE <DNPD>,<DNPD>,<DNPD>

:SYSTem:DATE?

Description:

This commands allows to change system device date.

Parameters:

<DNPD> Year, Range 2000 ... 2063

<DNPD> Month, Range 1 ... 12

<DNPD> Day, Range 1 ... 31

Remarks:

Overlapped command

Example:

SYST:DATE 2012,12,31

SYST:DATE? Response: 2012,12,31

:SYSTem:ERRor[:NEXT]?

Syntax:

:SYSTem:ERRor[:NEXT]?

Description:

This command reads SCPI error (maximum 32) that occurred at first. If number of SCPI errors exceed 32, error -350 “Queue overflow” is returned. For all available error codes and messages see “SCPI Error codes” table. Error queue is cleared by reading all errors or by issuing *CLS command.

Parameters:

<DNPD> Error code

<SPD> Quoted error message

Remarks:

Overlapped command

Example:

SYST:ERR? Response: -300,”Device error”

:SYSTem:KEY

Syntax:

:SYSTem:KEY <DNPD>

:SYSTem:KEY?

Description:

This command allows send key code to the device the same way the user can press keys on front panel. Query returns last pressed key.

Key	Code
KEY_0	12
KEY_1	11
KEY_2	15
KEY_3	19
KEY_4	10
KEY_5	14
KEY_6	18
KEY_7	9
KEY_8	13
KEY_9	17
KEY_SELECT	25
KEY_ENTER	24
KEY_CANCEL	23
KEY_UP	2
KEY_DOWN	1
KEY_LEFT	3
KEY_RIGHT	4
KEY_EXPONENT	21
KEY_BACKSPACE	22
KEY_POINT	16
KEY_USER_1	5
KEY_USER_2	6
KEY_USER_3	7
KEY_USER_4	8
KEY_SIGN	20
KEY_OPER	26
KEY_SHORT	27

Table 5 Keyboard codes

Parameters:
<DNPD> Key code. For particular key codes see table above.
Remarks:
Overlapped command
Example:
SYST:KEY 12
SYST:KEY? Response: 12

:SYSTem:LOCal

Syntax:
:SYSTem:LOCal
Description:
This command places device in the LOCAL mode and unlocks all keys on front panel of the device. The Command is valid only for RS232, LAN and USB interfaces. The device will not respond to commands in LOCAL mode.
Parameters:
None
Remarks:
Overlapped command
Example:
SYST:LOC

:SYSTem:PRESet

Syntax:
:SYSTem:PRESet
Description:
This command will preset all device settings. These settings are the same as the RESET ones.
Parameters:
None
Remarks:
Overlapped command
Example:
SYST:PRES

:SYSTem:REMote

Syntax:
:SYSTem:REMote
Description:
This command places device in the REMOTE mode and locks all keys but LOCAL key. The Command is valid only for RS232, LAN and USB interfaces. The device will not respond to any other command until is in REMOTE mode.
Parameters:
None
Remarks:
Overlapped command
Example:
SYST:REM

:SYSTem:RWLock

Syntax:
:SYSTem:RWLock
Description:

This command places device in the REMOTE mode and locks all keys including LOCAL key. The Command is valid only for RS232, LAN, USB interfaces. The device will not respond to any other command until is in REMOTE mode.

Parameters:

None

Remarks:

Overlapped command

Example:

SYST:RWL

:SYSTem:TIME

Syntax:

:SYSTem:TIME <DNPD>,<DNPD>,<DNPD>
:SYSTem:TIME?

Description:

This commands allows set system device time (RTC).

Parameters:

<DNPD> Hours, Range 0 ... 23
<DNPD> Minutes, Range 0 ... 59
<DNPD> Seconds, Range 0 ... 59

Remarks:

Overlapped command

Example:

SYST:TIME 10,45,15
SYST:TIME? Response: 10,45,15

:SYSTem:VERSion?

Syntax:

:SYSTem:VERSion?

Description:

This query retreives version of implemented SCPI language

Parameters:

<CPD> SCPI language version

Remarks:

Overlapped command

Example:

SYST:VERS? Response: 1999.0

:UNIT:TEMPerature

Syntax:

:UNIT:TEMPerature <CPD>
:UNIT:TEMPerature?

Description:

This function allows to set unit for all temperature functions (Platinum, Nickel).

Parameters:

<CPD> {CEL|FAR|K} (default CEL)
·CEL degrees of Celsius
·FAR degrees of Fahrenheit
·K Kelvin

Remarks:

Overlapped command
Value is not affected by reset

Example:

UNIT:TEMP CEL
UNIT:TEMP? Response: CEL

6.10. SCPI Error codes

RTD simulator distinguishes following SCPI error codes. These codes are reported on device display screen or can be read by SYST:ERR? Command.

Error	Message
-100	"Command error"
-101	"Invalid character"
-102	"Syntax error"
-103	"Invalid separator"
-104	"Data type error"
-105	"GET not allowed"
-108	"Parameter not allowed"
-109	"Missing parameter"
-112	"Program mnemonic too long"
-113	"Undefined header"
-114	"Header suffix out of range"
-120	"Numeric data error"
-121	"Invalid character in number"
-130	"Suffix error"
-141	"Invalid character data"
-144	"Character data too long"
-151	"Invalid string data"
-161	"Invalid block data"
-203	"Command protected"
-220	"Parameter error"
-222	"Data out of range"
-283	"Illegal variable name"
-350	"Queue overflow"
-400	"Query error"
-410	"Query INTERRUPTED"
-420	"Query UNTERMINATED"
-430	"Query DEADLOCKED"
-440	"Query UNTERMINATED after indefinite response"
514	"Command not allowed with GPIB"

Table 6 SCPI error codes

6.11. Compatible Commands

RTD simulator also responds to "Old style" command syntax to provide compatibility with previous decade box models.

Value setting / reading
A (?) <DNPD>

The command sets resistance value (resistance function), temperature value (temperature sensor simulating function) or "User function" value (if User function is selected).

<DNPD>
It represents resistance value in Ohm or simulated temperature in selected temperature unit or "user defined units" (if User function is selected). When temperature parameter is used, both negative and positive values are acceptable. For resistance parameter positive value only is acceptable. Limit values are shown in chapter "Technical data".

In case of control, the simulator confirms correct setting with string „Ok<cr><lf>".

In case of query, MC631 returns set resistance/temperature/user_function value in the same format as it is on the display (number of decimal places). For example value -120 °C is returned as -120.000<cr><lf>. Positive numbers are sent without polarity sign.

Example :

Command „A123.564 <cr>" sets temperature 123.564 °C if simulator is in temperature simulation function, 123.564 Ω if simulator is in resistance function and 123.564 X if simulator is in User function (X – represents user defined unit).

If query „A?<cr>" is sent, simulator returns response in format „123.564<cr><lf>".

RTD simulator function setting
F <CPD> { 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | S | O }

Following function can be set:

- 0 resistance mode
- 1 Pt385 (68) temperature sensor simulation
- 2 Pt385 (90) temperature sensor simulation
- 3 Pt3916 temperature sensor simulation
- 4 Ni temperature sensor simulation
- 5 User platinum temperature sensor simulation
- 6 Pt3926 temperature sensor simulation
- 7 User function simulation
- S Short
- O Open

MC631 confirms execution with string „Ok<cr><lf>".

Example :

„F1<cr>" sets Pt100 sensor simulation.

I/D (device identification)
***IDN?**

Response contains name of manufacturer, model type number, serial number, firmware version

Example :

If query „*IDN?<cr>" is sent, simulator returns response:
„Powertek,M631,622351,1.2 <cr><lf>".

R0 setting / reading
R (?) <DNPD>

Command sets resistance value R0 at temperature 0 °C. Set value R0 is valid for all types of simulated temperature sensors.

<DNPD>
It represents resistance value R0 in Ω. Limits are shown in chapter Technical data. MC631 confirms execution with string „Ok<cr><lf>". In case of query MC631 returns set value in Ω.

Example :

„R100<cr>" sets value R0 to 100 Ω (Pt100, Ni100).

After query „R?<cr>" simulator returns string „100<cr><lf>".

Temperature unit setting
U <CPD> { 0 | 1 | 2 }

Command sets used temperature unit.

- 0 sets degree Celsia °C
- 1 sets degree Fahrenheita °F
- 2 sets Kelvin unit K

MC631 confirms execution with string „Ok<cr><lf>".
Example :

„U0<cr>" sets °C as temperature unit.

Status reading
V?

MC631 returns device status in form „FxUx<cr><lf>". On positions of signs „x" there are values corresponding to the actual status of the simulator.

Example :

After query „V?<cr>" the simulator returns for example string „F2U0<cr><lf>", which means Pt (90), °C actual setting.

Correctly executed command is confirmed with string "Ok<cr><lf>. When correct query is received MC631 returns response in above described format. All commands must contain sign <cr> or <lf> at the end. Both small and large letters can be used.

6.12. Demo program

A simple operating program DecadeAssistant is supplied with the simulator in order to provide easy operation of the instrument from the computer, and to check the RS-232 line (IEEE488 bus) of the instrument. The installation CD ROM contains a program (for MS WINDOWS only), you can communicate with the instrument through standard serial line (IEEE488) with. For example, you can set value or function on the simulator. For IEEE488 connection this DecadeAssistant requires properly configured National Instruments IEEE488 card.

Download on www.Powertek.com.

7. Maintenance

This chapter explains how to perform the routine maintenance to keep your device in optimal operating condition. The tasks covered in this chapter include the following:

- Fuse replacing
- External surface cleaning

7.1. Fuse replacing

The instrument includes a fuse located in the mains connector at the rear panel. Replace the fuse as follows:

- Switch off the simulator
- Remove the end of power cord from the mains connector at the rear panel.
- Insert the blade of a flat screwdriver into the opening cut in the mains voltage selector and pull out the fuse holder.
- Remove the fuse and replace it with new fuse of the same rating.

7.2. External surface cleaning

To keep the device looking like new, clean the case and front panel keys using a soft cloth slightly dampened with either water or a non-abrasive mild cleaning solution that is not harmful to plastics.

8. Module 19” (version MC631-Vxx1x)

RTD Simulator can be ordered as 19” module for easy assembling into a 19” rack. Module height is 3HE.

Figure 28 Module 19" rack, front panel

9. Technical data

Resistance range	**:**	16 Ω … 400 kΩ SHORT, OPEN terminals
Pt sensor temperature simulation	**:**	-200.000 °C … 850.000 °C (-328 °F … 1562 °F)
Ni sensor temperature simulation	**:**	-60.000 °C … 300.000 °C (-76 °F … 572 °F)
Type of temperature sensors	**:**	Pt100 … Pt1000, Ni100 … Ni1000
Resolution	**:**	from 0.1 mΩ
Pt temperature standards	**:**	IEC 751 (1,3850 for IPTS68) (A=3.90802e-3, B=-5.80195e-7, C=-4.2735e-12) IEC 751 (1,3851 for ITS90) (A=3.9083e-3, B=-5.775e-7, C=-4.18301e-12) 1,3916 (A=3.9692e-3, B=-5.8495e-7, C=-4.2325e-12) 1,3926 (A=3.9848e-3, B=-5.870e-7, C=-4.0e-12)
Ni temperature standards	**:**	DIN 43760 (6180) (A=5.485e-3, B=6.65e-6, C=2.805e-11, D=-2e-17)
Maximal dissipation power	**:**	0.25 W
Maximal current	**:**	0.5 A
Maximal voltage	**:**	200 Vpk
Reaction time *	**:**	6 ms
Terminals	**:**	instrument terminals diameter 4mm, gold plated
Interface	**:**	RS232 (optionally IEEE488, USB, Ethernet)
Power supply	**:**	115/230 Vac, 45…65 Hz
Maximal power consumption	**:**	15 VA
Reference temperature	**:**	+20 °C … +26 °C
Working temperature	**:**	+5 °C … +40 °C
Storing temperature	**:**	-10 °C … +50 °C
Housing	**:**	metal sheet
Dimensions	**:**	W 390 mm, H 128 mm, D 310 mm
Weight	**:**	5.2 kg

Isolation resistance between output terminals and housing : > 2 GΩ (at 500V DC)

* *Reaction time means time interval between setting up value from front panel or receiving command from remote control bus and settling set-up value on output terminals.Value is valid for FAST switching mode.*

Notes:

Only data shown with tolerance or with band of limits are tested. All other values have informative character.

Accuracy

Specified accuracy is valid after 10 minutes warm up in temperature range 23 ± 3°C. Uncertainties include long-term stability, temperature coefficient, linearity, load and line regulation and traceability of factory to National calibration standards. Accuracies assigned in % are related to the set value. Specified accuracy is one-year accuracy.

MC631 Resistance accuracy

Range / Resolution	*Accuracy*
16.000 0 Ω - 20.000 0 Ω	0.002 % + 2 mΩ
20.001 Ω - 200.000 Ω	
200.01 Ω - 1000.00 Ω	0.003 %
1000.1 Ω - 3000.0 Ω	0.005 %
3001 Ω - 10000 Ω	0.015 %
10.01 kΩ - 30.00 kΩ	0.03 %
30.1 kΩ - 100.0 kΩ	0.1 %
101 kΩ - 400 kΩ	0.4 %

Table 7 MC631 Resistance

accuracy MC631 Pt

Temperature	*Accuracy Pt100 … Pt500*	*Accuracy Pt501 … Pt1000*
-200.000…0.000 °C	0.01 °C	0.01 °C
0.001…200.000 °C	0.015 °C	0.02 °C
200.001…500.000 °C	0.03 °C	0.04 °C
500.001…850.000 °C	0.04 °C	0.1 °C

Table 8 MC631 Pt simulation

accuracy MC631 Ni simulation

Temperature	*Accuracy Ni100 … Ni500*	*Accuracy Ni501 … Ni1000*
-60.000…0.000 °C	0.01 °C	0.01 °C
0.001…300.000 °C	0.01 °C	0.02 °C

Table 9 MC631 Ni simulation

accuracy MC631 Frequency

R	*AC/DC difference*		
	100 Hz	*1 kHz*	*10 kHz*
16 Ω	0.01 %	0.01 %	0.04 %
100 Ω	0.01 %	0.03 %	0.30 %
1 kΩ	0.03 %	0.30 %	3.00 %
10 kΩ	0.30 %	3.00 %	
100 kΩ	3.00 %		

Table 10 MC631 Frequency response

Temperature coefficient

Temperature coefficient outside of the reference temperature range is 10 % of the stated specification per °C (for eample 2x specification for 36°C).

Short and Open simulation

When function Short is selected, output resistance is lower than 60 mΩ. Maximal allowed current is 500 mA.
When function Open is selected, output resistance is higher than 1 GΩ. Maximal allowed voltage is 200 Vpk.

Note:

Resistance values in range 16 Ω - 400 kΩ are calibrated absolutely. Resistance value is not defined against SHORT position. Short and Open positions are intended for functional checking of tested instrument only.

10. Ordering information – options

Bus	
MC631-V1xxx	- RS232
MC631-V2xxx	- RS232, LAN, USB, IEEE488
	- table version
Housing	- module 19“, 3HE
MC631-Vxx0x	
MC631-Vxx1x	

Example of order:
MC631-V2010
- Precision RTD Simulator 16Ω - 400kΩ, RS232, LAN, USB, IEEE488, 19“rack

Manufacturer

For Uk & European sales, support, service and deliveries:
Powertek UK 19 Cornwallis Road, Billon. Rugby CV22 7HL UK
New Tel: 01788 519911 Fax: 0870 0940135
Int'l Tel: +44 1788 519911 Inrl Fax: +44 870 0940135
Email: info@powertekuk.com www.powertekuk.com

For USA sales, support, service and deliveries:
Powertek US Inc. 7 Third Street, Holbrook. NY 11741 USA
Tel: +1 631 615 6279 Fax: +1 973 273 5893
Email: info@powertekus.com www.powertekus.com