M194

High Resistance Decade

Operation manual

MEATEST

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ATTENTION !

The decade can withstand test voltage generated by UUT up to 6 kV DC !!!

Don't use the decade when not properly connected to the mains socket.

Use test leads delivered with UUT.

Do not touch metal parts of test leads when connected to UUT.

The decade can only be used in accordance with this operation manual. Use the decade for calibration of safety testers and insulation meters.

1. Basic information

M194 High Resistance Decade is designed for calibration of insulation testers, megaohmmeters and resistance ranges of safety testers, HIPOTs etc. It can be used for calibration of any DC high resistance meter with working voltage up to 6 kV. M194 is based on programmable series high resistance decade box which is completed with additional electronic circuits allowing measurement of test voltage sourced by UUT and testing of short current.

Basic feature of the M194 is adjustable high resistance decade in summary range from 10 kΩ to 100 GΩ. It offers basic accuracy 0.1% to 1 % depending on set resistance value.

M194 can be controlled manually using front panel keypad or in remote mode using RS232 interface or optionally IEEE488, USB and Ethernet bus. The decade can easily fit within calibration systems featuring CALIBER software support.

2. Preparation for use

2.1. Inspecting package content, selecting the installation location

Basic package includes the following items:

- Power line cable   1 pc
- Test lead   2 pc
- User´s manual   1 pc
- Calibration certificate   1 pc
- Spare fuse   1 pc
- Cable RS-232   1 pc

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

- Check the position of the mains voltage selector located at the rear panel before connecting the instrument to the mains.

- 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.
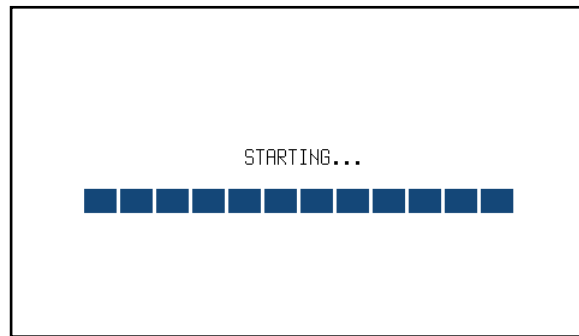
Fig 1 Starting Screen

- 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   100.0 MΩ
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 15 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
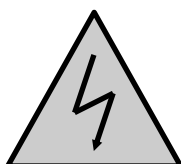
Warning - risk of electric shock.
Hazardous voltage. Voltage > 30 V
DC or AC peak might be present.

⚡   Danger - high voltage

⏚   Earth ground
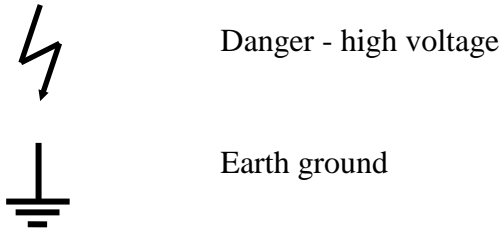
3. Description

3.1.   Front panel
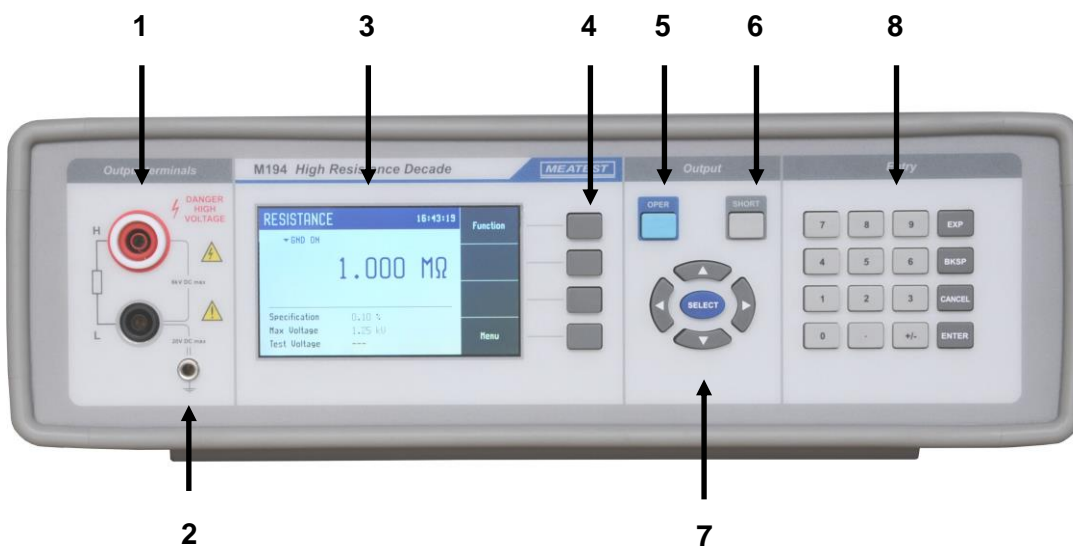
Fig 2 Front panel

On the front panel there are located all main control keys, display and output terminals.

1   Output terminals

Output terminals contains H (high) signal terminal with maximum working voltage to 6 kVDC and L (low) terminal. The L terminal can be internally connected to protection earth (PE) potential in grounded mode or can be applied as floating. The L terminal must not float more than 20 VDC from PE potential in this case.

2   Ground terminal

Central ground terminal (protective earth) connected to the metal case of the instrument and PE wire in supplying mains.

3   Display
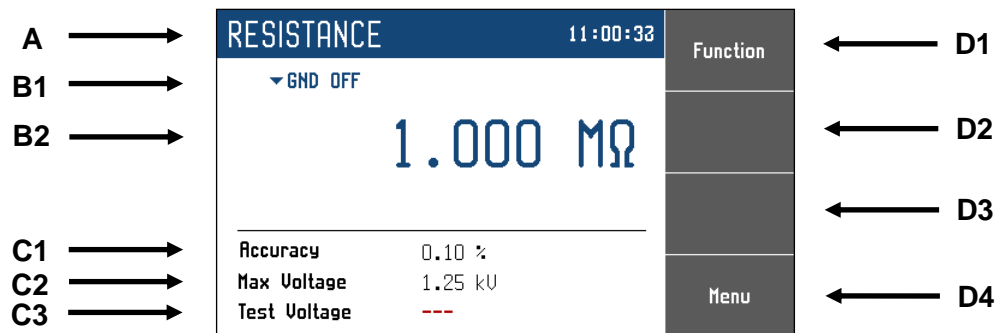
Fig 3 Display

The display is divided into four sections:

A. *Information line*

- Selected function RESISTANCE, TIMING
- Real time

B. *Main area*

This section displays the set-up values of generated signals and the data related to the decade box status. The section includes the following types of data:

1. *Auxiliary parameters*
   This section displays auxiliary parameters of actually selected function:
   - L output terminal grounding on or off
   - Preset timing procedure in TIMING mode

2. *Main value*
   There is displayed main value of selected function with the unit. There is displayed also actual position of cursor ▼▲ if the parameter is in edit mode. Position of cursor can be changed using keys ◄, ► and parameter can be changed using keys ▲,▼.

C. *Specification*

This section displays specification and limits relating to the main value:

1. *Specification*
   This section displays accuracy of the main value.

2. *Max Voltage*
   This section displays maximum allowed applicable test voltage for the main value.

3. *Test Voltage*
   This section displays measured test voltage sourced by UUT. Readings are suppressed bellow 50VDC at 6 kVDC range or bellow 5V at 400 VDC range and symbol "---" is shown instead.

D. *Softkey labels*

   4   Softkeys

There are four keys D1 to D4 next to the display with variable function. The functions of these keys change during operation (depends on selected function and actual display mode).

5   OPER (Operate key)

OPER key connects / disconnects selected value to the output terminals. Connected output terminals are indicated by the lit LED in the key.

6   SHORT (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.

7   Cursor keys

Using these keys, the cursor can be controlled within allowed limits on the display. The keyboard includes two buttons (◄, ►) which allow the cursor to be set to the required position at the display. The cursor can be moved to the left or right. Numeric values can be set in some control modes as well. In these cases, the buttons marked (▲,▼) allow the user to increase or decrease the number at the cursor position.

The central SELECT key is used to select value you want to change (like TAB key).

Meaning of softkeys is shown in the right part of display. If there is no description next to the softkey, the softkey is not active in selected function.

8   Numeric keyboard

The keyboard allows the entry of numeric values on the display. ENTER button is used to confirm the selection. CANCEL button can be used to cancel the entry.

Colors on display

Common rules are used for applied color of labels and values.
- Red color is applied, when displayed value is measured by the instrument.

- Blue color is applied for those parameters or values, which can be set-up or modified directly from front panel keyboard or via Main menu.

- Black color is used for fix values, labels, notes, parameters which cannot be modified and for other fix text with general information purpose.

3.2.   Rear panel

There are located power cord socket, power line fuse, power line voltage selector 115/230V, interface connectors RS232 and optionally LAN, USB and IEEE488 on the rear panel.

Fig 4 Rear panel

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 OPER key.

Disconnected output terminals has typically $> 2\text{T}\Omega$ "Open terminals" resistance.

"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. Output resistance of the SHORT is $100\,\Omega \pm 10\%$.

4.2. Wires connection

Output resistance is available between H and L output terminals. Ground terminal is connected to the metal case and to the protective earth (PE).

4.2.1. Connection of UUTs with grounded output terminal

Never connect high output terminal of UUT to L input terminal of M194 when calibrated electronic UUTs with supplying from mains with grounded low output terminals. This wrong connection ca n cause damage of M194.

Correct connection is as follows:

- UUT high (source) terminal must be connected to H input terminal of M194

- UUT low (sense) terminal must be connected to L input terminal of M194

4.2.2.   Connection of battery operated UUTs

High and low terminals of battery operated UUTs can be connected to either H or L input terminal of M194 from safety point of view. However correct connection is as follows:

- UUT high (source) terminal must be connected to H input terminal of M194

- UUT low (sense) terminal must be connected to L input terminal of M194

4.2.3.   Grounding terminal

There is located ground terminal (GND) on the front panel. It is directly connected to PE terminal in power line socket and to metal parts of M194 housing. This terminal serves for measurement application. Use the terminal for connection to test leads shielding if they are equipped with shielding.

L input terminal can be internally connected to GND terminal via relay. Grounded or floating mode of L terminal can be setup in M194 SETUP menu.

It is recommended to use grounding mode for all applications except those where UUT has grounded Low terminal (for example HIPOT testers).

Be aware that measurement configuration should be always grounded, and in one lpoit to get stable and reliable readings.

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:

4.3.1.   Resistance

It offers direct setting of requested resistance value.
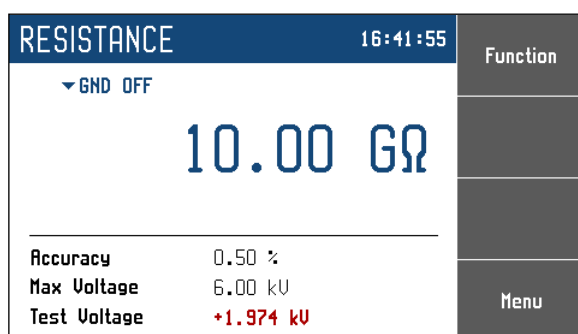
Fig 5 Resistance screen

Editable parameters:
Resistance value: 10.00 kΩ … 100.0 GΩ

Measured parameters:
Test voltage: 5.0 V to 400.0 V in resistance range 10.00 kΩ to 999.9 kΩ
                               0.050 kV to 6.000 kV in resistance range 1.000 MΩ to 100.0 GΩ

4.3.2. Timings

The function offers simulation of time-varying resistance defined by a table. User can define more time curves.
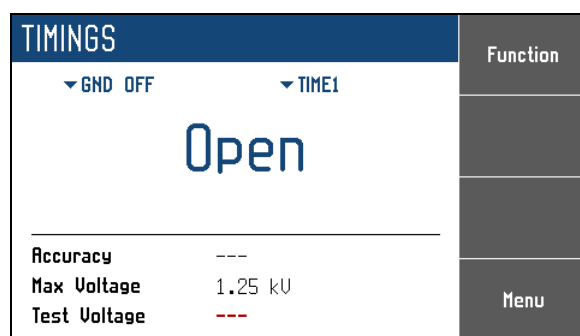
Fig 6 Timing screen

Editable parameters:
Timing table: table defined by the user

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, 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:*
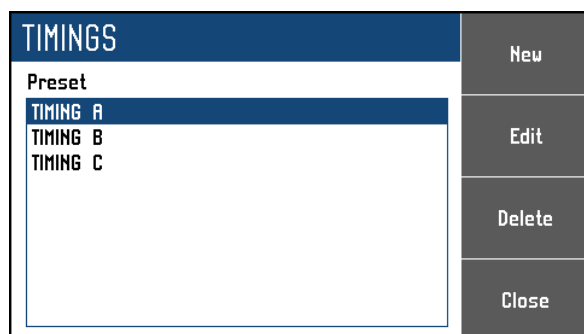
Fig 7 Time sequence list

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:
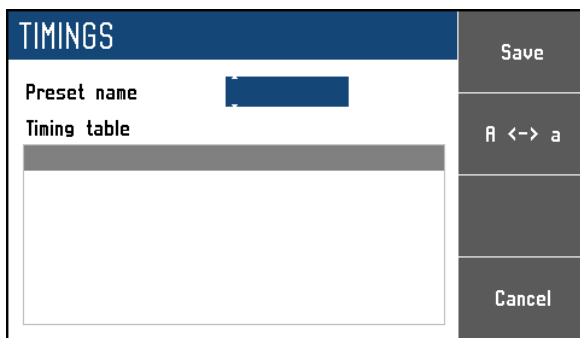
Fig 8   New sequence

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.
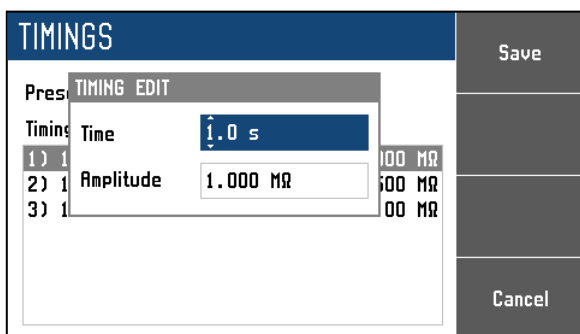
Fig 9   Timing sequence point editing

    Time – duration of selected resistance (from 1.0 s to 60 s).

> > **Amplitude** – corresponding Ω value. Range is restricted to actual resistance range of the decade.

> **Edit** – edit selected point.

> **Delete** – delete selected point.

Save – closes the table and saves current settings.

Cancel – closes the table and <u>does not</u> 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.
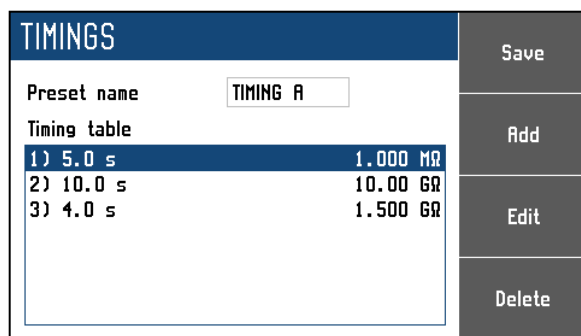
Fig 10 Timing sequence edit

4.4.   Setting the value of output resistance

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 new value in different units can be entered.
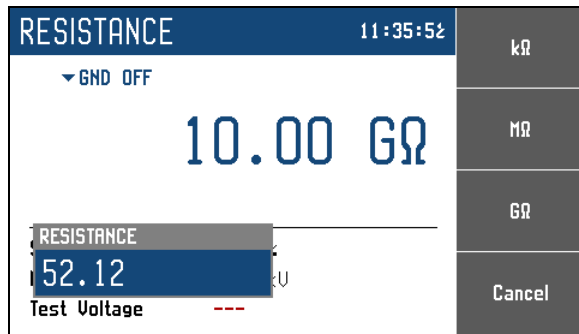
Fig 11   Numeric value entry

- Enter desired value.

- After the entry is complete press softkey with requested unit or press ENTER key.

- 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.
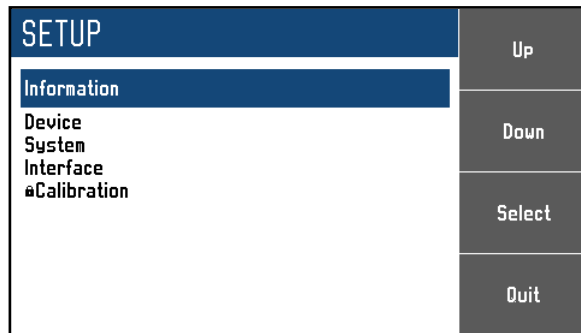
Fig 12   Setup menu

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*
> *Serial number*
> *Software version*
> *Hardware version*

Device
This menu permits setting operational parameters of device.

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.

L terminal ground
This menu permits grounding or floating mode of operation. In grounding mode L output terminal is internally connected to PE.

Grounding mode is recommended for most of applications. It eliminates noise and resistance fluctuations during calibrations. However UUT has to be floating (for example battery operated).

In floating mode L output terminal is not directly connected to PE. It can float up to about 20 VDC above PE potential. Floating mode is recommended for those calibrations where UUT has grounded output L terminal.

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. Meter is always disconnected during switching.

DEFAULT	Switch from R1 to R2 is done in a series of steps preventing high voltage peaks. Resistance during switching goes up above max(R1,R2) and then slowly drops down to R2. T is less than 200ms. E.g. 100 to 200 MΩ switch typically takes 45 ms.
VIA OPEN	Similar to DEFAULT mode, only the initial rise of resistance goes all the way up to OPEN state. T is less than 200ms. E.g. 100 to 200 MΩ switch typically takes 100 ms.
(direct)	This method can't be selected and takes place only when measured voltage is less than 500 V. Switch from R1 to R2 is done in two steps where resistance reaches no more than 2x max(R1,R2). T is typically 25ms.

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	M194_SN590031	only valid if DHCP is ON

4.6.   Calibration mode

In this mode resistance elements and meters of the decade 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 CANCEL.
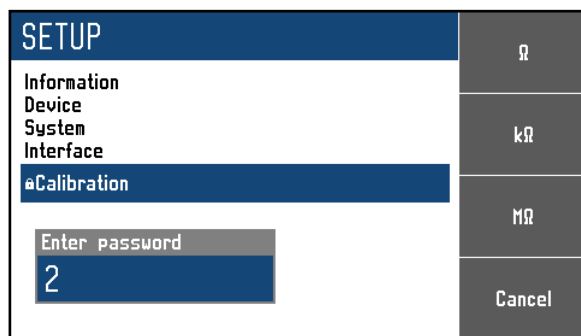
Fig 13   Password entry

Recalibration procedure consists of entering calibration values of internal partial resistance standards and adjustment of internal test voltage/current meter ranges.

Resistance standards

Calibration of resistance consists of measuring of 60 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 ▲,▼, ◄, ►.

Required standards:
- 81/2 digit multimeter type Fluke 8508A or similar with 0.01 % accuracy and resistance range to 20 GΩ.

- 81/2 digit multimeter Agilent 3458A or pA-meter Keithley 2635A or similar with DC current range 100 nA to 10 mA

- Multifunction calibrator Meatest M140, M142, Fluke 5500A or similar with DC voltage range to 1000 V.

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

Standard	Nominal value [1]	Requested Accuracy	Applied standard
R1	100 Ω	50 mΩ	Fluke 8508A
R2	102 Ω	50 mΩ	Fluke 8508A
R3	103 Ω	50 mΩ	Fluke 8508A
R4	107 Ω	50 mΩ	Fluke 8508A
R5	110 Ω	50 mΩ	Fluke 8508A
R6	118 Ω	50 mΩ	Fluke 8508A
R7	133 Ω	50 mΩ	Fluke 8508A
R8	156 Ω	50 mΩ	Fluke 8508A
R9	202 Ω	50 mΩ	Fluke 8508A
R10	293 Ω	50 mΩ	Fluke 8508A
R11	466 Ω	50 mΩ	Fluke 8508A
R12	700 Ω	70 mΩ	Fluke 8508A
R13	1.10 kΩ	100 mΩ	Fluke 8508A
R14	2.01 kΩ	200 mΩ	Fluke 8508A
R15	3.62 kΩ	300 mΩ	Fluke 8508A
R16	6.94 kΩ	500 mΩ	Fluke 8508A
R17	11.5 kΩ	1 Ω	Fluke 8508A
R18	21.9 kΩ	2 Ω	Fluke 8508A
R19	39.8 kΩ	4 Ω	Fluke 8508A
R20	70.1 kΩ	10 Ω	Fluke 8508A
R21	110 kΩ	50 Ω	Fluke 8508A
R22	200 kΩ	100 Ω	Fluke 8508A
R23	374 kΩ	500 Ω	Fluke 8508A
R24	682 kΩ	1 kΩ	Fluke 8508A
R25	1.03 MΩ	3 kΩ	Fluke 8508A
R26	2.00 MΩ	5 kΩ	Fluke 8508A
R27	3.60 MΩ	10 kΩ	Fluke 8508A
R28	6.60 MΩ	40 kΩ	Fluke 8508A
R29	11.2 MΩ	100 kΩ	Fluke 8508A
R30	20.0 MΩ	200 kΩ	Fluke 8508A
R31	38.2 MΩ	500 kΩ	Fluke 8508A
R32	72.8 MΩ	1 MΩ	Fluke 8508A
R33	9.2 kΩ	1 Ω	Fluke 8508A
R34	18.1 kΩ	2 Ω	Fluke 8508A
R35	35.8 kΩ	3 Ω	Fluke 8508A
R36	53.1 kΩ	5 Ω	Fluke 8508A
R37	100 kΩ	10 Ω	Fluke 8508A
R38	195 kΩ	20 Ω	Fluke 8508A
R39	378 kΩ	40 Ω	Fluke 8508A
R40	730 kΩ	70 Ω	Fluke 8508A
R41	1.43 MΩ	100 Ω	Fluke 8508A

R42	2.80 MΩ	300 Ω	Fluke 8508A
R43	5.46 MΩ	500 Ω	Fluke 8508A
R44	10.7 MΩ	1 kΩ	Fluke 8508A
R45	20.7 MΩ	2 kΩ	Fluke 8508A
R46	40.4 MΩ	4 kΩ	Fluke 8508A
R47	78.2 MΩ	8 kΩ	Fluke 8508A
R48	151 MΩ	30 kΩ	Fluke 8508A
R49	287 MΩ	50 kΩ	Fluke 8508A
R50	530 MΩ	100 kΩ	Fluke 8508A
R51	900 MΩ	200 kΩ	Fluke 8508A
R52	1.40 GΩ	500 kΩ	Fluke 8508A
R53	2.90 GΩ	900 kΩ	Fluke 8508A
R54	5.40 GΩ	1.5 MΩ	Fluke 8508A
R55	9.90 GΩ	3 MΩ	Fluke 8508A
R56	18.0 GΩ	10 MΩ	M140, Agilent 3548A [2]
R57	33.3 GΩ	20 MΩ	M140, Agilent 3548A [2]
R58	50.0 GΩ	30 MΩ	M140, Agilent 3548A [2]
R59	50.0 MΩ	5 kΩ	Fluke 8508A
R60	10.0 GΩ	5 MΩ	Fluke 8508A

Tab 1 M194 Resistance calibration points

[1] Nominal value indicated on the calibration screen serves for easier finding requested partial standard. Real calibration value can differ from the nominal value up to 10 %.

[2] Volt-amper calibration method is applied, see chapter 5 Performance verification test.

Process of calibration consists of measuring partial resistances and writing their actual values into the decade:

- Set the first calibration point (resistance element). Use display softkeys "Previous" and "Next" to select the element.
- Measure resistance of the selected element. Use ohmmeter with appropriate accuracy in two-wire connection mode for values above 10 kΩ and in four-wire connection for values bellow 10 kΩ.
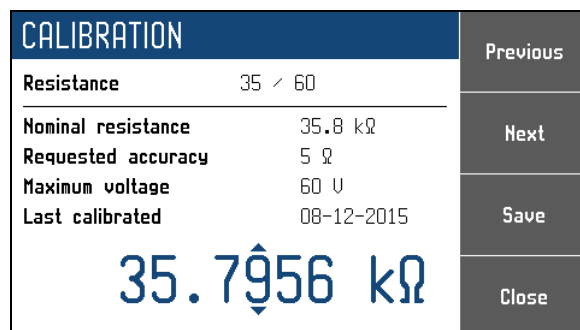
Fig 14 Calibration point screen

- Using cursor keys ▲,▼, ◄, ► adjust resistance value in M194 according to the standard ohmmeter reading .
- Confirm new calibration value by pressing "Save" softkey.

- Repeat above described procedure for all resistance elements.

Meter ranges

Calibration of meters consists of adjustment of seven voltage ranges of the test voltage meter and one range of short current milliammeter. Calibration of voltage ranges needs repeated adjustment of range 6 kVDC and once adjustment of range 400 VDC. Adjustment on all ranges is done in two points, zero and slope calibration. Calibration point can be changes using display softkeys "Previous" and "Next". Calibration value of selected resistance can be change using cursor keys ▲,▼, ◄, ►.

Required standards:
- DC High voltage source Heinzinger PNC-10000 or similar with output voltage accuracy 0.2%.

  Note: If accuracy of High voltage source is not enough, use additional voltage divider and voltmeter for DC voltage level measurement.

- Multifunction calibrator Meatest M-140, M142, Fluke 5500A or similar with DC current range to 10 mA.

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

Position	Range	Nominal value	Requested accuracy	Comment	Applied standard
M 1	400 VDC	0.0 V	0.1 V	Zero	M140
M 2	400 VDC	350.0 V	0.1 V	Slope	M140
M 3	6 kVDC (1)	0 V	2 V	Zero	Heinzinger PNC
M 4	6 kVDC (1)	5.5 kV	5 V	Slope	Heinzinger PNC
M 5	6 kVDC (2)	0 V	2 V	Zero	Heinzinger PNC
M 6	6 kVDC (2)	5.5 kV	5 V	Slope	Heinzinger PNC
M 7	6 kVDC (3)	0 V	2 V	Zero	Heinzinger PNC
M 8	6 kVDC (3)	5.5 kV	5 V	Slope	Heinzinger PNC
M 9	6 kVDC (4)	0 V	2 V	Zero	Heinzinger PNC
M 10	6 kVDC (4)	5.5 kV	5 V	Slope	Heinzinger PNC
M 11	6 kVDC (5)	0 V	2 V	Zero	Heinzinger PNC
M 12	6 kVDC (5)	5.5 kV	5 V	Slope	Heinzinger PNC
M 13	6 kVDC (6)	0 V	2 V	Zero	Heinzinger PNC
M 14	6 kVDC (6)	5.5 kV	5 V	Slope	Heinzinger PNC
M 15	10 mADC	0.0 mA	25 µA	Zero	M140
M 16	10 mADC	8 mA	25 µA	Slope	M140

Tab 2 M194 Meter calibration points

5. Performance verification test

Procedure recommended for verifying parameters of the decade is described in this chapter.

Required equipment

Following instruments are required for calibration:

- 81/2 digit multimeter type Fluke 8508A or similar with 0.01 % accuracy and resistance range to 20 GΩ.

- 81/2 digit multimeter Agilent 3458A or pA-meter Keithley 2635A or similar with DC current range 100 nA to 10 mA

- Multifunction calibrator Meatest M140, M142, Fluke 5500A or similar with DC voltage range to 1000 V.

- DC High voltage source Heinzinger PNC-10000 or similar with output voltage accuracy 0.2%.

Configuration of the decade
Decade should be tested directly from the front panel terminals. Performance verification may be performed after warm-up period i.e. 15 minutes after switching on. Decade has to be in temperature stabilize condition at minimum 8 hours before performance verification test is started.

Basic steps of the performance verification test
Verification procedure consists of following steps:

- **High resistance decade resistors verification** in range from 10 kΩ to 100 GΩ

- **DC voltage verification** to 6 kVDC

- **DC current verification** to 10 mADC

Procedure

Following part describes procedure of performance verification test. Recommended test points including applied method specification and allowed limits are shown in table Tab 3.

Resistance verification (No. 1 to 27)
1. Connect the decade to the mains and let them switched on for at least one 15 minutes in a laboratory at 23±1 °C.

2. Connect M194 output to standard multimeter type according to the Tab 3, select function of ohmmeter.

3. Set resistance values 10kΩ to 400 kΩ. Check reading of the standard multimeter and compare with limits in the table Tab 3.

4. Select function High-ohm in standard multimeter. Set resistance values 1MΩ to 10 GΩ. Check reading of the standard multimeter and compare with limits in the table Tab 3.

5. Disconnect standard multimeter and connect standard megaohmmeter, see Tab 3. Set test voltage (Parameter) in standard megaohmmeter. Set resistance values 20 GΩ to 100 GΩ in M194. Compare readings with the limits in the table Tab 3.

6. Disconnect standard megaohmmeter. Connect DC High voltage source and standard multimeter according to Fig 15. Set DC current function in standard multimeter. Set recommended DC test voltage according to the table Tab 3. If necessary, check DC output voltage using standard DC voltage divider and standard voltmeter.
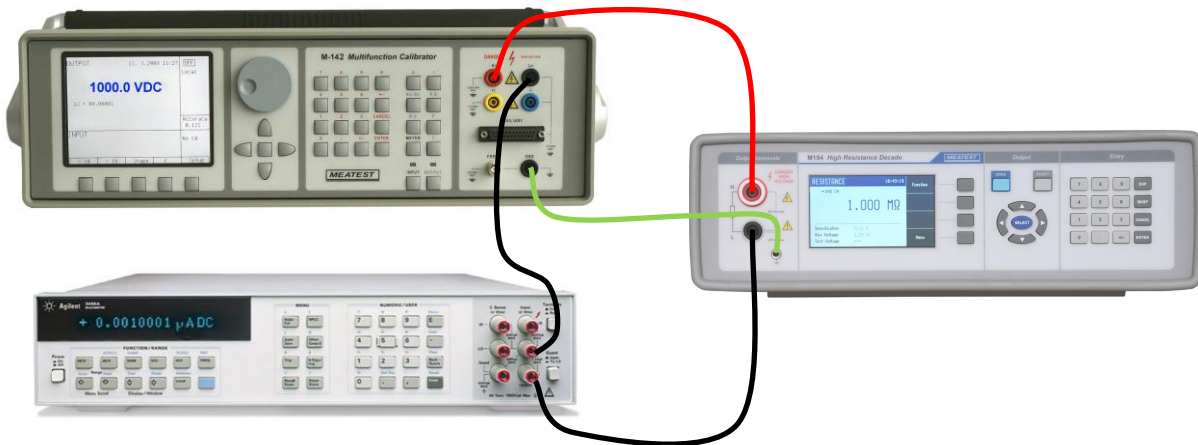
Fig 15 Volt-amper method of verification

7. Set resistance values 10MΩ, 100MΩ, 1GΩ, 10GΩ, 100GΩ. Calculate measured resistance according to formula:

    R = U/I   where I is standard multimeter reading and U is output voltage of the DC High voltage source.

Compare with limits in the table Tab 3.

DC voltage verification (No. 28 to 31)
8. Connect voltage output of multifunction calibrator to M194 H-L output terminals. Set 800 kΩ in M194. Compare voltage reading of M194 with set calibrator output voltage.

9. Disconnect multifunction calibrator. Connect DC High voltage source directly to H – L output terminals of the M194. Set indicated output resistance in M194. Compare voltage reading of M194 with set DC voltage. If necessary, check DC output voltage using standard DC voltage divider and standard voltmeter to improve accuracy of the source.

DC current verification (No. 32 to 33)
10. Connect current output of the multifunction calibrator to M194's H-L output terminals, set DCI function in the calibrator and set function SHORT in M194.

11. Set DC current values in the calibrator according to the table Tab 3. Compare reading of the DC current indicated by M194 with min/max limits in the table Tab 3.

Test point No.	Function	Range	Nominal value	Standard unit	Parameter	Test method	Limit min	Limit max
1	HVR	100kΩ	10.00kΩ	Fluke 8508A	<10V	DM	9.99kΩ	10.01kΩ
2	HVR	100kΩ	20.00kΩ	Fluke 8508A	<10V	DM	19.98kΩ	20.02kΩ
3	HVR	100kΩ	40.00kΩ	Fluke 8508A	<10V	DM	39.96kΩ	40.04kΩ
4	HVR	100kΩ	100.0kΩ	Fluke 8508A	<10V	DM	99.9kΩ	100.1kΩ
5	HVR	1MΩ	200.0kΩ	Fluke 8508A	<10V	DM-HVM	199.8kΩ	200.2kΩ
6	HVR	1MΩ	400.0kΩ	Fluke 8508A	<10V	DM-HVM	399.6kΩ	400.4kΩ
7	HVR	1MΩ	1.000MΩ	Fluke 8508A	< 250V	DM-HVM	0.999MΩ	1.001MΩ
8	HVR	10MΩ	2.000MΩ	Fluke 8508A	< 250V	DM-HVM	1.998MΩ	2.002MΩ
9	HVR	10MΩ	4.000MΩ	Fluke 8508A	< 250V	DM-HVM	3.996MΩ	4.004MΩ
10	HVR	10MΩ	10.00MΩ	Fluke 8508A	< 250V	DM-HVM	9.99MΩ	10.01MΩ
11	HVR	100MΩ	20.00MΩ	Fluke 8508A	< 250V	DM-HVM	19.98MΩ	20.02MΩ
12	HVR	100MΩ	40.00MΩ	Fluke 8508A	< 250V	DM-HVM	39.96MΩ	40.04MΩ
13	HVR	100MΩ	99.99MΩ	Fluke 8508A	< 250V	DM-HVM	99.89MΩ	100.09MΩ
14	HVR	1GΩ	200.0MΩ	Fluke 8508A	< 250V	DM-HVM	199.6MΩ	200.4MΩ
15	HVR	1GΩ	400.0MΩ	Fluke 8508A	< 250V	DM-HVM	399.2MΩ	400.8MΩ
16	HVR	1GΩ	999.9MΩ	Fluke 8508A	< 250V	DM-HVM	997.9MΩ	1001.9MΩ
17	HVR	10GΩ	2.000GΩ	Fluke 8508A	< 250V	DM-HVM	1.990GΩ	2.010GΩ
18	HVR	10GΩ	4.000GΩ	Fluke 8508A	< 250V	DM-HVM	3.980GΩ	4.020GΩ
19	HVR	10GΩ	9.999GΩ	Fluke 8508A	< 250V	DM-HVM	9.949GΩ	10.049GΩ
20	HVR	100GΩ	20.00GΩ	Multifunction calibrator M140 + multimeter HP3458A	1000 V	MM	19.8GΩ	20.2GΩ
21	HVR	100GΩ	40.00GΩ	Multifunction calibrator M140 + multimeter HP3458A	1000 V	MM	39.6GΩ	40.4GΩ
22	HVR	100GΩ	100.0GΩ	Multifunction calibrator M140 + multimeter HP3458A	1000 V	MM	99.0GΩ	101.0GΩ
23	HVR	10MΩ	10.00MΩ	DC High voltage source Heinzinger PNC + multimeter HP3458A	5000V	VAM	9.99MΩ	10.01MΩ
24	HVR	100MΩ	99.99MΩ	DC High voltage source Heinzinger PNC + multimeter HP3458A	5000V	VAM	99.89MΩ	100.09MΩ
25	HVR	1GΩ	999.9MΩ	DC High voltage source Heinzinger PNC + multimeter HP3458A	5000V	VAM	997.9MΩ	1001.9MΩ
26	HVR	10GΩ	9.999GΩ	DC High voltage source Heinzinger PNC + multimeter HP3458A	5000V	VAM	9.949GΩ	10.049GΩ
27	HVR	100GΩ	100GΩ	DC High voltage source Heinzinger PNC + multimeter HP3458A	5000V	VAM	99.0GΩ	101.0GΩ
28	DCV	400V	300V	Multifunction calibrator M140	800kΩ	DM-V	296.5V	303.5V
29	DCV	6000V	1000V	DC High voltage source Heinzinger PNC	100MΩ	DM-V	980V	1020V
30	DCV	6000V	2000V	DC High voltage source Heinzinger PNC	100MΩ	DM-V	1975V	2025V
31	DCV	6000V	5000V	DC High voltage source Heinzinger	100MΩ	DM-V	3965V	4035V

				PNC				
32	DCI	10mA	2mA	Multifunction calibrator M140	---	DM-C	1.971mA	2.029mA
33	DCI	10mA	8mA	Multifunction calibrator M140	---	DM-C	8.959mA	9.041mA

Tab 3 M194 Verification points

Test method description
DM	*direct measurement using standard multimeter, four wire connection bellow 10 kΩ, two wire connection above 10 kΩ*
DM-HVM	*direct measurement using standard multimeter, two wire connection, high voltage mode.*
VAM	*volt-amper method using multifunction calibrator and uA-meter*
DM-V	*direct measurement of DC voltage source*
DM-C	*direct measurement of DC current source*

6. Remote control

Decade box can be controled via RS232, GPIB, LAN and USB interface. The decade 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 decade in the "LOCAL" mode.

SYSTem:REMote

This command places decade in the "REMOTE" mode.

SYSTem:RWLock

This command places the decade 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 decade (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 decade box can be controled via standard RS232 interface.

Following equipment is required:

- M194 High Resistance Decade
- 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 decade system menu to be in operation (*SETUP->Interface->Active bus*). There is only one RS232 setting accesible from the decade 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
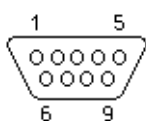
Pin	Label	I/O	Description
2	TXD	output	Transmitter
3	RXD	input	Receiver
5	GND	-	Ground

Fig 16 RS232 9 pin D-SUB MALE connector

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

Computer	D-Sub 1	D-Sub 2	M194
Receiver	2	2	Transmitter
Transmitter	3	3	Receiver
Ground	5	5	Ground

Tab 4 RS232 cable connection

6.2.   GPIB Interface (option)

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

Following equipment is required:

- M194 high resistance decade with LAN, USB, IEEE488 bus option
- Personal Computer (or other controling device) with GPIB interface
- GPIB cable

The GPIB interface must be selected from decade system menu to be in operation (*SETUP->Interface->Active bus*). There is only one GPIB setting accesible from the decade 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
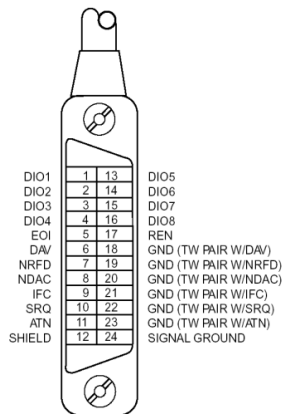
The instrument also recognizes the following general commands:
DCL Device Clear - resets the instrument to its basic state
SDC Selected Device Clear - resets the instrument to its basic state
GTL Go To Local - switches the remote control off
LLO Local Lock Out - switches the local control off, the instrument 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.

Fig 17 IEEE488 connector

6.3.   *LAN Interface (option)*

LAN Interface allows communication with decade box using Telnet protocol. A propper setting must be established.

Following equipment is required:

- M194 high resistance decade with LAN, USB, IEEE488 bus option
- Personal Computer (or other controling device) with LAN interface
- LAN cable

The LAN interface must be selected from decade system menu to be in operation (*SETUP->Interface->Active bus*). There are folowing LAN settings accesible from decade 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	M194_SN590031	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".

6.4.   USB Interface (option)

The decade box can be controled via USB (Universal Serial Bus) interface.

Following equipment is required:

- M194 high resistance decade 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 decade system menu to be in operation (*SETUP->Interface->Active bus*). There is no USB setting in the decade.

Decade box is equiped with USB type B connector.
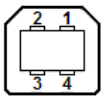
Pin	Label	Description
1	+5V	Power supply
2	DATA-	Data signal -
3	DATA+	Data signal +
4	GND	Ground

Fig 18 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 decade 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
     :MEASure
          :AMPLitude(?) <DNPD>
          :VALue(?) <DNPD>
          :SELect(?) <DNPD>
     :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}
:MEASure
      :CURRent? <DNPD>
      :VOLTage? <DNPD>
:OUTPut
      :GROund(?) {ON|OFF|1|0}
      :SHORt(?) {ON|OFF|1|0}
      [:STATe](?) {ON|OFF|1|0}
[:SOURce]
      :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>
: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>
*CLS
*ESE(?)
*ESR?
*IDN?
*OPC(?)
*OPT?
*RST
*SRE(?)
*STB?
*TST?
*WAI
```

6.7. Standard Status Data Structures

Decade box 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.
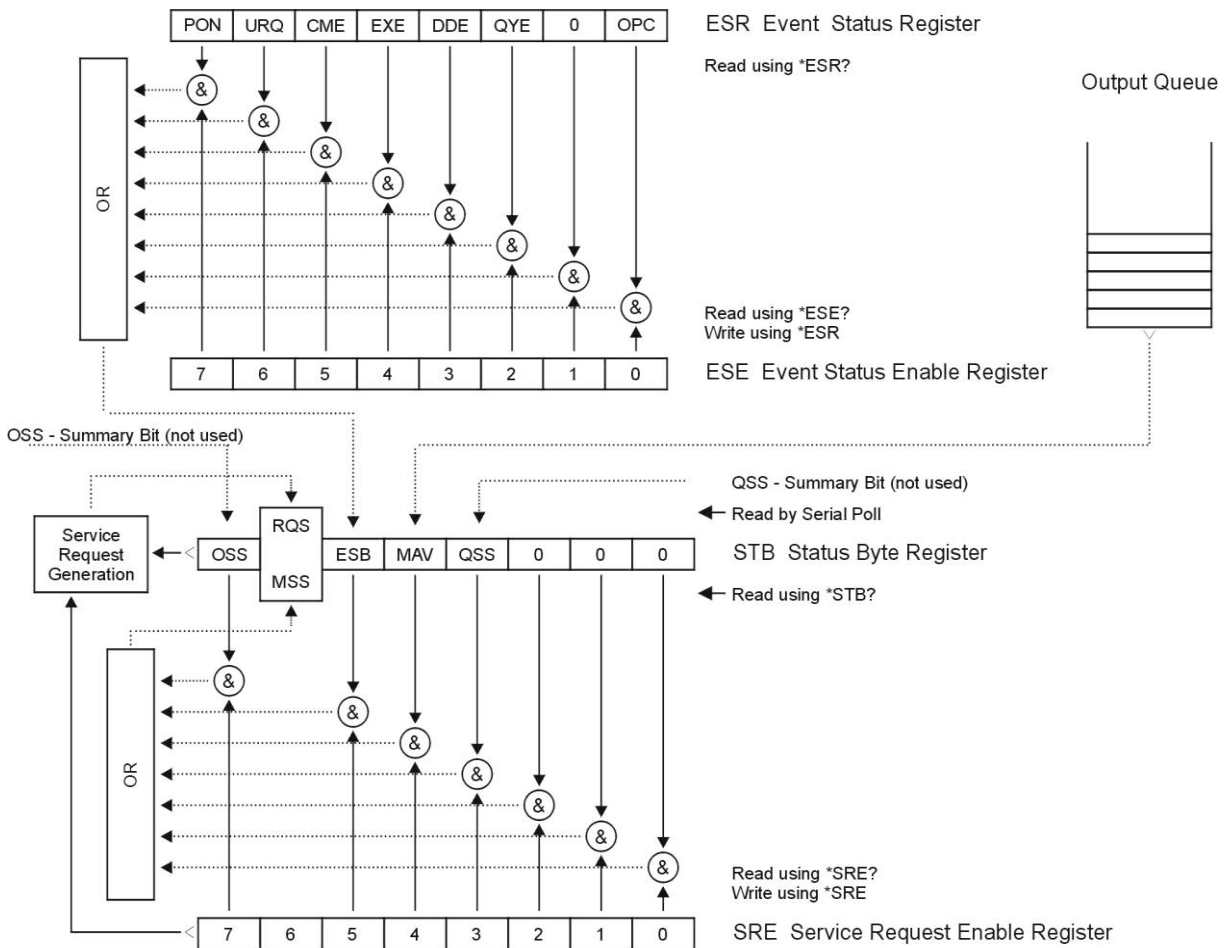
Status Register Overview

Fig 19 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 decade box 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 decade box 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 decade box.

Questionable Status Register

Not used in the decade box.

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: MEATEST,M194,590321,1.00

*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 decade box 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:MEASure:AMPLitude

Syntax:

:CALibration:MEASure:AMPLitude?

Description:

This auxiliary command reads calibration constant of selected meter range.

Parameters:

<DNPD>   Range 0 … 65535.

Remarks:

This command requires "Calibration" access

Overlapped command

Value is not affected by reset

Example:

CAL:MEAS:AMPL? Response: 32773

:CALibration:MEASure:VALue

Syntax:

:CALibration:MEASure:VALue <DNPD>

:CALibration:MEASure:VALue?

Description:

This command sets calibration value of standard from which calibration constant is calculated. Read command returns actual meter readout.

Parameters:

        <DNPD>   Standard voltage value in Volts. Ranges and default values varies in accordance to selected calibration point (see table "M194 Meter calibration points").

Remarks:

    This command requires "Calibration" access

    Overlapped command

Example:

    CAL:MEAS:VAL 5500

    CAL:MEAS:VAL? Response: 5.500000E+03

:CALibration:MEASure:SELect

Syntax:

    :CALibration:MEASure:SELect <DNPD>

    :CALibration:MEASure:SELect?

Description:

    This command enters calibration mode and selects meter range for calibration. Output terminals are automatically switched-on.

Parameters:

    <DNPD>   Range 0 ... (2x Max. Meter Range Count) -1, zero based index of resistance standard

Remarks:

    This command requires "Calibration" access

    Overlapped command

Example:

    CAL:MEAS:SEL 1

    CAL:MEAS:SEL? Response: 1

: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 decade box.

Parameters:

    <DNPD>   Standard resistance value in Ohms. Ranges and default values varies in accordance to selected resistance etalon (see table "M194 Resistance calibration points").

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 0 ... Max. Resistance Count -1, zero based index of resistance standard

Remarks:
     This command requires "Calibration" access
     Overlapped command
Example:
     CAL:RES:SEL 0
     CAL:RES:SEL? Response: 0

: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 decade 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} (default ENGL)
>   ·ENGLish   english version

Remarks:
>   Overlapped command
>   Value is not affected by reset

Example:
>   DISP:LANG ENGL
>   DISP:LANG? Response: ENGL

:MEASure:CURRent
Syntax:

:MEASure:CURRent?
Description:
This command reads actual meter readout. Short function only.
Parameters:
<DNPD>   Meter value in Amps.
Remarks:
Overlapped command
Example:
MEAS:CURR? Response: 5.044000E-03

:MEASure:VOLTage
Syntax:
:MEASure:VOLTage?
Description:
This command reads actual meter readout. Non-shorted functions only.
Parameters:
<DNPD>   Meter value in Volts.
Remarks:
Overlapped command
Example:
MEAS:VOLT? Response: 1.944000E+03

:OUTPut:GROund
Syntax:
:OUTPut:GROund <BOOL>
:OUTPut:GROund?
Description:
This setting affects Lo-terminal grounding.
Parameters:
<BOOL>   {ON|OFF|1|0} (default 0)
·ON   Lo-terminal is switched to ground
·OFF   Lo-terminal is floating
·1   same as ON
·0   same as OFF
Remarks:
Overlapped command
Value is set to default after reset
Example:
OUTP:GRO ON
OUTP:GRO? Response: 1

: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:SWITching

Syntax:

:OUTPut:SWITching <CPD>

:OUTPut:SWITching?

Description:

Quick changes in output resistance with output terminals loaded with high voltage may cause voltage spikes at output terminals. This setting allows selecting a method how new resistance at output terminals is achieved.

Parameters:

<CPD>   {DEFault|OPEN} (default DEFault)

·DEFault   series of steps preventing high voltage peaks

·OPEN   open function is activated before new resistance is set

Remarks:

Overlapped command

Value is not affected by reset

Example:

OUTP:SWIT DEF

OUTP:SWIT? Response: DEF

: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

Tab 5 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

[: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 10.0e3 ... 100.0e9, default 100.0e6

<UNIT>   {OHM}

        ·OHM

Remarks:

Overlapped command

Value is set to default after reset

Example:

RES 1000000.0

RES? Response: 1.000000E+06 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 "0.5,2200000.0"

  TIM:PRES2:ROW1:AMPL? Response: " 5.000000E-01,2.200000E+06"

[: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 0 ... Preset count-1 (default 0)

Remarks:

  Overlapped command

  Value is not affected by reset

Example:

  TIM:SEL 0

  TIM:SEL? Response: 0

: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 M194_SNXXXXXX

    SYST:COMM:LAN:HOST? Response: M194_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_STBY	27

Tab 6 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

6.10. SCPI Error codes

Decade box 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"

Tab 7 SCPI error codes

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 decade box
- 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.

MEATEST   *M194 High Resistance Decade*

8. Technical data

Accuracies include long-term stability, temperature coefficient, linearity, load and line regulation and the traceability of factory and National calibration standards. Specified accuracy is valid after 15 minute warm up in temperature range 23 ± 2 °C. Specified accuracy is one year accuracy.

Function RESISTANCE

Total resistance range:	10.00 kΩ to 100.0 GΩ
Resolution	3½ digit
Maximal test voltage	65 VDC to 6 000 VDC depending on resistance value

Accuracy & maximal ratings

Resistance range	Accuracy[*] %	Maximum DC test voltage[**] V	Test voltage accuracy
10.00 kΩ - 99.99 kΩ	0.1	65	0.5 % + 2 V
100.0 kΩ - 999.9 kΩ	0.1	315	0.5 % + 2 V
1.000 MΩ - 1.999 MΩ	0.1	1 250	0.5 % + 10 V
2.000 MΩ - 9.999MΩ	0.1	2 500	0.5 % + 10 V
10.00MΩ - 99.99MΩ	0.1	6 000	0.5 % + 10 V
100.0MΩ - 499.9MΩ	0.2	6 000	0.5 % + 10 V
500.0MΩ - 999.9MΩ	0.2	6 000	0.5 % + 10 V
1.000GΩ - 9.999GΩ	0.5	6 000	0.5 % + 10 V
10.00GΩ - 19.99GΩ	1.0	6 000	0.5 % + 10 V
20.00GΩ - 100.0GΩ[***]	1.0	6 000	0.5 % + 10 V

Tab 8 Accuracy

[*]   Accuracy is valid for reference temperature range 23+/-2 °C with RH < 50%.
[**]   Maximum measured DC test voltage is 5% over the specified range.
[***] Full accuracy is reached 1 minute after the test voltage is attached.

Temperature dependency:	Add: 0.1 x specified accuracy /°C at reference temperature for temperature outside of reference temperature 23 ± 2°C, from +13 °C to +33 °C
Humidity dependency:	Add: 0.02 x specified accuracy / % RH for range 100.0 MΩ to 9.99 GΩ 0.05 x specified accuracy / % RH for range 10.00 GΩ to 100.0 GΩ for ambient humidity in range 50 to 70 % RH
Test voltage range:	max 6 000 VDC + 5% over range, see Tab 8
Test voltage indication:	3 digit voltmeter with range: 6000 VDC with suppressed indication bellow 50 VDC in resistance range 1.000 MΩ to 100.0 GΩ 400 VDC with suppressed indication bellow 5 VDC in resistance range 10.00 kΩ to 999.9 kΩ

Maximum safe DC voltage between H and L terminal:	6 500 VDC
Maximum safe DC voltage between L and GND terminal:	20 VDC

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Function TIMING
Range of time interval: 1.0 to 60.0 s
Resistance range: 10.00 k Ω to 100.0 G Ω
Max. number of time intervals: 60 in all tables
Max. number of tables: 10

Function SHORT (Short test current)
Current range: 0.00 – 10.00 mA DC
Input resistance: 200 Ω ± 10%
Short test current accuracy: 0.2% + 25 uA

General data
Warm up time: 15 minutes
Operating temperatures: 23 ± 10 ℃, relative humidity < 70%
Storage temperatures: -10 °C to +50 °C
Reference condition: Ambient temperature 23 ± 2 °C
                                 Relative humidity < 50 % for resistance range from 10 GΩ   to
                                 100 GΩ
                                 Relative humidity < 70 % for resistance range from 10 kΩ to
                                 10 GΩ

Housing: metal sheet
Terminals: instrument terminals diameter 4mm, gold plated
Interface: RS232 (optionally IEEE488, USB, Ethernet)
Dimension: 450 (W) x 430 (D) x 150 (H) mm
Weight   6 kg
Power line: 110/115/120/125 - 220/230 V – 45/65 Hz
Power consumption: 25 VA
Safety class: I according to EN 1010-1
Isolation resistance between
Output terminals and housing: > 2 GΩ (at 500V DC)
Used external fuses: T500mL250V for 230 VAC power supply voltage, 1 pc
                                 T1L250V for 115 VAC power supply voltage, 1 pc

9. Accessory

Basic accessories (included in delivery)
- Power line cable   1 pc
- Test lead   2 pc
- User´s manual   1 pc
- Calibration certificate   1 pc
- Spare fuse   1 pc
- Cable RS-232   1 pc

Options (extra ordered)
- Opt 10   Test cable 1000V/20A black
- Opt 11   Test cable 1000V/20A red
- Cable GPIB   IEEE488/IEEE488, 2m

10. Ordering information

Interface
M194-V1xxx   - RS232
M194-V2xxx   - RS232, LAN, USB, IEEE488

Housing
M194-Vxx0x   - table version
M194-Vxx1x   - module 19", 3HE

Order example:
M194-V2010   High Resistance Decade, RS232, LAN, USB, IEEE488, 19" rack