

Precision Resistance Decade OCM-612

Owner's Manual



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1. Use of the instrument

OCM612 Simulator is designed for parameter checking of various regulators and process meters which use resistance temperature sensors for temperature measuring. Both Pt and Ni sensors can be simulated. Low thermal voltage relays and very stable foil resistors with low temperature coefficient are used to achieve high accuracy and stability. The selected value of the resistance or the temperature is displayed at the front panel display. The instrument is supplied from internal battery. An external power adapter is used for charging the battery or for uninterrupted operation of the instrument.

OCM612 is suitable for automatic testing procedures. Two data ports RS232 (standard) and GPIB (Option) can be used for communication with a PC.

2. Contents of delivery

OCM-612 standard version

RTD simulator M-612
Power line adapter
Cable RS-232
Demo program
User's manual

OCM-612 GPIB version

RTD simulator M-612 GPIB
Power line adapter
Demo program
User's manual

3. Technical data

Range of Pt sensor temperature simulation	-200.000 °C – 850.000 °C
Range of Ni sensor temperature simulation	-60.000 °C – 300.000 °C
Resolution	0.001 °C for Pt100, Pt200, Ni100 0.01 °C for Pt500, Pt1000, Ni1000
Simulated temperature sensors	Pt100, Pt200, Pt500, Pt1000, Ni100, and Ni1000
Temperature scale	IPTS68, ITS90
Pt Sensor standard	DIN (IEC751) (1,3850 for IPTS68 / 1,3851 for ITS90) US (US/JIS) (1,3916)
Ni sensor standards	DIN 43760 (6180)
Resistance range	16.0000 Ω - 10000 Ω
Temperature coefficient	< 1ppm/ °C (16 Ω - 2000 Ω) < 5ppm/ °C (2 kΩ - 10 kΩ)
Maximal power dissipation	0,3 W
Maximum current	100 mA (16 - 30 Ω) 50 mA (30 - 100 Ω) 20 mA (100 - 500 Ω) 10 mA (500 - 3000 Ω) 5 mA (3000 - 10000 Ω)

Maximum voltage	50 V eff
Connection type	2, 3 or 4 wire
Terminals	gold plated terminals 4mm
Remote control	RS-232, galvanic isolated
Reaction time *	< 3 ms
Power supply	internal battery 12 V – 2.6 Ah (WP2.6-12) Ext. power line adapter 5V/1A (100–240V)
Operating period	typically 6 hours
Range of reference temperatures	+18 °C ... +28 °C
Range of working temperatures	+5 °C ... +40 °C
Range of storage temperatures	-10 °C ... +50 °C
Dimensions	W 325 mm, H 111 mm, D 316 mm
Weight	4 kg

* Reaction time means time interval between setting up value at the front panel or receiving command from remote control bus and settling the value at the output terminals.

Note:

During the switching time the output terminals can be OPEN for approx. 1 ms.

Accuracy

The specified accuracy is valid after 10 minutes warm up in the ambient temperature 23 ± 5 °C. Uncertainties include long-term stability, temperature coefficient, linearity, load and line regulation and traceability to the National Calibration Standards. The accuracy in % is related to the set value. The specified accuracy is valid for one year.

Resistance accuracy

Range	Accuracy
16 Ω ... 400 Ω	0.003 % + 3 m Ω
400 Ω ... 2000 Ω	0.005 %
2000 Ω ... 10000 Ω	0.015 %

Pt sensors simulation accuracy

Temperature range	Accuracy Pt100	Accuracy Pt200	Accuracy Pt500	Accuracy Pt1000
-200 ... 200 °C	0.02 °C	0.02 °C	0.02 °C	0.1 °C
200 ... 500 °C	0.03 °C	0.04 °C	0.06 °C	0.2 °C
500 ... 850 °C	0.04 °C	0.06 °C	0.15 °C	0.3 °C

Ni sensors simulation accuracy

Temperature range	Accuracy Ni100	Accuracy Ni1000
-60 ... 300 °C	0.02 °C	0.1 °C

Leads simulation

Two resistors of 10Ω are build-in. They can be used to simulate the leads compensation. The accuracy is 0.1%, maximal allowed current is 100 mA.

4. Preparing for use

OCM-612 Simulator is supplied from internal battery or from external power line adapter. The range of the line voltage is 100 V to 240 V 50/60 Hz. OCM-612 is a laboratory device and its accuracy is guaranteed for a temperature range $23 \pm 5\text{ }^{\circ}\text{C}$. The instrument can be operated in horizontal or slope position. The angle of slope is determined by downcast holder.

Unpack the instrument and put it on flat surface. Do not switch it ON. Have it first stabilized for the ambient temperature for at least 1 hour.

4.1. Switching on

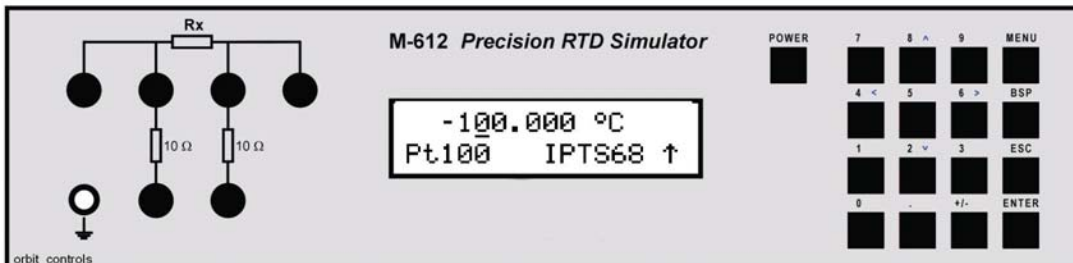
If the instrument is supplied from internal battery only, push the button POWER. If the power line adapter is connected, the instrument will switch-on automatically. After switching-on, internal tests are performed for approx. 3s. The display shows the type of the instrument and the manufacturer, during internal tests are performed. At the end of the test the display switches into the initial position: Temperature 100°C or Resistance 100Ω .

4.2. Warm-up time

The instrument can be used immediately after the power has been switched-on. The specified parameters are valid after 10 minutes of operation. During the first 10 minutes the instrument shall not be calibrated (see Instrument's calibration).

5. Description

5.1. Front panel



The keyboard, the display and the output terminals are located at the front panel.

Keyboard

Numerical values can be entered from the numerical part of the keyboard. The keys 2, 4, 6, 8 are also cursor keys.

Key	Meaning
MENU	opens the SETUP/CALIBRATION menu.
BSP	deletes last entered number.
ESC	cancels last entered value or leaves last set mode
ENTER	confirms the value or the item in the MENU, or switches between numerical function (black label) and display cursor function (blue label) of the keys 2, 4, 6, 8. The switching is indicated with the symbol (↑) in the right lower corner of the display.
POWER	switches on and off the power. When switching-off is requested, the key must be pushed twice.

Display

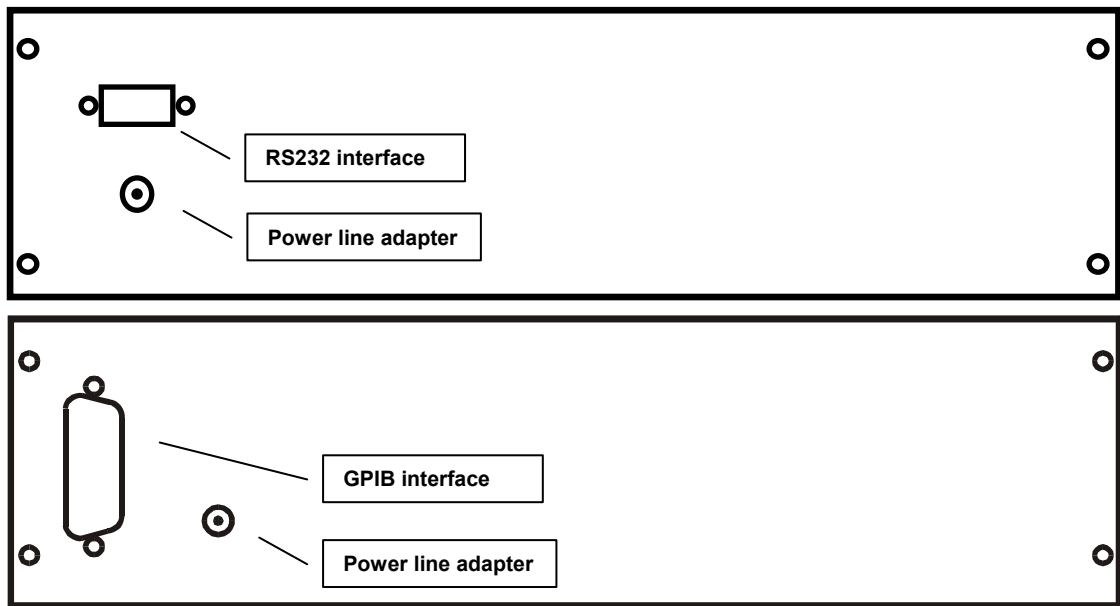
Two-row alphanumerical display is used. The main value (the simulated temperature or output resistance) is displayed in the upper row. Additional information are displayed in lower row. Depending on the mode of operation, following symbols can be displayed in lower right:

- ↑ keys 2, 4, 6 and 8 are switched to the cursor function (blue labels are valid)
- ☐ The instrument is remotely controlled via RS232 or GPIB (option)
- ☐ Internal battery is out of power
- ⚡ Power line adapter is connected

Output terminals

The simulated value of the resistance is connected to the output terminals in 2, 3 or 4 wire configuration. Two terminals in the lower row are connected to the output terminals through 10Ω resistors, which can be used for simulation of the leads. The left terminal with symbol "GROUND" is connected to the metal cabinet.

5.2. Rear panel




The rear panel contains the power supply connector, interface RS-232 or GPIB connectors and the instruments label.

6. Operation


6.1. Switch ON and OFF

When the power line adapter is connected, the instrument switches automatically.

When the power line adapter is not connected, the instrument runs from the internal battery and has to be switched-on with the key POWER. To switch-off, push the key POWER twice. Supplied from internal battery, the instrument switches-off automatically when none of the keys is used for longer than 20 minutes or when the battery is discharged - symbol  at the display.

6.2. Standard mode

After switching-on the instrument switches into the standard mode. The display shows following information:



-100.000 °C
Pt100 IPTS68 ↑

In the upper row displays the simulated temperature [°C] or resistance [Ω]. In the lower row displays the simulated temperature sensor (Pt100, Pt200, Pt500, Pt1000, Ni100, Ni1000), temperature scale IPTS68, ITS90 according to the IEC751 or US/JIS standards. Arrow symbol in right corner informs that the cursor keys 2, 4, 6, 8 are activated. When the key MENU is pressed, the SETUP function is activated.

Using the cursor keys

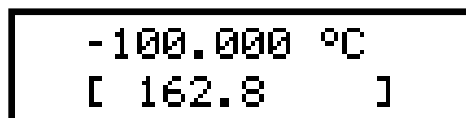
With the cursor keys ↑ ↓ the activated display position can be increased or decreased. The activated position is signed with a symbol _.

With the cursor keys ← → the active position of the cursor can be changed.

With the key ENTER the keys 2, 4, 6, 8 change their function between cursor and numerical function.

Numerical keyboard

With numerical keys the Temperature or the Resistance values can be directly entered. The latest entered value is displayed in brackets under the actually set value. To confirm the new value push the key ENTER.



-100.000 °C
[162.8]

ENTER change the function of the keys 2,4,6,8 between cursor and numerical entry.

ESC exits the entry of the numerical keys.

BSP deletes the last entered number.

6.3. Setup mode

This mode enables to set and display some auxiliary parameters. Push the key



MENU to enter this mode. To leave the setup mode, push the key ESC. With cursor keys ↑ ↓ following items in setup menu can be displayed:

Function

With the keys ← → one of basic functions can be set: R, Pt100, Pt200, Pt500, Pt1000, Ni100 and Ni1000. The selected function is displayed in the lower display row. To confirm, press ENTER. The new function appears in the upper row.

The last entered function remains stored also when the instrument is switched off.

Temperature Scale

With the keys ← → the scale IPTS68 or ITS90 can be selected. It will be displayed in lower row. To change the scale press the key ENTER. The new scale appears in the upper row.

This function is active for Pt Sensors according to IEC 751 standard only. For Ni and Pt sensors of the "US" type, this function is inactive.

The last entered function remains stored also when the instrument is switched off.

Pt Sensor Type

With keys ← → either US (coefficient 1,3916 according to the US/JIS standard) or IEC (coefficient 1.3850 for IPTS68 and coefficient 1,3851 for ITS90) can be selected. The selected standard is displayed in lower row. With the key ENTER the setting can be changed.

The last entered function remains stored also when the instrument is switched off.

Volume

Enables or disables acoustic indication of the front panel keys.

With the keys ← → the beep tone can be switched OFF, set to low level LOW or level HIGH of intensity.

The last entered function remains stored also when the instrument is switched off.

Baud rate RS-232 (optionally GPIB address)

With keys ← → the baud rate can be selected: 300, 600, 1200, 2400, 4800, 9600 or 19200 bd. Press ENTER to confirm the new setting.

If the simulator is equipped with GPIB, the address 00...30 can be selected.

The last entered function remains stored also when the instrument is switched off.

Illumination

With keys ← → the back light can be set for OFF (the back light is switched off), 30 s (the back light is switched on for 30 sec. after last key pressing), 5m (the back light is switched on for 5 minutes after last key pressing) or ON (the back light is switched on permanently) Confirm the setting with ENTER.

If the instrument is supplied from the external power adapter, the back light is switched-on permanently.

Note: The back light consumes a significant part of battery power. The battery operation prolongs by approx. 50% when the back light is not used.

Calibration Code and Password Setting

The calibration code is a five-digit number, which must be entered to access the calibration mode. The calibration code appears in the Setup Menu only when set to "00000". New calibration code can be directly entered via the numeric keyboard and confirmed with ENTER. Non-zero calibration code is not displayed.

The purpose of the calibration code is to prevent unauthorized users from changing the calibration of the instrument.

Note:

It is advisable to note the new calibration code. In case of its lost the instrument has to be returned to the manufacturer.

The last set calibration code is valid even if the instrument is switched off.

Serial number

The Display shows the serial number of the instrument. The parameter cannot be changed.

6.4. Calibration Mode

In the calibration mode the internal resistors can be recalibrated. Access to the calibration mode is enabled after double pushing the key MENU from the standard mode or after single pushing the same key from the setup mode.

Correct password must be entered before calibration. Without correct password the access to the calibration mode is refused. Return to standard mode is possible after pushing the key ESC.

Enter password :
00000

The recalibration procedure consists of measuring of 22 basic resistance values and entering their values. The keys $\uparrow \downarrow$ can be used.

The following table shows the nominal values in the calibration points and the required accuracy:

Calibration point	Nominal value	Accuracy
R00	31,6 Ω	1 m Ω
R01	61,9 Ω	1 m Ω
R02	121 Ω	2 m Ω
R03	237 Ω	3 m Ω
R04	464 Ω	6 m Ω
R05	909 Ω	15 m Ω
R06	1780 Ω	30 m Ω
R07	3480 Ω	100 m Ω
R08	6870 Ω	250 m Ω
R09	13,5 k Ω	500 m Ω
R10	26,6 k Ω	1 Ω
R11	52,2 k Ω	5 Ω
R12	103 k Ω	10 Ω
R13	202 k Ω	20 Ω
R14	398 k Ω	40 Ω
R15	780 k Ω	80 Ω
R16	1540 k Ω	200 Ω
R17	3020 k Ω	400 Ω
R18	5920 k Ω	1 k Ω
R19	12 M Ω	5 k Ω
R20	23 M Ω	50 k Ω
R21	46 M Ω	200 k Ω
R22	85 M Ω	500 k Ω

Calibration Steps:

- Enter the first calibration point (resistance element). Use keys $\uparrow \downarrow$ to set the element.
- Measure resistance of the selected element. Use ohm-meter in 4-wire connection.

- Change functions of the keyboard to the numerical.
- Write measured resistance value (the original value in the first row and newly entered value in the second row).

R00	62.00000	Ω
	62.0200	

- Confirm new calibration data by pushing the key ENTER.
- Repeat above described procedure for all resistance elements.

7. Performance verification test

This chapter describes the parameter verification procedure. The verification procedure is based on measuring resistance on the simulator output terminals with a precision digital ohmmeter in recommended points.

Required Equipment

- Ohm-meter nominal accuracy 0.001% in range 10 Ω to 10 k Ω (type HP3458A or Wavetek 1281 or similar)

Setting

Switch the instrument into the resistance mode. Connect the ohmmeter to the output terminals in 4 wire type connection.

Range

- output resistance checking
- lead resistance simulation checking

Procedure

1. Connect the instrument to the ohmmeter, switch both instruments on and let them warm-up for at least 1 hour at the ambient temperature of 23 ± 2 °C.
2. Perform output resistance verification test in all points according to the table below. The maximum deviation should not exceed the limits in the table.
3. Connect the ohm-meter to the 10 Ω lead resistors in terminal Hi and measure its resistance. Allowed deviation is $\pm 0.1\%$. In the same way check the resistance of lead resistor in Lo terminal.

Maximal deviations

Nominal value [Ω]	Max. deviation[m Ω]
20.0000	3.6
50.000	4.5
100.000	6.0
200.00	9.0
500.00	25
1000.0	50
2000.0	100
5000	750
10000	1500

8. Remote control

The standard instrument is equipped with RS232 bus. The GPIB version is option and it is described in chapter 8.4. The commands for the both versions are the same.

8.1. Commands

The communication between the instrument and the PC consists of flow of periodically alternating commands type command-response or query-response. Command is always a letter followed by parameter and ended by control sign <cr> or <lf>. Response is always ended with control signs <cr> <lf>.

Syntax Description

- <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. {0 | 1 | 2 | 3}.
- ? = 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.

8.2. Command List

Value setting / reading

A (?) <DNPD>

The command sets resistance value (resistance function) or temperature value (temperature sensor simulating function).

<DNPD>.

It represents resistance value in Ohm or simulated temperature in °C. When the temperature parameter is used, both negative and positive values are acceptable. For the 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 a string „Ok <cr><lf>”.

In case of query, OCM612 returns set resistance/temperature 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 the instrument is in the temperature simulation function and 123.564 Ω if the instrument is in the resistance mode of operation.

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

Simulator function setting**F <CPD> { 0 | 1 | 2 | 3 | 4 | 5 | 6 }**

Following function are available:

- 0 Resistance generation
- 1 Pt100 simulation
- 2 Pt200 simulation
- 3 Pt500 simulation
- 4 Pt1000 simulation
- 5 Ni100 simulation
- 6 Ni1000 simulation

OCM612 confirms the 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

Response format is as follows:

1 2 3 4 5 6 7 8	
O R B I T,	- manufacturer
9 10 11 12 13	
M 6 1 2 ,	- model
14 15 16 17 18 19	
X X X X X ,	- serial number
20 21 22 23	
X . X	- firmware version

Example:

If query „*IDN?<cr>” is set, simulator returns response:

„ORBIT,M612,61200,2.4 <cr><lf>”.

Switching off**P0**

The command will switch the simulator off. The command is executed if simulator is supplied from internal battery only. Correct execution is confirmed with string „Ok <cr><lf>”.

Example:

„P0<cr>” switches simulator off (if not used external power adapter).

Type of sensor setting**T <CPD> { 0 | 1 }**

Standard according to is temperature sensor simulated can be set with this command.

- 0 type US/JIS (1.3916)
- 1 type IEC 751 (1.385)

M-612 confirms correct execution with string „Ok <cr><lf>”.

Example:

„T1<cr>” sets Pt sensor type 1.385 (IEC 751).

Temperature scale setting**S <CPD> { 0 | 1 }**

The command set temperature scale.

- 0 scale ITS90
- 1 scale IPTS68

M-612 confirms correct execution with string „Ok <cr><lf>”.

Example:

„S1<cr>” sets scale IPTS68.

Status query**V?**

M-612 returns device status in format „FxSxTx <cr><lf>”, where „x” means numbers corresponding to the real instrument status.

Example:

If query „V?<cr>” is sent, simulator returns response for example:

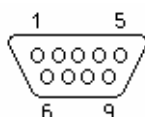
„F4S1T1<cr><lf>” (Pt1000, 1.385, IPTS68).

When unknown command is received OCM612 returns a string " ? <cr><lf>”. Correctly executed command is confirmed with a string "Ok <cr><lf>”. When correct query is received OCM612 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.

8.3. Remote control RS232

The transmission baud rate can be selected from 300 to 19200 bd. The number of data bits is 8, 1 Stop, no parity. The hardware handshake RTS/CTS and the program handshake XON/XOFF are not used. The RS 232 is optical isolated.

RS-232 connection



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

9 pin connector D-SUB MALE

Use not crossed cable between the instrument and the PC.

Computer	D-Sub 1	D-Sub 2	M-612
Receiver	2	2	Transmitter
Transmitter	3	3	Receiver
Ground	5	5	Ground

8.4. Remote control GPIB

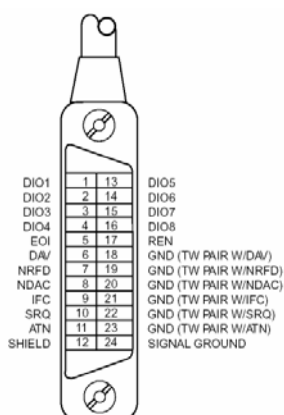
The RS232 list of commands is also valid for the GPIB interface.

The instrument performs the following functions based on GPIB 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



8.5. Demo program

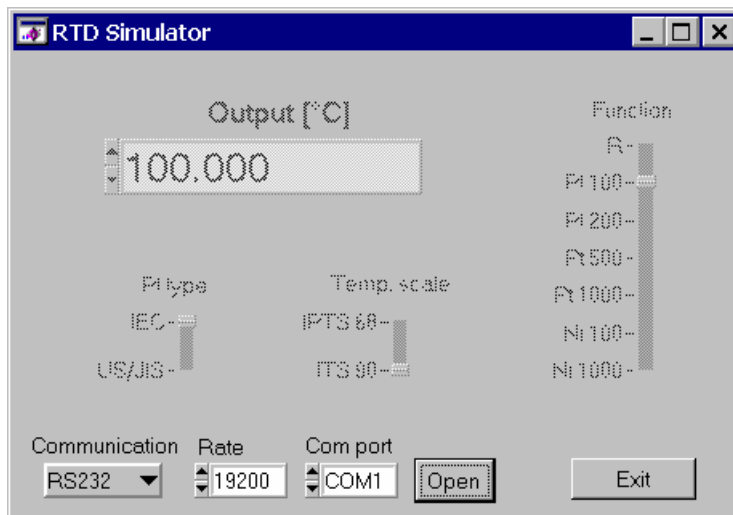
A simple operating program is supplied with the simulator in order to provide easy operation of the instrument from the computer, and to check the RS-232 line (GPIB bus) of the instrument. The installation diskette contains a program (for WIN95/98/ME/NT/2000 only).

Program Installation

When you launch SETUP.EXE, the installation program asks for the destination directory (pre-defined is RTD simulator) and executes the actual installation. The UNINST.EXE program is also copied into the selected directory.

Program Description

When you start the “simulator” program, the display shows:



First use the operating element „Communication“ to select the interface RS232 or GPIB. For RS232 set the serial port and the baud rate. For GPIB set the address. Click at “Open” to start the communication. Now the instrument can be controlled from the PC.

To close the program, click at the “Exit”.

9. Electric Function

The resistors are internally switched in binary code with precision relays with very low thermoelectric voltage. The resistors are of foil or metal type with low temperature coefficient. The metal housing is connected to the ground terminal only. The PC-board with resistors and relays is an independent mechanical block.

The CPU with one-chip micro-controller generates all necessary internal control signals. Calibration data and set-up parameters are saved in an EEPROM.

10. Mechanical Construction

The cabinet is standardised aluminium housing. The keyboard, the display and the output terminals are located on the front panel. The power supply connector, the RS232 and/or GPIB connectors are located on the rear panel. The internal rechargeable battery is mounted at the rear panel inside the cabinet.

10.1. Battery Maintenance

Approximately 40 hours are required for a full battery charge. If the instrument is stored for longer than 3 months without connection to the line charger, the battery has to be fully charged.

10.2. Battery Replacement

The internal battery is a sealed lead-acid maintenance-free long-life 12V rechargeable battery with a capacity of 2.6Ah.

To replace the battery:

- Disconnect the line power supply adapter and RS-232 (GPIB) cable.
- Switch off the instrument.
- Unscrew the 4 screws of the rear panel.
- Remove the top cover.
- Disconnect the connectors from the battery and dismount the metal belt to release the battery.
- Replace the battery pack.
- Connect the new battery and place it into the cabinet.

Manufacturer

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