DPR-145

TEMPERATURE PROTECTION RELAY

- **PT100 INPUTS: 4**
- **RELAY OUTPUTS: 4**
- **RS-485 MODBUS PORT**
- **19-150VDC SUPPLY**

DESCRIPTION

DPR-145 is a precision unit designed for the temperature protection of dry type or resin filled MV transformers. The unit offers a high degree of protection against electromagnetic disturbances.

The unit has 4 temperature inputs of PT100 type. Three of them are used for the transformer protection. The fourth input may be used as core temperature protection or ambient temperature monitoring.

Alarm and trip levels of the unit are independently adjustable for first 3 sensors and the fourth sensor input.

Alarm levels are adjusted using the program mode. If no operation is performed, then the unit will exit program mode in 3 minutes.

The unit offers a cable compensation function in order to prevent long cables from impairing the measurement precision.

The unit has 4 dry contact relay outputs rated 6A.

FAN: provides cooler fan control
TRIP: high temperature failure relay
ALARM: pre-alarm relay
FAULT: sensor or internal failure indicator

The unit offers an automatic self test feature. The self test consists on the verification of sensor inputs and internal memory integrity.

The standard isolated RS-485 MODBUS RTU communication port is not affected by ground potential differences and allows safe transfer of information to remote management and automation systems.

The supply input is isolated from sensor connections. The unit has 2 supply options, being 19-150VDC or 85-305VAC.

FEATURES

1 degrees C measurement precision

4 x PT100 analog inputs

Allows cable length compensation

Automatic detection of sensor failures

Automatic and manual self test

4 x relay outputs, 5A/250Vac

Fully isolated RS-485 serial port

MODBUS-RTU communication

Recording of maximum temperatures

Front panel programmable

2 alarm thresholds for channels 1-2-3

2 alarm thresholds for channel 4

Easy to read, 3 digit 14mm led display

Wide supply voltage range: 19-150VDC

AC supply version available (85-305VAC)

Reduced panel depth, easy to install

Wide operating temperature range, -20 to +70°C

Sealed front panel (IP65 with gasket)

2 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
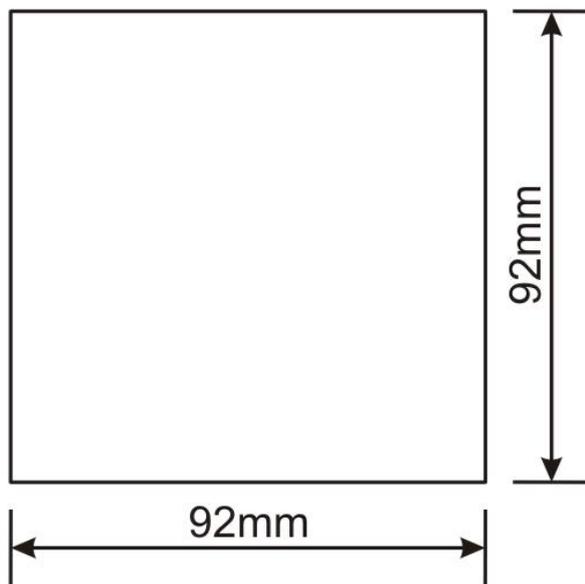
Below conditions may cause abnormal operation:
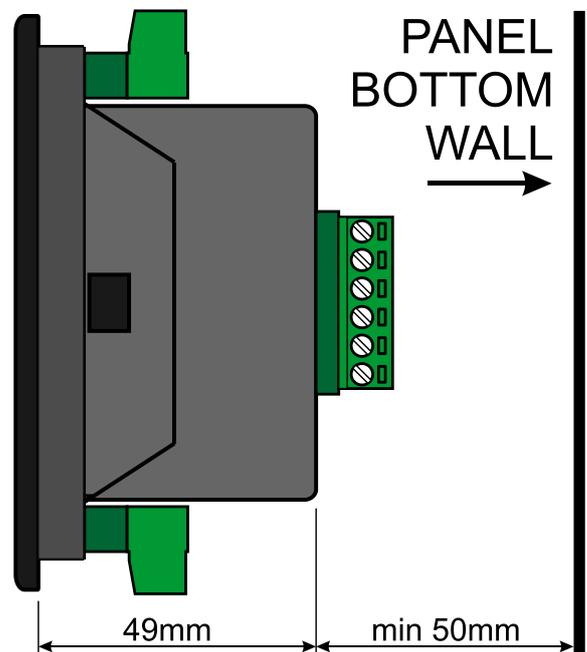
- Power supply voltage below minimum acceptable level.

1.1 FRONT / REAR PANELS
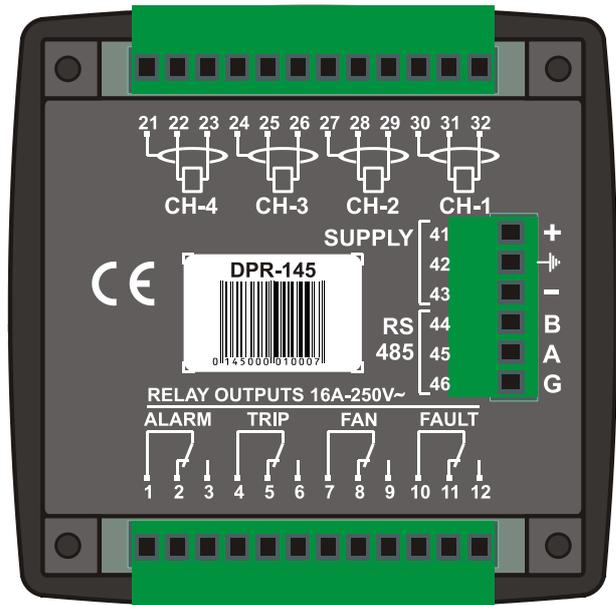
1.2 MECHANICAL INSTALLATION

Panel Cutout   **Required Panel Depth**

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.**

2. PUSHBUTTON FUNCTIONS

Programming and measuring screens are opened using 3 pushbuttons on the front panel.

PUSHBUTTON	FUNCTION
MODE	**Switched between operating modes.**
MODE	**IF HELD PRESSED DURING 5 SEC:** **Switches to the Alarm menu. (Trip, Fault and Alarm messages displayed)**
⬆	**Switch to the previous channel or** **increase related value (program mode)**
⬇	**Switch to the next channel or** **decrease related value (program mode)**
⬆	**IF HELD PRESSED DURING 5 SEC:** **"ɾ5ʃ" will be displayed and all Trip, Fault and Alalrm messages will be deleted.**
⬇	**IF HELD PRESSED DURING 5 SEC:** **"ɾ5ʃ" will be displayed and maximum temperature values for each channel will be deleted.**
⬆⬇	**IF HELD PRESSED TOGETHER DURING 5 SEC:** **Enters/exits PROGRAM mode.**
	* NO KEY PRESSED DURING 3 MINUTES: **Resumes to last operating mode.**

3. DISPLAYS

SELECTED CHANNEL LEDS: indicates the related channel to alarm or information on display.

MOD LEDS: indicated the current mode of operation.

ALARM LEDS: indicates the type of alarm if any.

TEST LED: turns on during lamp test or relay test.

PPROGRAM LED: turns on in program mode.

3.1 MODES OF OPERATION

The unit has 4 operating modes: SCAN, AUTO, MAN, MAX.

Every depression of the MODE button switches the unit to the next operating mode. Related mode led will turn on. Channel leds on the right side (1,2,3,4) indicate the related channel number.

- **SCAN:** Displays channel temperatures, switches to the next channel every 5 seconds.

- **AUTO:** Displays the temperature of the highest channel.

- **MAN:** Displays the temperature of the selected channel. Channels may be scrolled with ⬆ and ⬇ pushbuttons.

- **MAX:** Displays the maximum recorded temperature of the selected channel. Channels may be scrolled with ⬆ and ⬇ pushbuttons.

NOTE: If any of ⬆ or ⬇ pushbuttons is depressed in SCAN or AUTO modes, then the unit will automatically switch to the MANUAL mode. If no pushbutton is depressed during 30 minutes, it will resume previous mode.

4. ALARMS

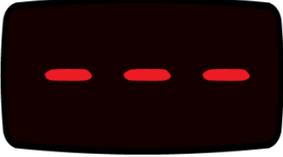The unit continuously monitors various abnormal conditions during operation.

Programmable alarm limits are provided for every measured value.

If any fault condition occurs, the related alarm led (TRIP, FAULT or ALARM) turns on, alarm code is displayed, the alarm relay operates and the alarm code is added to the alarm menu.

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
5[1	**SHORT CIRCUIT (5[1__5[4)** Indicates a short circuit on the related channel. The FAULT led and the related channel led turns on. Cables should be checked.
O[1	**OPEN CIRCUIT (O[1__O[4)** Indicates a missing connection in the related channel. The FAULT led and the related channel led turns on. Sensor connections should be checked.
H[1	**HIGH TEMPERATURE ALARM (H[1__H[4)** Occurs if the temperature goes over the adjusted Alarm limit. The ALARM led and the related channel led turns on and the alarm relay operates.
t[1	**HIGH TEMPERATURE TRIP (t[1__t[4)** Occurs if the temperature goes over the adjusted Trip limit. The TRIP led and the related channel led turns on and the trip relay operates.

4.1 ALARM MENU

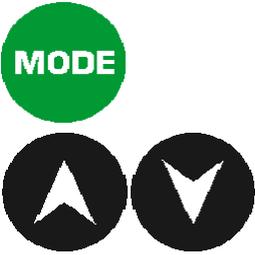| PUSHBUTTON	OPERATION	DISPLAY
MODE	In order to enter the Alarm menu, the MODE pushbutton should be held pressed during 5 seconds in *SCAN, AUTO, MAN or MAX modes.* The related channel led and the ALARM led of the last occurres alarm will turn on. The alarm code will be displayed.	*SC3*
MODE	Different alarm types (fault, trip, alarm) may be scrolled with the **MODE** pushbutton. If the related type of alarm has not occurred on any channel, then (**---**) wil be displayed.	*---*
▲ ▼	If the same alarm type occurred on more than one channel, alarm messages may be scrolled with up/down arrow pushbuttons.	*SC1*
MODE	In order to exit alarm menu, hold pressed the MODE button during 5 seconds. The previous operating mode will be resumed.	

5. PROGRAMMING

5.1 ENTERING THE PROGRAM MODE

In order to provide the maximum flexibility of use, the unit features various 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.

PUSHBUTTON	OPERATION	DISPLAY
⬆ ⬇	In order to enter the PROGRAM mode, hold pressed both up/down arrow pushbuttons for 5 seconds. **PGM** will be displayed.	PGM
MODE	Every depression to the **MODE** button will switch to the next parameter. Related parameter name is displayed.	AL2
MODE ⬆ ⬇	When the name of the parameter to be modified is displayed, hold pressed the MODE button for 5 seconds. The value of the parameter will be displayed. Modify and adjust the value with up/down arrow pushbuttons.	140

PUSHBUTTON	OPERATION	DISPLAY
⬆ ⬇	In order to exit program mode, hold pressed both up/down arrow pushbuttons during 5 seconds.	

⚠ **If no pushbutton is depressed during 3 minutes, the PROGRAM mode will be automatically terminated.**

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 3 minutes, the** **PROGRAM mode will be automatically terminated.** **In this case LAMP TEST is not performed.** |

5.3 RELAY TEST

PUSHBUTTON	OPERATION	DISPLAY
MODE	The required relay to be tested is selected with MODE button. Trip (ᵗʳᴾ), Fault(FLᵗ), Alarm(ᴬLʳ) or Fan(Fᴬⁿ) can be selected.	trP
MODE	When the relay name is on display, hold MODE button pressed during 5 seconds. The test screen of this relat will open. The initial value of "0" is displayed.	0
⌃	Arrow up button activates the relay output and displays "1" on the screen.	1
⌄	Arrow down button deactivates the relay output and displays "0" on the screen.	0
MODE	Mode button will switch to next relay or parameter display.	FLt

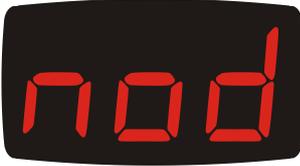| ⚠ | **Exiting the relay test display will cause the relay resume normal operation.** |

5.4 MODIFYING PROGRAM PARAMETERS

TUŞ	İŞLEM	EKRAN
MODE	The parameter to be modified is selected with MODE button.	**AL 4**
MODE	When the parameter name is on display, hold the MENU button pressed during 5 seconds. The parameter value will be displayed.	**140**
⬆ ⬇	Adjust the parameter using up/down arrow buttons. In order to increase/decrease faster you can hold arrow buttons pressed.	**148**
MODE	When MODE button is pressed, the parameter value is recorded and the next parameter name is displayed.	**tr 1**

5.5 PROGRAM PARAMETER LIST

DISPLAY	DESCRIPTION	MIN	MAX
CbA	**PT100 CABLE SECTION (CbA)** PT100 cable section in mm^2. The factory set value is $0.5mm^2$.	0.10	9.99
CbL	**PT100 CABLE LENGTH (CbL)** PT100 cable length in meters (m). The factory set value is 0m.	0	999
trP	**TRIP RELAY TEST (trP)** Used to test the TRIP relay. The value of "1" activates the relay. The value of "0" deactivates it.	0	1

DISPLAY	DESCRIPTION	MIN	MAX
FLt	**FAULT RELAY TEST (FLt)** Used to test the FAULT relay. The value of "1" activates the relay. The value of "0" deactivates it.	0	1
ALr	**ALARM RELAY TEST (ALr)** Used to test the ALARM relay. The value of "1" activates the relay. The value of "0" deactivates it.	0	1
FAn	**FAN RELAYE TEST (FAn)** Used to test the FAN relay. The value of "1" activates the relay. The value of "0" deactivates it.	0	1
AL1	**ALARM PARAMETER (AL1___AL4)** Adjusts High Temperature Alarm limit values of each channel.	0	295
tr1	**TRIP PARAMETER (tr1___tr4)** Adjusts High Temperature Trip values of channels.	5	300
FCH	**FAN CHANNEL PARAMETER (FCH)** This parameter defines from which channels the fan will operate. 0: none 8: channel_4 1: channel_1 9: channel_1+4 2: channel_2 10: channel_2+4 3: channel_1+2 11: channel_1+2+4 4: channel_3 12: channel_3+4 5: channel_1+3 13: channel_1+3+4 6: channel_2+3 14: channel_2+3+4 7: channel_1+2+3 15: channel_1+2+3+4	0	15
FOn	**FAN ON PARAMETER (FOn)** Adjusts Fan Turn ON Temperature	5	300

DISPLAY	DESCRIPTION	MIN	MAX
FOF	**FAN OFF PARAMETER (FOF)** Adjusts Fan Turn OFF Temperature.	0	295
Ch1	**ALARM ENABLE PARAMETER (Ch1-Ch2-Ch3-Ch4)** **0:** No alarm is generated from this channel **1:** if the temperature read from this channel is over Alx limit, then an alarm is generated.	0	1
bdr	**RS-485 DATA RATE: (bdr)** 0: 2400 baud 5: 28800 baud 1: 4800 baud 6: 38400 baud 2: 9600 baud 7: 56000 baud 3: 14400 baud 8: 57600 baud 4: 19200 baud 9: 115200 baud	0	9
nod	**MODBUS NODE ADDRESS (nod)** This parameter defines the address of the unit in a Modbus network. Each device in the same network must have a different address.	0	255

⚠️ **For any channel, the difference between Alarm and Trip temperatures cannot be less than 5 degrees C and the Trip temperature is always higher than Alarm temperature.**

The same way, the difference between Fan Turn ON and Turn OFF parameters cannot be less than 5 degrees C and Fan Turn ON is always higher than Fan Turn OFF.

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

12 parameters are available in total. Parameter values may be modified with Function 10 (Write Multiple Registers). All values should be sent at once.

ADDRESS	NAME	DESCRIPTION	LENGTH	R/W	TYPE	X
0	Alarm 1	Channel 1 Alarm temperature (°C)	16 BIT	R/W	unsigned word	1
1	Alarm 2	Channel 2 Alarm temperature (°C)	16 BIT	R/W	unsigned word	1
2	Alarm 3	Channel 3 Alarm temperature (°C)	16 BIT	R/W	unsigned word	1
3	Alarm 4	Channel 4 Alarm temperature (°C)	16 BIT	R/W	unsigned word	1
4	Trip 1	Channel 1 Trip temperature (°C)	16 BIT	R/W	unsigned word	1
5	Trip 2	Channel 2 Trip temperature (°C)	16 BIT	R/W	unsigned word	1
6	Trip 3	Channel 3 Trip temperature (°C)	16 BIT	R/W	unsigned word	1
7	Trip 4	Channel 4 Trip temperature (°C)	16 BIT	R/W	unsigned word	1
8	Fan Channel	Fan relay channel selection	16 BIT	R/W	unsigned word	1
9	Fan ON	Fan Turn On Temperature (°C)	16 BIT	R/W	unsigned word	1
10	Fan OFF	Fan Turn Off Temperature (°C)	16 BIT	R/W	unsigned word	1
11	Cable Lenght	Cable Length (m)	16 BIT	R/W	unsigned word	1
12	Cable Section	Cable Section(mm^2)	16 BIT	R/W	unsigned word	0.01
13	Channel_1 Alarm	Alarm enable parameter of the related channel	16 BIT	R/W	unsigned word	1
14	Channel_2 Alarm	Alarm enable parameter of the related channel	16 BIT	R/W	unsigned word	1
15	Channel_3 Alarm	Alarm enable parameter of the related channel	16 BIT	R/W	unsigned word	1
16	Channel_4 Alarm	Alarm enable parameter of the related channel	16 BIT	R/W	unsigned word	1
17	Baud Rate	RS-485 data rate	16 BIT	R/W	unsigned word	1
18	Modbus Address	Modbus address of the device	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 Maximum Temperatures
16385	1	W-O	Reset all Alarms
16386	-	W-O	Arrow Down pushbutton
16387	-	W-O	Arrow Up pushbutton
16388	-	W-O	MODE pushbutton
16389	-	W-O	Arrow Down pushbutton long press
16390	-	W-O	Arrow Up pushbutton long press
16391	-	W-O	MODE pushbutton long press
16392	-	W-O	PROGRAM pushbutton long press

6.4 ALARM BITS

MODBUS Warning Record are contains 20 bits in 3 registers.

ADDRESS	BIT	R/W	DESCRIPTION
20488	0	R-O	Alarm Relay Status
	1	R-O	Trip Relay Status
	2	R-O	Fan Relay Status
	3	R-O	Fault Relay Status
	4-15	R-O	Not used
20489	0	R-O	Channel 1 Alarm
	1	R-O	Channel 2 Alarm
	2	R-O	Channel 3 Alarm
	3	R-O	Channel 4 Alarm
	4	R-O	Channel 1 Trip
	5	R-O	Channel 2 Trip
	6	R-O	Channel 3 Trip
	7	R-O	Channel 4 Trip
	8-15	R-O	Not used
20490	0	R-O	Channel 1 Open Circuit Alarm
	1	R-O	Channel 2 Open Circuit Alarm
	2	R-O	Channel 3 Open Circuit Alarm
	3	R-O	Channel 4 Open Circuit Alarm
	4	R-O	Channel 1 Short Circuit Alarm
	5	R-O	Channel 2 Short Circuit Alarm
	6	R-O	Channel 3 Short Circuit Alarm
	7	R-O	Channel 4 Short Circuit Alarm
	8-15	R-O	Not used

6.5 SENSOR DATA

ADDRESS	NAME	DESCRIPTION	LENGTH	R/W	TYPE	X
20480	Max Temp 1	Channel 1 Maximum Temp.	16 BIT	R-O	unsigned word	1
20481	Max Temp 2	Channel 2 Maximum Temp.	16 BIT	R-O	unsigned word	1
20482	Max Temp 3	Channel 3 Maximum Temp.	16 BIT	R-O	unsigned word	1
20483	Max Temp 4	Channel 4 Maximum Temp.	16 BIT	R-O	unsigned word	1
20484	Temp 1	Channel 1 Actual Temperature	16 BIT	R-O	unsigned word	1
20485	Temp 2	Channel 2 Actual Temperature	16 BIT	R-O	unsigned word	1
20486	Temp 3	Channel 3 Actual Temperature	16 BIT	R-O	unsigned word	1
20487	Temp 4	Channel 4 Actual Temperature	16 BIT	R-O	unsigned word	1

7. TECHNICAL SPECIFICATIONS

Supply Input:
    DC version: 19-150VDC
    AC version: 85-305VAC (88-450VDC)
Measuring Inputs:
    4 x PT100 (3 terminals)
Accuracy: 1% + 1 digit
Measurement Range: -40 to +250°C
Power Consumption: < 4 VA
Relay Outputs: 5A @ 250V AC
Serial Port:
    Signal type: RS-485
    Protocol: Modbus RTU
    Data Rate: 2400-115200b, adjustable
    Isolation: 1000V AC, 1 minute
Operating Temperature range:
    -20°C to +70 °C (-4°F to 158°F)
Max Relative Humidity:
    95% non condensing

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)

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