DPR-165

TRANSFORMER STEP & TEMPERATURE INDICATOR

DESCRIPTION

DPR-165 is a microprocessor controlled precision instrument displaying steps and temperatures of MV/HV transformers. The unit has a high degree of protection against electromagnetic noises.

The unit determines the step by measuring the resistive converter of the transformer.

The step information is displayed on the screen. Additionally it is output through the 4-20mA analog output. This information may be fed to automation systems or to the next DPR-165 unit.

It can also display the step information from the analog value coming from another DPR-165 unit.

With analog inputs and outputs, an unlimited number of DPR-165 units may be cascaded.

The unit offers one PT100 type temperature sensor input. This input may be used for the transformer or ambient temperature. The alarm level of the temperature input is adjustable and the alarm information is output as a relay contact.

The unit offers an adjustable cable length compensation function in order to have precise measurements with long cables.

The unit offers 2 volt-free relay contacts rated 6A. Any function may be assigned to these outputs, selected from list.

Alarm levels are adjusted within the programming mode of the unit. If no action is taken, the unit will terminate the programming mode in 1 minute.

The standard isolated RS-485 Modbus RTU port of the unit is free from ground potential differences and allows safe transfer of information to automation and monitoring systems.

The supply inputs of the unit is isolated from measurement inputs. It operates between 88-400VDC and 85-270VAC.

FEATURES

Up to 50 steps

Installation without energy interruption

Accurate step measurement input, 10 bit

16 bit analog output accuracy

10 bit analog input accuracy

PT100 temperature input, 1°C accuracy

Cable length compensation

Automatic sensor failure detection

2 relay outputs, 6A/250Vac

Fully isolated RS-485 serial port

MODBUS-RTU communications

Logging of maximum temperature

Front panel adjustable parameters

Temperature alarm threshold level

Easy to read, 4 digits 14mm led display

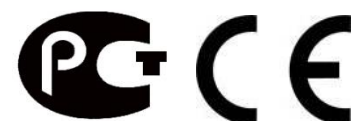*Minimum 20 years data retension*

Wide supply range: 88-400 VDC (85-270VAC)

Low panel depth, easy installation

Wide operating temp. range, -20...+70°C

Sealed front panel (IP65 with gasket)

Two part connection system

SAFETY NOTICE

⚠️ **WARNING**
Failure to follow below instructions may result in death or serious injury.

- Electrical equipment should be installed only by qualified specialist. No responsibility is assumed by the manufacturer or any of its subsidiaries for any consequences resulting from the non-compliance to these instructions.

- Check the unit for cracks and damages due to transportation. Do not install damaged equipment.

- Do not open the unit. There is no serviceable parts inside. Warranty voids if the unit is open.

- Fuse must be connected to the power supply input.

- Fuses must be of fast type (FF) with a maximum rating of 6A.

- Disconnect all power before working on equipment.

- When the unit is connected to the network do not touch terminals.

- Any electrical parameter applied to the device must be in the range specified in the user manual.

- Do not try to clean the device with solvent or the like. Only clean with a dry cloth.

- Verify correct terminal connections before applying power.

- Only for front panel mounting.

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1. INSTALLATION

Before installation:

- Read the user manual carefully, determine the correct connection diagram.
- Remove all connectors and mounting brackets from the unit, then pass the unit through the mounting opening.
- Put mounting brackets and tighten. Do not tighten too much, this can brake the enclosure. Spring type brackets do not require tightening.
- Make electrical connections with plugs removed from sockets, then place plugs to their sockets. Otherwise sockets may get damaged.
- Make sure not overloading relay outputs. Use additional contactors if required.

Below conditions may damage the device:

- Incorrect connections.
- Incorrect power supply voltage.
- Voltage at measuring terminals beyond specified range.
- Current at measuring terminals beyond specified range.
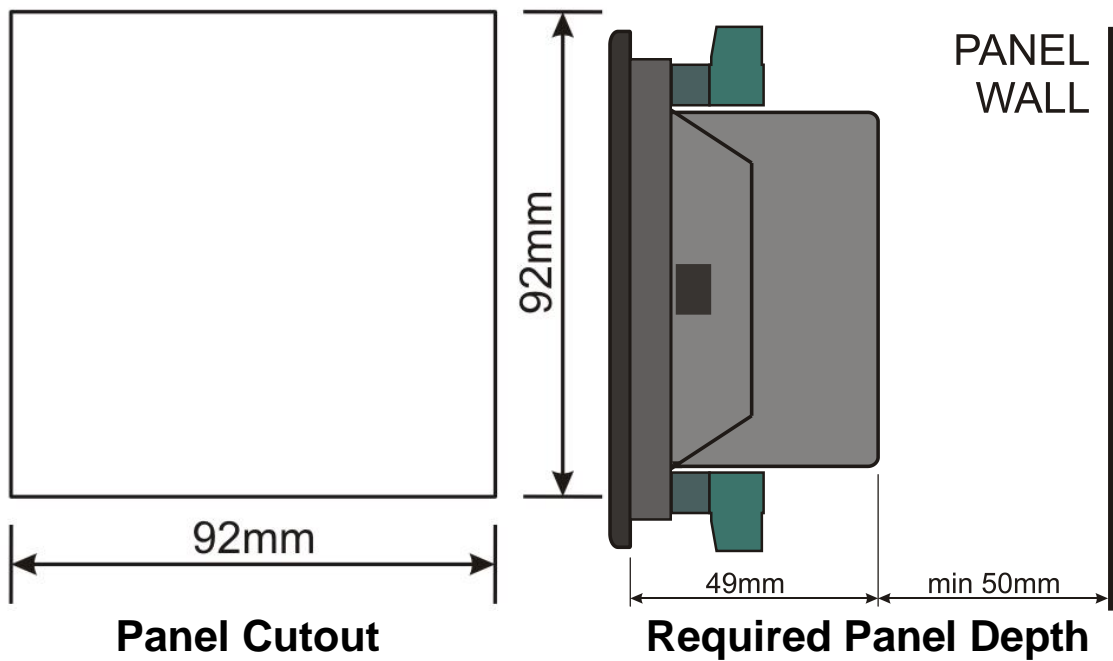- Overload or short circuit at relay outputs

Below conditions may cause abnormal operation:

- Power supply voltage below minimum acceptable level.

1.1 FRONT / REAR PANELS
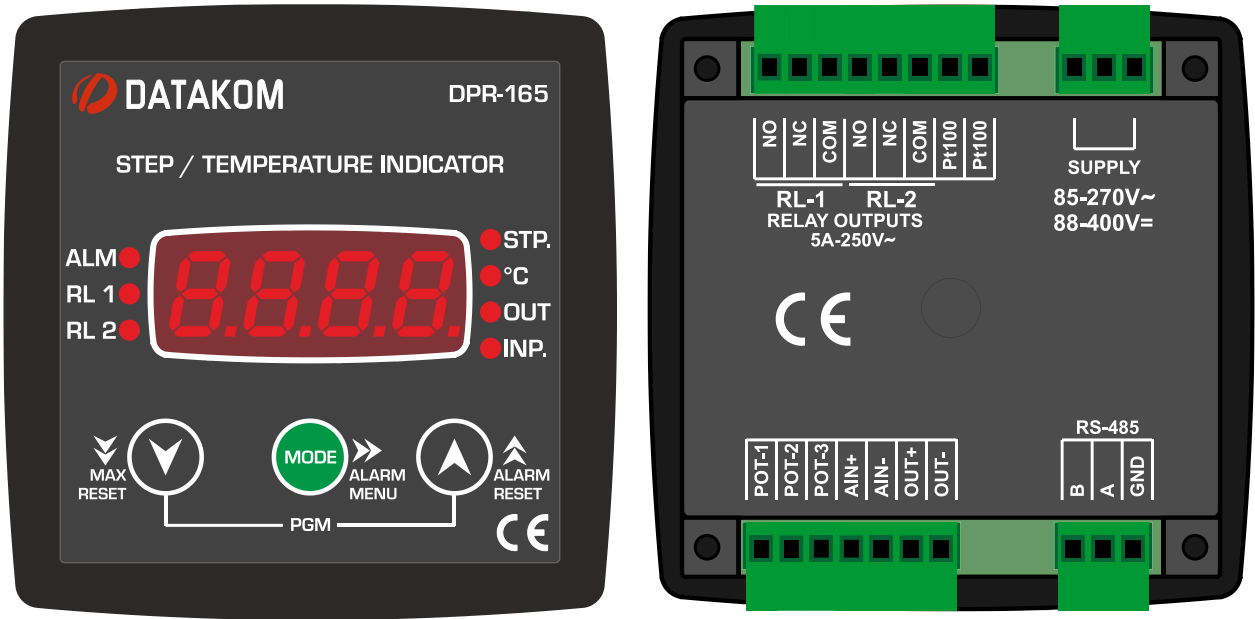
1.2 MECHANICAL INSTALLATION

Panel Cutout

92mm

92mm

Required Panel Depth

49mm   min 50mm

PANEL WALL

1.3 ELECTRICAL INSTALLATION

⚠️ **Do not install the unit close to high electromagnetic noise emitting devices like contactors, high current busbars, switchmode power supplies and the like.**

Although the unit is protected against electromagnetic disturbance, excessive disturbance can affect the operation, measurement precision and data communication quality.

- **ALWAYS remove plug connectors when inserting wires with a screwdriver.**

- **Fuse must be connected to the power supply input, in close proximity of the unit.**

- **Fuses must be of fast type (FF) with a maximum rating of 6A.**

- **Use cables of appropriate temperature range.**

- **Use adequate cable section, at least 0.75mm^2 (AWG18).**

- **For the RS-485 connection, use appropriate shielded twisted wire cable. Communication quality will depend highly on the cable used.**

1.4 INSTALLATION DIAGRAM
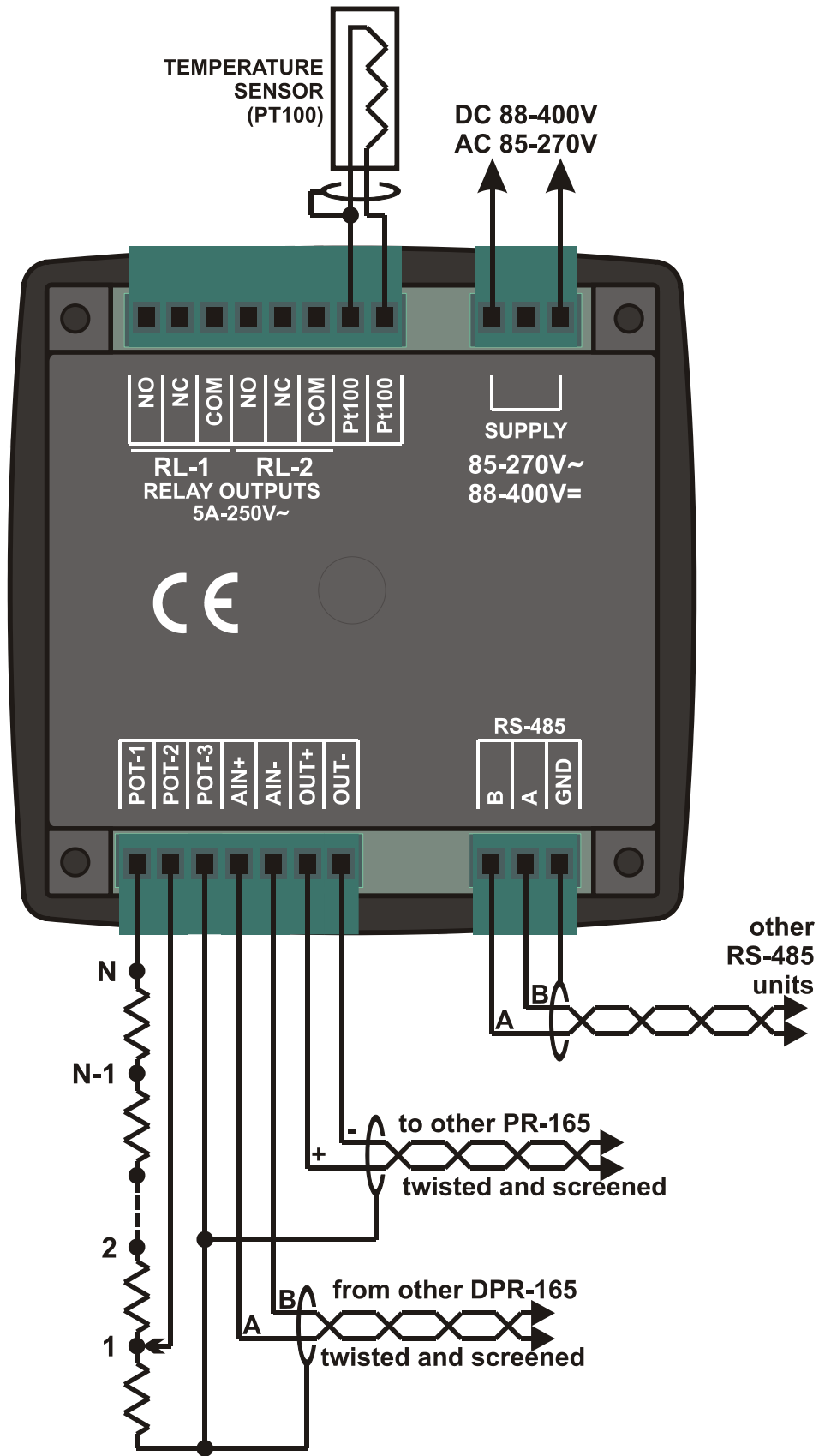
2. PUSHBUTTON FUNCTIONS

Three buttons on the front panel provide access to configuration and measurement screens.

BUTTON	FUNCTION
MODE	**Selects modes of operation.**
MODE	**HELD PRESSED FOR 5 SEC:** **Displays alarm menu. (if there is any alarm)**
⬆	**Increase related value (configuration mode)**
⬇	**Decrease related value (configuration mode)**
⬆	**HELD PRESSED FOR 5 SEC:** **Clears alarms.**
⬇	**HELD PRESSED FOR 5 SEC:** **Resets Maximum Temperature value. "rst" message appears on screen for 3 sec.**
⬆ ⬇	**HELD PRESSED FOR 5 SEC:** **Enters configuration mode.**
MODE ⬆	**HELD PRESSED FOR 5 SEC:** **Enables calibration mode of transformer step.**

3. DISPLAYS

Alarm Led

Mode Leds
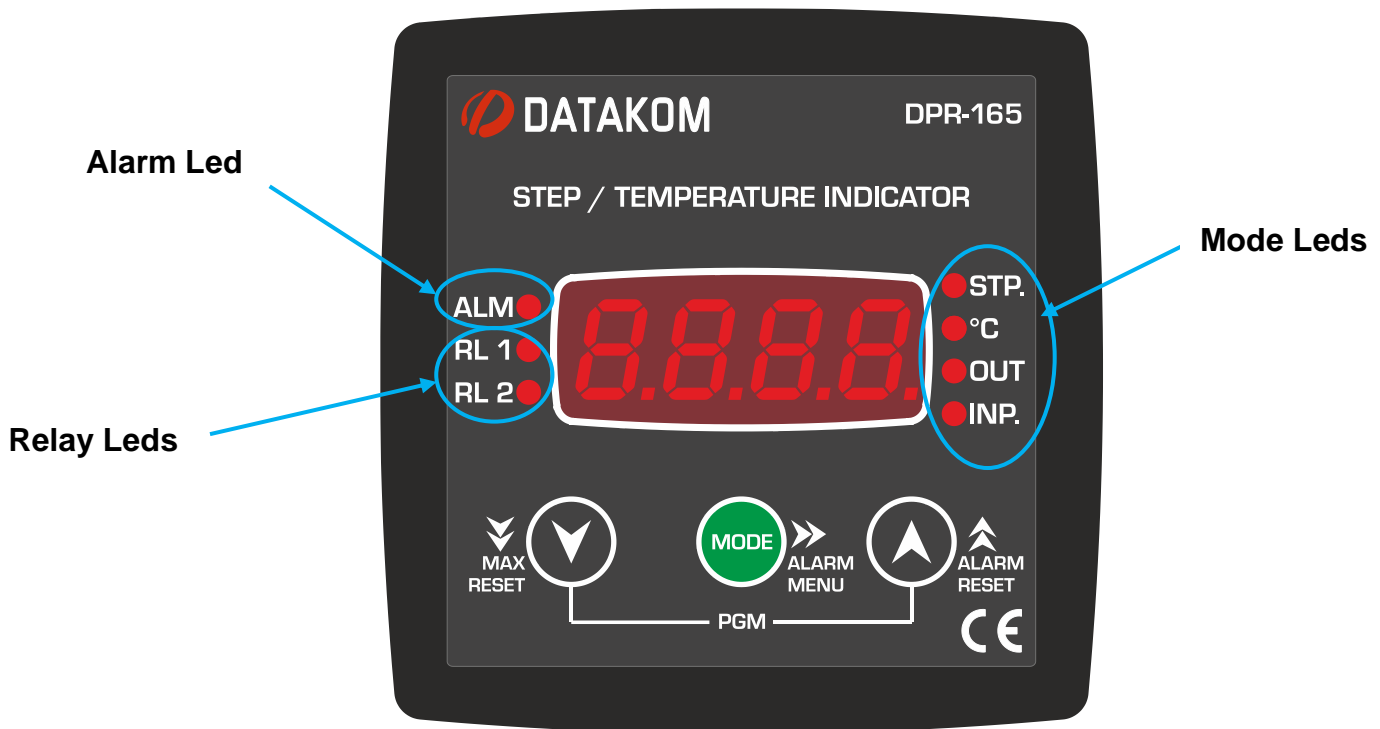
Relay Leds

Mode Leds: will reflect the mode of operation.

Alarm Led: will turn on if there is any alarm.

Relay Leds: will turn-on when the relay output is active.

3.1 DISPLAY NAVIGATION

The unit has 4 display mode: STEP, TEMPERATURE, 0-20MA OUTPUT, 0-20MA INPUT.

"Mode" button allow navigation between measurement values. Leds related to the currently displayed values will turn on, other leds will turn off.

- **STP:** Displays the step by measuring the resistive converter of the transformer.
- **°C:** Displays the PT100 temperature input with 1°C accuracy.
- **OUT:** Displays the value of 0-20ma analog output.
- **INP.:** Displays the value of 0-20ma input coming from another DPR-165 unit.

4. ALARMS

The unit continuously monitors various alarm conditions during operation.

Programmable alarm limits are provided for every measured value.

If any fault condition occurs, the related alarm led turns on, alarm code is displayed and the alarm relay operates.

Even if the alarm goes off, the related alarm led will stay on but the relay output will be deactivated. By depressing the MODE pushbutton, alarm display will turn off and normal operating mode will be resumed.

ALARM CODE	DESCRIPTION
SCP 1	**SHORT CIRCUIT** Indicates a short circuit on the related channel. Cables should be checked.
OCP 1	**OPEN CIRCUIT** Indicates a missing connection in the related channel. Cables should be checked.
tEMP	**HIGH TEMPERATURE ALARM** Occurs if the temperature goes over the adjusted alarm limit.
tAPE	**STEP FAULT** Occurs if resistor value or the value measured from mA input equals to middle of the two steps.

4.1 ALARM MENU

BUTTON	OPERATION	DISPLAY
MODE	Hold pressed **MODE** button for 5 seconds to enter alarm menu.	**OCP 1**
MODE	**MODE** button will navigate between alarm messages.	**tEMP**
MODE	Hold pressed **MODE** button for 5 seconds to exit alarm menü.	

5. PROGRAMMING

5.1 ENTERING THE PROGRAMMING MODE

In order to offer the maximum flexibility to the customer, the module has several programmable parameters.

Parameters are recorded in a non-volatile memory and are not affected by power failures.

Relay testing is also performed through program mode.

BUTTON	OPERATION	DISPLAY
⋀ ⋁	In order to enable the programming menu,hold both up/down buttons pressed for 5 seconds. **PGM** will be displayed.	PGM
MODE	Parameters may be scrolled with **Mode** button. Related parameter name is displayed.	PtCA
MODE	When **Mode** button is pressed for **5 seconds,** the parameter value is displayed.	148
⋀ ⋁	Parameter values are modified with up and down buttons. If the button is held pressed, the the value will change with larger steps.	140
MODE	The value on the screen is recorded with **Mode** button and the next parameter is displayed.	rL It

BUTTON	OPERATION	DISPLAY
⋀ ⋁	In order to exit programming menu, hold both programming buttons pressed for 5 seconds.	

⚠ **If no button is pressed during 1 minute, then the unit will automatically close the programming mode.**

5.2 LAMP TEST

> ⚠ **When exiting the PROGRAM mode, the unit makes a LAMP TEST during 5 seconds.**
> **During LAMP TEST, all leds will turn on. At the end of 5 seconds or if MODE button is depressed, the LAMP TEST is terminated.**

> ⚠ **If no pushbutton is depressed during 1 minute, the**
> **PROGRAM mode will be automatically terminated.**
> **In this case LAMP TEST is not performed.**

5.3 RELAY TEST

BUTTON	OPERATION	DISPLAY
MODE	The required relay to be tested is selected with MODE button.	rL2t
MODE	When the relay name is on display, hold MODE button pressed during 5 seconds. The initial value of relay position is "0".	0
⬆	Up button activates the relay output and displays "1" on the screen.	1
⬇	Down button deactivates the relay output and displays "0" on the screen.	0
MODE	Mode button will select the next relay output or parameter value.	PtCA

⚠️ **Exiting the relay test display will cause the relay resume normal operation.**

5.4 PROGRAM PARAMETER LIST

DISPLAY	DESCRIPTION	MIN	MAX
tAP	**STEP (TAP) PARAMETER** Total number of steps	0	50
LnEr	**STEP(TAP) LINEARITY** It is the parameter that selects transformer step values change linearly or not. 0: Step values are not linear. 1: Step values are linear.	0	1
tPSC	**STEP(TAP) SHORT CIRCUIT DETECTION PARAMETER** It is the parameter to enable short circuit detection. 0: disabled 1: enabled	0	1
tP2r	**MULTIPLE RESISTIVE STEP PARAMETER** It is the parameter to set the step with multiple resistive value. It must be "0" if there is no any step with multiple resistive value.	0	50
tAPS	**ALARM ENABLE PARAMETER** It is the parameter to enable alarm function of steps. 0: disabled 1: enabled	0	1
curL	**LOWER VALUE OF ANALOG OUTPUT** It is the parameter to set lower value of analog output.	0	20
curH	**UPPER VALUE OF ANALOG OUTPUT** It is the parameter to set upper value of analog output.	0	20

DISPLAY	DESCRIPTION	MIN	MAX
PtCA	**PT100 CABLE SECTION** PT100 cable section in mm^2. The factory set value is $0.5mm^2$.	0.10	9.99
PtCL	**PT100 CABLE LENGTH** PT100 cable length in meters (m). The factory set value is 0m.	0	999
PtHt	**TEMPERATURE ALARM PARAMETER** It is the parameter to adjust temperature limit.	0	300
PtS	**PT100 ALARM ENABLE PARAMETER** It is the parameter to enable PT100 temperature protection 0: disabled 1: enabled	0	1
20nS	**0-20(4-20)ma ANALOG INPUT ALARM ENABLE** It is the parameter to enable alarm function of 0-20(4-20)ma analog input. 0: disabled 1: enabled	0	1
rLF1	**RELAY FUNCTION PARAMETER** It is the parameter to define the function of relay outputs. The relay function is selected from the list at 5.6	0	8
SCAn	**SCAN PARAMETER** It is the parameter to select display mode. 0: Scan Mode, 1: Step Mode, 2: Temperature Mode, 3: Analog Input Mode, 4: Analog Output Mode	0	4

DISPLAY	DESCRIPTION	MIN	MAX
5Cnt	**SCAN MODE TIMER** It is the delay timer to navigate between each display in Scan Mode.	1	9999
rL 1t	**RELAY 1 Test Parameter** It is the parameter to activate Relay 1 output. Relay 1 will turn on if value is set to 1 and it will turn off if value is set 0.	0	1
rL2t	**RELAY 2 Test Parameter** It is the parameter to activate Relay 2 output. Relay 1 will turn on if value is set to 1 and it will turn off if value is set 0.	0	1
nodE	**MODBUS NODE ADDRESS** This parameter defines the address of the unit in a Modbus network. Each device in the same network must have a different address.	1	240
bAUd	**MODBUS BAUD RATE** Modbus Baud rate parameter.	24 (x100)	1152 (x100)

5.5 AUTO SETUP AND TRANSFORMER STEP-TEMPERATURE CALIBRATION

BUTTON	OPERATION	DISPLAY
⬆ ⬇	In order to enable the programming menu, hold both up/down buttons pressed for 5 seconds. **PGM** will be displayed.	**PGM**
MODE	Parameters may be scrolled with **Mode** button. Related parameter name is displayed. Select tAP(step) parameter and hold **Mode** button for 5 seconds.	**tAP**
⬆ ⬇	Enter the total step number with up/down buttons.	

BUTTON	OPERATION	DISPLAY
MODE	The value on the screen is recorded with **Mode** button and the next parameter is displayed.	
MODE	Select tP2r parameter if there is any step with multiple resistive value. Hold **Mode** button for 5 seconds.	**tP2r**
⬆⬇	Enter the number of step which has multiple resistive value.	
MODE	The value on the screen is recorded with **Mode** button and the next parameter is displayed.	
MODE	Select PtCA(cable section) parameter to enable PT100 calibration and hold **Mode** button for 5 seconds.	**PtCA**
⬆⬇	Enter PT100 cable section(mm^2)	
MODE	The value on the screen is recorded with **Mode** button and the next parameter is displayed.	
MODE	Select PtCL(cable lenght) parameter to enable PT100 calibration and hold **Mode** button for 5 seconds.	**PtCL**
⬆⬇	Enter PT100 cable lenght (m).	
MODE	The value on the screen is recorded with **Mode** button and the next parameter is displayed.	
⬆⬇	In order to exit programming menu, hold both programming buttons pressed for 5 seconds.	

MANUAL CALIBRATION OF EACH STEP

MODE ⬆	When step mode is active, hold pressed Mode and up buttons together for 5 seconds to enable calibration process. Step led will flash and it will display "1" on the screen.	1
⬆ ⬇	Step value on the screen must reflect the current position of transformer. Adjust the value until it is equal to the current position of transformer. It must be "1".	
MODE	The value on the screen is recorded with **Mode** button and step led will flash for 10 seconds. Calibration process is completed for step 1. It will display "2" on the screen to calibrate step 2.	2
MODE	The same operations continue until the last step is calibrated. When the last step is calibrated, the device automatically exits the calibration process and returns to operating modes.	

CABLE LENGTH CALIBRATION

MODE ⬇	When step mode is active, hold pressed Mode and down buttons together for 5 seconds to enable calibration process. The current position of transformer is adjusted manually.	2
MODE	Press Mode button to complete calibration process. It is recommended not to calibrate according to first 3 steps.	

5.6 RELAY FUNCTIONS

The unit has 2 relay outputs. The function of a programmable relay output may be selected from the below list.

Value	Relay Function
0	PT100 Over Temperature
1	PT100 Open Circuit
2	POT 1 Open Circuit
3	POT 2 Open Circuit
4	PT100 Short Circuit
5	POT 1 Short Circuit
6	POT 2 Short Circuit
7	Analog Input Open Circuit
8	Step Fault

6. MODBUS COMMUNICATION

6.1 DESCRIPTION

The unit offers serial data communication port allowing it to be integrated in automation systems.

The serial port is of RS-485 MODBUS-RTU standard. It is fully isolated from power supply and measurement terminals for failure-free operation under harsh industrial conditions.

The MODBUS properties of the unit are:
>   -Data transfer mode: RTU
>   -Serial data: 9600 bps, 8 bit data, no parity, 1 bit stop

-The answer to an incoming message is sent with a minimum of 4.3ms delay after message reception.

Each register consists of 2 bytes (16 bits). Larger data structure contain multiple registers.

Detailed description about the MODBUS protocol is found in the document "**Modicon Modbus Protocol Reference Guide"**. This document may be downloaded at:
www.modbus.org/docs/PI_MBUS_300.pdf

Supported functions:
>   -Function 3 (Read multiple registers)
>   -Function 6 (Write single register)
>   -Function 16 (Write multiple registers)

Error codes
Only 3 error codes are used:
>   01: illegal function code
>   02: illegal address
>   10: write protection (attempt to write a read_only register)

Data types

Each register consists of 16 bits (2 bytes)

If the data type is a byte, only the low byte will contain valid data. High byte is don't care.

For data type longer than 16 bits, consecutive registers are used. The least significant register comes first.

6.2 PROGRAM PARAMETERS

ADDRESS	NAME	DESCRIPTION	LENGTH	R/W	TYPE	X
0	Step number	Total number of steps	16 BIT	R/W	unsigned word	1
1	Linearity of steps	Linearity of steps	16 BIT	R/W	unsigned word	1
2	Step short circuit	Step short circuit	16 BIT	R/W	unsigned word	1
3	Multiple resistive step	Multiple resistive step	16 BIT	R/W	unsigned word	1
4	Alarm enable	Alarm enable	16 BIT	R/W	unsigned word	1
5	Analog output lower limit	Analog output lower limit	16 BIT	R/W	unsigned word	1
5	Analog output upper limit	Analog output upper limit	16 BIT	R/W	unsigned word	1
6	Cable length	PT100 Cable length	16 BIT	R/W	unsigned word	1
7	Cable section	PT100 cable section	16 BIT	R/W	unsigned word	0.01
8	Temperature	PT100 alarm limit	16 BIT	R/W	unsigned word	1
9	PT100 Alarm	PT100 alarm is enabled	16 BIT	R/W	unsigned word	1
10	0-20mA analog input	0-20mA analog input alarm	16 BIT	R/W	unsigned word	1
11	Relay 1 function	Relay 1 function	16 BIT	R/W	unsigned word	1
12	Relay 2 function	Relay 2 function	16 BIT	R/W	unsigned word	1
13	Scan Mode	Scan mode is enabled	16 BIT	R/W	unsigned word	1
14	Scan Mode Time	Scan Mode time	16 BIT	R/W	unsigned word	1
15	Modbus Node	Mode Bus Node address	16 BIT	R/W	unsigned word	1
16	Modbus Baudrate	Modbus Baud Rate	16 BIT	R/W	unsigned word	1

6.3 COMMANDS

Commands should be sent with Function 6 (Write Single Register).

ADDRESS	Value	R/W	DESCRIPTION
16384	1	W-O	Reset all alarms
16385	1	W-O	Reset maximum temperature
16386	-	W-O	Down button simulate
16387	-	W-O	Up button simulate
16388	-	W-O	Mode button simulate
16389	-	W-O	Down button long press
16390	-	W-O	Up button long press
16391	-	W-O	Mode button long press
16392	-	W-O	Programming buttons long press

6.4 ALARM BITS

MODBUS alarm bits contains 32 bits in 2 registers.

ADDRESS	KAYIT BIT	R/W	DESCRIPTION
20488	0	R-O	High temperature relay status
	1	R-O	PT100 open circuit relay status
	2	R-O	Pot1 open circuit relay status
	3	R-O	Pot2 open circuit relay status
	4	R-O	PT100 short circuit relay status
	5	R-O	Pot1 short circuit relay status
	6	R-O	Pot2 short circuit relay status
	7	R-O	Analog input open circuit relay status
	8	R-O	Pot2 non-linear relay status
	9-32	R-O	Not used
20490	0	R-O	Temperature Alarm
	1	R-O	PT100 open circuit
	2	R-O	Pot1 open circuit
	3	R-O	Pot2 open circuit
	4	R-O	PT100 short circuit
	5	R-O	Pot1 short circuit
	6	R-O	Pot2 short circuit
	7	R-O	Analog input open circuit
	8	R-O	Pot2 non-linear
	9-32	R-O	Not used

6.5 SENSOR DATA

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ADDRESS	NAME	DESCRIPTION	LENGTH	R/W	TYPE	X
20480	Temperature	PT100 Temperature value	16 BIT	R-O	Signed word	1
20481	Max. Temperature	PT100 Maximum Temperature value	16 BIT	R-O	unsigned word	1
20482	Step Value	Step value measured from resistive converter of transformer	16 BIT	R-O	unsigned word	1
20483	Analog output	mA value of analog output	16 BIT	R-O	unsigned word	0.01
20484	Analog input	mA value of analog input	16 BIT	R-O	unsigned word	1
20485	Step value from analog	Step value from analog input	16 BIT	R-O	unsigned word	1
20486	Step fault	Value of whether the resistive input is connected or not	16 BIT	R-O	unsigned word	1
20487	PT100 fault	Value of whether the PT100 input is connected or not	16 BIT	R-O	unsigned word	1
20488	Analog input	Value of whether the analog input is connected or not	16 BIT	R-O	unsigned word	1

7. TECHNICAL SPECIFICATIONS

Supply Input: 88-400VDC
                           85-270VAC (50/60Hz)
Power Consumption: < 2 W
Maximum Step Count: 50
Resistor Measuring Input: 3 terminals
Resistor Measuring Accuracy: 10 bits, 0.1%
Resistor Range: 30 ohm to 2K-ohm
Temperature Input: PT100
Temp. Measuring Range: -40°C to +250°C
Temp. Measuring Accuracy: ±1°C
Analog Output: 0-20mA
Analog Output Accuracy: 16 bit
Analog Input: 0-20mA
Analog Input Accuracy: 10 bit, 0.1%
Relay Outputs: 6A @ 250V AC
Serial Port:
      Signal Type: RS-485
      Communication: Modbus RTU
      Data Rate: 2400-115200baud
      Isolation: 1000V AC, 1 minute
Operating Temp. Range: -20°C...+70 °C
Max. Relative Humidity: %95 non-condensing
IP Protection: IP 65 (front panel, with gasket)
                            IP 30 (back panel)
Enclosure: Flame retardant, ROHS compliant, high temperature ABS/PC (UL94-V0)
Installation: Panel mount, rear retaining plastic
             brackets.
Dimensions: 102x102x53mm (WxHxD)
Panel Cut-out: 92x92mm
Weight: 200 gr (approx)

EUDirectives:	**Reference Standards:**
2006/95/EC (LVD)	EN 61010 (safety)
2004/108/EC (EMC)	EN 61326 (EMC)