RTD-500 Precision RTD Simulator

Operations Manual.

Table of Content.

1 – Scope.

The ***RTD-500 Precision RTD Simulator*** is designed for applications related to calibration of temperature monitoring equipment. Both Pt and Ni sensors can be simulated using a simplified keyboard and LCD screen interface. It also offers programmability through a RS-232 computer interface. Operation is from internal battery power or external AC source.

2 – Package Content.

RTD-500 Simulator.
Power Line adapter.
RS-232 Cable.
Demo program for RS-232 interface control.
Operations manual.

3 – Technical Data.

Pt sensor temperature simulation range: -200^{o}C – 850^{o}C.
Ni sensor temperature simulation range: 60^{o}C – 300^{o}C.
Resistance range: 16.0000 Ohms – 10,000 Ohms.
Resolution: 0.001^{o}C for Pt100, Pt200, Ni100.
0.01^{o}C for Pt500, Pt1000, Ni1000.
0.0001 Ohms for 16 – 30 Ohms.
0.001 Ohms for 30 – 100 Ohms.
0.01 Ohms for 100 – 500 Ohms.
0.1 Ohms for 500 – 2000 Ohms
1 Ohm for 2000 – 10,000 Ohms.

Simulated sensors: Pt100, Pt200, Pt500, Pt1000
Ni100, Ni1000
Temperature Scales: IPTS68 and ITS90
Pt sensor standard: DIN (IEC751)
US (US/JIS)
Ni sensor standard: Din 43760
Temperature Coefficient: <1 ppm/^{o}C (16 – 2000 Ohms)

Maximum power dissipation: 0.3W
Maximum current: 100 mA (16- 30 Ohms)
50 mA (30 – 100 Ohms)
20 mA (100 – 500 Ohms)

10 mA (500 – 3,000 Ohms)
5 mA (3,000 – 10,000 Ohms)

Maximum Voltage: 50 V
Connections: 2, 3, 4 wire.
Terminals: Gold plated terminals.
Remote Control: RS232 Interface.
Reaction Time: 3 mS.
Power Supply: Internal battery 12V 2.6 Ah
External power adapter 15V/2A (100 – 240 ACV)

Range of reference temperature: 18°C – 28°C
Range of working temperature: 5°C – 40°C
Range of storage temperature: -10°C – 50°C
Dimensions:
Weight:

4 – Preparation for use.

The RTD-500 is supplied from an internal battery or from an external power source. Range of external power source is from 100 ACV to 250 ACV 50/60 Hz.

The RTD-500 is a test laboratory device its accuracy is guaranteed when operated at 23 +/- 5°C.

After unpacking let the instrument stabilize for on hour prior to using it.

4.1 – Switching on.

If the instrument will be used from the internal battery only, push the Power button. If the instrument will be used form an external supply, the RTD-500 will turn on automatically once is connected to the AC source.

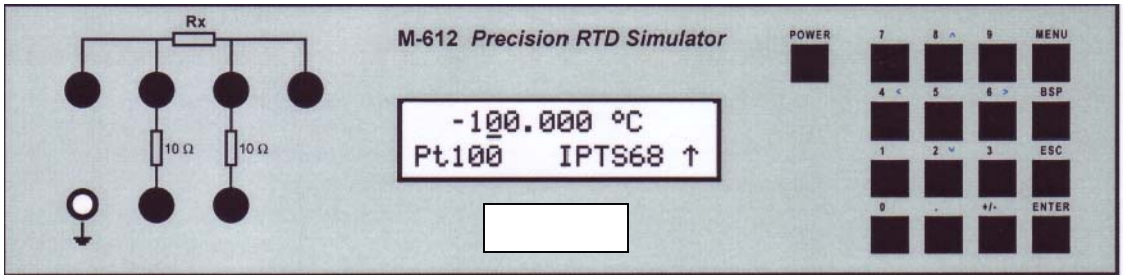
After switching on internal tests are performed for approximately 3 seconds. The display will show the instrument model number and it manufacturer. After completing the self test routine the instrument defaults to simulated temperature of 100°C.

4.2 – Warm up time.

After a 10 minutes warm-up period the instrument will perform to the advertised specifications.

5 – Description.

5.1 – Front Panel.



5.1.1 Keyboard.

Numerical values are entered from the numerical part of keyboard. Keys with number 2, 4, 6, 8 have the added function of controlling the display cursor.

5.1.2 Special Keys.

MENU → enters the SETUP/CALIBRATION MENU.

BSP → deletes last entered number.

ESC → cancels last entered value or leaves last set mode.

ENTER → confirms set value or confirms selected item in MENU or switches between numerical function (black label) and display cursor function (blue label) of the keys 2, 4, 6, 8. Switching over is indicated with symbol (T) in right low corner of the display.

POWER → switches on and off the simulator. When switching off is requested, the key must be pushed twice to confirm switching off.

5.1.3 Display.

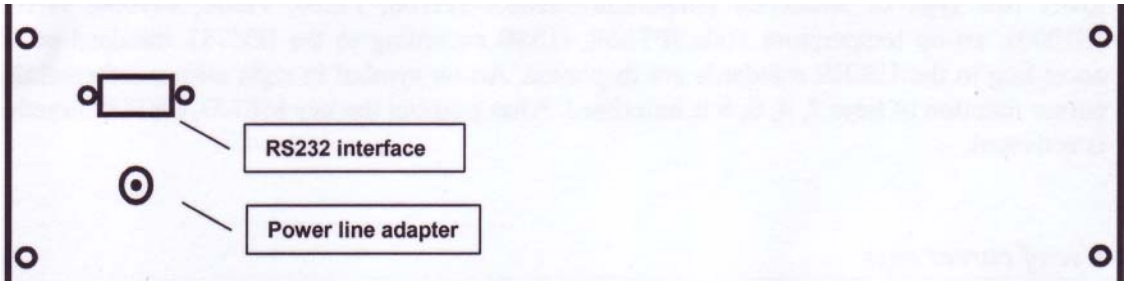
The LCD screen is a two row alphanumeric display . The upper row displays the main value, i.e. simulated temperature or output resistance. Auxiliary information

is displayed in the lower row. The bottom right corner is reserved for special symbols that indicate current key function, power source or RS-232 operation.

5.1.4 Output Terminals.

Simulated value of resistance is connected to the output terminals according to the symbol on the front panel. Two-, three- or four- wire connection can be used. Two terminals in lower row are connected to the output terminals through 10 Ohms resistors, which can simulate lead resistance. Left terminal with symbol "GROUND" is connected to the housing.

5.2 Rear Panel.



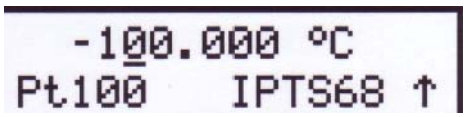
6 – Operation.

6.1 Switch on and off.

When supplied from power line adapter, simulator is automatically switched on and remains on while the adapter is connected to the power source. When supplied from internal battery (power line adapter is not connected to the power line connector, or adapter is not connected to the power source), simulator must be switched on by pushing the key POWER. To switch off the simulator, push the same key twice. When supplied from internal battery, simulator is automatically switched off, if for the last 20 minutes no key was pushed or if internal battery is discharged. One minute before automatic switching off, simulator displays symbol and beeps to warn the user.

6.2 Standard Mode.

Standard mode of operation is selected as soon as the unit is turned on. The display looks as follows:



Each line indicates the following:

- The upper row displays actual simulated temperature [°C] or resistance [Ω].
- The lower row displays the type of sensor (Pt100, Pt200, Pt500, Pt1000, Ni100, Ni1000) and the temperature scale (IPTS68, ITS90 according to the IEC751 standard or US according to the US/JIS standards) that are being simulated.
- The up arrow symbol in right corner informs that cursor function of keys 2, 4, 6, 8 is initialized.

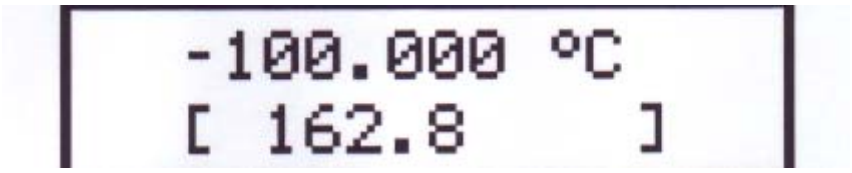
Use of cursor keys:

Cursor key enable to increase or decrease the number on the active position. The active position is indicated by the underline symbol (_) under a number. With the cursor keys < or > the user is able to change the active number and with the cursor keys ^ or the user is able to increase of decrease the active number.

Pushing the ENTER key switches key 2,4,6,8 function from cursor control to numerical input.

Numeric Keyboard:

With numerical keys value of temperature (or resistance) can be directly entered. Newly entered value is displayed in brackets under the actual set value. To confirm new value press ENTER.



Pressing the ENTER key switches keys 2, 4, 6, 8 function between cursor control and numeric input mode.

Press ESC key to exit setting value from numerical keyboard mode.

The BSP (back space) key deletes the last entered number.

6.3 Setup Mode.

This mode enables to set operational parameters for the simulator. The mode is entered by pressing the MENU key. To exit this mode, press the ESC key.

While in the set up mode the following parameters can be set:

- Function : Type of sensor options are Pt100, Pt500, Pt1000, Ni100, Ni1000, Resistance.
- Temperature Scale: IPTS68 or ITS90.
- Platinum Type : US or IEC.
- Volume: Off, LOW, HIGH.
- Baud rate: 300, 600, 1200, 2400, 4800, 9600, 19200.
- Lightning: Off, On, 5minutes of light from last key pressed, 30 s of light from last key pressed.
- Cal. Code: *****.
- Serial Number.

To move from one function to the other press the 8 key or the 2 key to scroll in the direction of the arrow (UP or DWN). To change values within a function press the 6 key or 4 key to move in the direction of the arrow (right or left).

The calibration code is a five-digit number which must be entered to access the calibration mode. If the calibration code is set to "00000", this information is displayed in the Setup menu. Calibration code can be changed. New calibration code can be directly entered using numeric keyboard and confirmed by pressing ENTER. If non-zero calibration code is set, correct calibration code must be entered to access the calibration mode. Non-zero calibration code is not displayed further on the display.

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

Note: it is advisable to write down actual calibration code if changed. If you forget the calibration code, you have to send the calibrator to the manufacturer. Note: the last set calibration code is valid even if the instrument is switched off.

6.4 Calibration Mode.

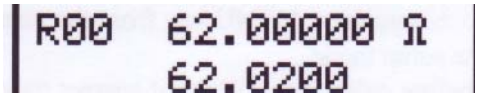
In this mode resistance elements of the simulator can be recalibrated. Access to the calibration mode is enabled after double pressing the MENU key from the standard mode or after single pushing the same key from the setup mode.

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 ESC key. Recalibration procedure consists of measuring 22 basic resistance values and entering their measured data. To move through the list of calibration values push the Up arrow (8 key) or the down arrow (2 key). The nominal values of calibration are as follows:

Calibration Point	Nominal Value	Accuracy
R00	31.6 Ohms	1 mili-Ohm
R01	61.9 Ohms	1 mili-Ohm
R02	121 Ohms	2 mili-Ohms
R03	237 Ohms	3 mili-Ohms
R04	464 Ohms	6 mili-Ohms
R05	909 Ohms	15 mili-Ohms
R06	1,780 Ohms	30 mili-Ohms
R07	3,480 Ohsm	100 mili-Ohms
R08	6,870 Ohms	250 mili-Ohms
R09	15.5 Kohms	500 mili-Ohms
R10	26.6 Kohms	1 Ohm
R11	52.2 Kohms	5 Ohms
R12	103 Kohms	10 Ohms
R13	202 Kohms	20 Ohms
R14	398 Kohms	40 Ohms
R15	780 Kohms	80 Ohms
R16	1,540 Kohms	200 Ohms
R17	3,020 Kohms	400 Ohms
R18	5,920 Kohms	1 Kohm
R19	12 Mohms	5 Kohms
R20	23 Mohms	50 Kohms
R21	46 Mohms	200 kohms
R22	85 Mohms	500 Kohms

Process of calibration is as follows:

- Set the first calibration point (resistance element). Use the Up or Down arrow to select the element.
- Measrue the resistance of the selected element. Use external ohmmeter with 4-wire capabilities for accuracy.
- Change function of the keyboard to the numerical one by pushing the ENTER key.
- Enter the measured resistance value (the first row of the display shows the original value the second row is where the value measured is entered).



- Confirm new calibration by pressing the ENTER key.
- Repeat for all other resistance elements.

7.- Performance verification test.

This chapter describes the procedures to verify performance of this instrument. The basic procedure is based on measuring resistance on the simulator output terminals with standard multimeter.

The multimeter used shall be of a nominal accuracy of 0.001% in the range from 10 Ohms to 10,000 Ohms.

Switch the RTD-500 simulator to the resistance function. Connect the multimeter to the 4-wire output terminals.

Procedure:

1. Connect the simulator output terminals to the multimeter input. Switch both instruments on and wait 1 hour to stabilize. Keep the room temperature within 23 +/-2^{o}C.

2. Perform output resistance check per the following table.

Nominal Value	Max. deviation [mili-Ohms]
20.0000	3.6
50.0000	4.5
100.000	6.0
200.00	9.0
500.00	25
1000.0	50
2000.0	100
5000	750
10000	1500

3. Connect multimeter to the 10 Ohms lead resistor Hi terminal and measure its resistance. Allowed deviation is +/- 0.1%. Repeat for the Lo terminal.

8.- Remote Control.

The RTD-500 includes a RS-232 computer interface. This section describes the communication process between a computer and the RTD-500.

8.1- Commands.

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.

Command 1: A(?)<DNPD>

This command sets a resistance value or a temperature value.

<DNPD> represents the resistance value or simulated temperature in degrees Celsius. When a temperature parameter is being set, both positive and negative values are acceptable. For resistance parameters only positive values are acceptable.

Example:

Command ,,A123.564<cr> sets temperature to 123.564^{o}C if simulator is in temperature simulation and to 123.564 Ohms if simulator is in resistance function.

Command ,,A?<cr> the RTD-500 simulator will reply with the current setting that is ,,123.564<cr><lf>

Command 2: F <CPD> { 0 | 1 | 2 | 3 | 4 | 5| 6 | S | 0 }

Following function is set

0	resistance generation.
1	Pt100 simulation.
2	Pt200 simulation.
3	Pt500 simulation.
4	Pt1000 simulation.
5	Ni100 simulation.
6	Ni1000 simulation.
S	Short simulation.
0	Open simulation.

Example:

,,F1<cr> sets Pt100 simulation.

,,F0<cr> sets Open simulation.

Command 3: *IDN?

The RTD-500 simulator responds by displaying the name of the manufacturer, model number, serial number and firmware version.

Example:

,,*IDN?<cr> the RTD-500 simulator responds:

,,General Resistance,RT-500,serial number,firmware version <cr><lf>

Command 4: P0

This command will switch the simulator off. The command will only execute if the simulator is supplied from internal battery only.

Example:
,,P0<cr>

Command 5: T<CPD> { 0 | 1 }

0	Type IEC 751 (1.385)
1	Type US/JIS (1.3916)

Example:
,,T0<cr> sets Pt sensor type 1.385 (IEC 751).

Command 6: S<CPD> { 0 | 1 }

This command sets the temperature scale.

0	Scale ITS90.
1	Scale IPTS68.

Example:

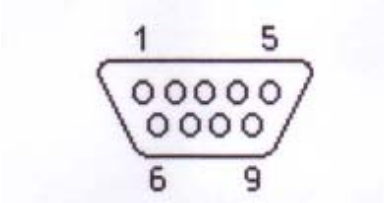
,,S1<cr> sets scale to IPTS68.

Command 7: V?

The RTD-500 returns the simulator status in the format FxSxTx <cr><lf>

8.2 RS232.

Transmission baud rate can be selected from 300 to 19200 bauds. Number of data bits is 8, number of stop bits is 1, parity is not used. For data flow control neither hardware handshake (RTS/CS) nor program handshake (XON/XOFF) is used. RS232 line is galvanically isolated form other circuits.

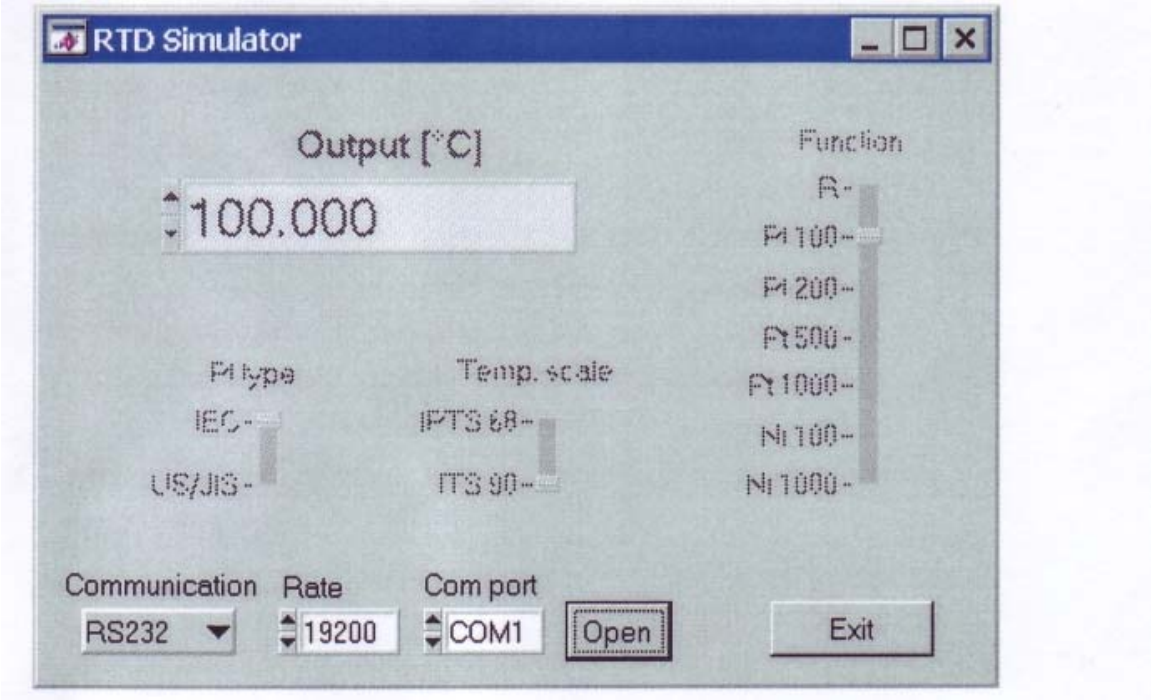


Pin	Label	I/O	Description
2	TXD	Output	Transmitter
3	RXD	Input	Receiver
5	GND	-	Ground

8.3 Demo Program.

A simple demo program is supplied with the RTD-500 Simulator in order to provide easy operation of the instrument from a personal computer. Install this program by running the SETUP.EXE program in the CD.

When the simulator program is launched the following control panel is displayed on the screen.



First use the Communication selection box to select the proper interface, in our case that is RS232. Then select the baud rate and communication port to use. After pushing the command button OPEN the program checks if the instrument is connected. If the instrument is found then it will be under computer control.

The other interface element are obvious, make your selections according to your requirements.

9.- Battery Maintenance.

Period for fully battery charging is approximately 40 hours. If the instrument has been stored for more than 3 months without being connected to external power line adapter, battery should be charged prior to use.

9.1- Battery Replacement.

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

To replace the battery use the following procedure:

1. Disconnect external power supply and RS232 cable.
2. Switch simulator off.
3. Dismount 4 screws located in the corners of rear panel.
4. Remove top cover.
5. Disconnect connector from the battery and dismount metal belt to release battery.
6. Replace battery pack.
7. Attach metal belt.
8. Reinstall top cover.
9. Mount 4 screws located in the corners of rear panel.
10. Connect external power to charge battery.