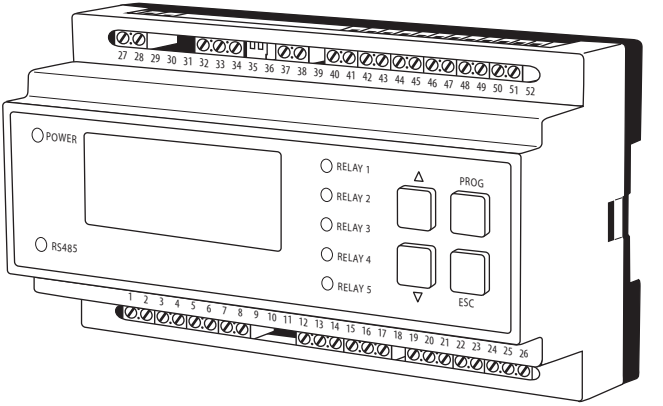
Sigmian GmbH

ELECTRONIC TEMPERATURE CONTROLLER
PTM-2000



USER MANUAL

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TABLE OF CONTENTS:

IMPORTANT!

Before starting installation, read this manual carefully.

NOTE:

Refer to the "Installation and Connection" section for wiring diagrams and installation guidelines.

We recommend using qualified specialists for installation of the temperature controller and heating system.

Electrical connections must be performed by a certified electrician.

This manual does not substitute for professional training.

The manufacturer's warranty does not cover damage resulting from mechanical impact, improper installation, or operation outside the intended purpose or conditions specified in the manual.

1. DESCRIPTION. FUNCTIONS OF THE TEMPERATURE CONTROLLER

1.1. Purpose and Functionality

The PTM-2000 electronic temperature controller (hereinafter referred to as "controller") is designed for temperature measurement and control in heating cable systems, including:

- Roof and open area de-icing;
- Industrial pipeline and tank heating;
- Other cable-based electric heating systems.

The heating control algorithms and sensor kits ensure efficient temperature control and energy savings, improving overall system performance.

The controller provides 5 control algorithms, selectable via the display menu. Each algorithm configures output relays and sensor terminals for specific functions.

Supported Control Algorithms:

- **PIPE** – Two-position control across 4 channels
- **PIPE+** – Proportional control across 4 channels
- **ROOF/AREA** – Roof and open area de-icing across 4 zones
- **TIMER** – Power control per channel over time periods
- **METER** – Display and measurement of 8 temperature channels

The PTM-2000 supports all current heating cable de-icing system variants. Its flexible settings allow adaptation to local climate conditions, achieving up to 40% energy savings.

Features:

- Temperature and moisture detection (precipitation and water sensors)
- Integration with automated control systems (SCADA) via RS485 (MODBUS RTU)
- LCD display showing system status and settings
- Relay outputs for heating system control

1.2. Indication Menu Structure

The display menu includes the following sections:

1. Main display windows
2. Temperature settings for each algorithm
3. System settings: RS485, firmware updates, etc.

Main Display Windows:

Each control algorithm has its own main display screen, showing current and measured parameters.

- These screens remain active when no buttons are pressed
- Backlight switches to dim mode after 40 seconds
- Use the **Up/Down** keys to view settings and current temperature statuses

Legend for Symbols in Menu Displays:

- **DO** – Precipitation sensor
- **DW** – Water (melt) sensor
- **T** – Temperature or time (depending on context)
- **K** – Control channels
- **P** – Power level (shown as a percentage)
- **DT** – Temperature sensor
- **4 mA / 20 mA** – Standard analog input signal
- **9.6K** – RS485 baud rate (9600 bps)
- **MODBUS/RTU** – Communication protocol used via RS485

The composition of the LED display is shown in the table:

Table 1. Indication

Label on Controller Housing	LED color	Function
ON	Red	Power is supplied to the controller
RS485	Orange	Data exchange via the RS485 interface
RELAY1, RELAY2, RELAY3, RELAY4, RELAY5	Green	Relay control channels 1–5 are activated

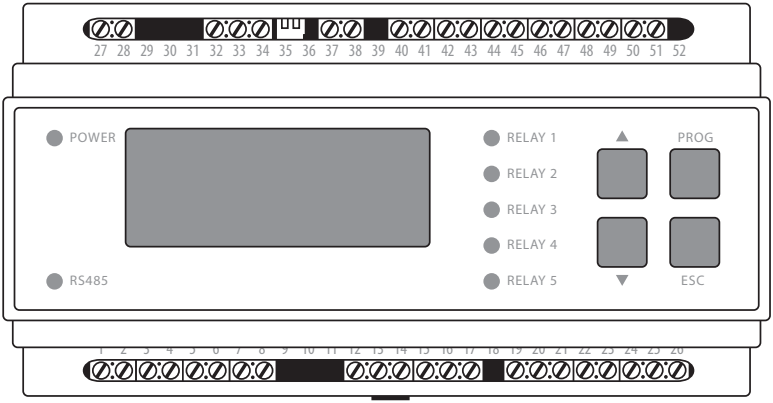


Figure 1. Device Appearance

1.3. Indication Menu Structure

The controller's indication menu consists of several sections:

1. Main Display Screens
2. Settings and Temperature Configuration Section for each control algorithm
3. System Settings Section, including RS485 interface, firmware updates, etc.

The **Main Display Screens** section represents a set of primary status screens.
The main screen should be understood as the display shown when the controller is in its working state — that is, when no buttons are being pressed and the backlight is in its dimmed mode.
Each control algorithm has its own dedicated main screen that displays the current and measured parameters relevant to that algorithm.
These main screens also allow the user to view current settings and temperature statuses for the selected algorithm.
To scroll through these settings and current status screens, use the **"UP"** and **"DOWN"** keys.

Legend and Abbreviations Used in the Display Menu Windows:

1. **DO** – Precipitation sensor
2. **DW** – Water (melt) sensor
3. **T** – Temperature or time, depending on the context of the menu window
4. **K** – Control channels
5. **P** – Power level, followed by a percentage value
6. **DT** – Temperature sensor
7. **4 mA / 20 mA** – Standardized analog signal input (4 to 20 mA)
8. **9.6K** – RS485 communication speed: 9600 bits/sec
9. **MOD_BUS/RTU** – Communication protocol via RS485 interface

Main Display Windows for Viewing Settings for Each Control Algorithm.

1. Display Screens for Viewing Settings in the "PIPE" Algorithm

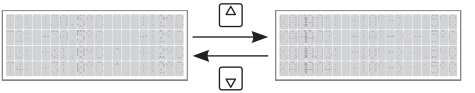
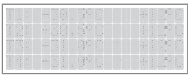
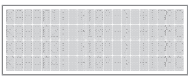


Figure 2.

Table 2.

Information Displayed on the Main Screen of the Controller When Operating in the "PIPE" Algorithm	
	**T1, T2, T3, T4** – Current measured temperatures across the 4 channels **+12 °C** – Set temperature setpoint for maintaining heating **"Up/Down Arrow"** – Direction of temperature change (updates every minute)
	**CHANNEL 1, 2, 3, 4** – Configured ON/OFF temperatures for heating across the 4 channels

2. Display Windows for Viewing Settings of the "PIPE+" Algorithm

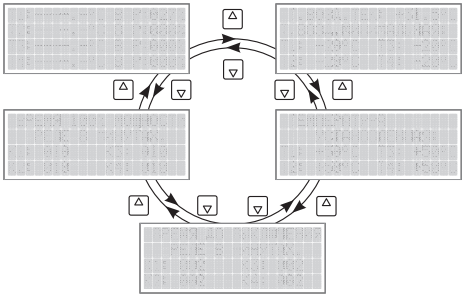
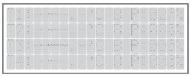
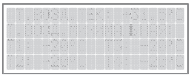
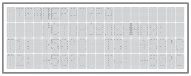
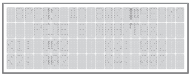
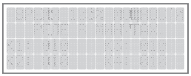


Figure 3.

Table 3.

Information Displayed on the Main Screen of the Controller When Operating in the "PIPE+" Algorithm	
	T1, T2, T3, T4 – Current measured temperature for each of the 4 channels P:027% – Calculated power output for each of the 4 channels Symbol "B" – Indicates that the current channel is operating based only on air temperature "Up/Down Arrow" – Direction of change in measured pipeline temperature when a pipeline sensor is used; displayed in place of the "B" symbol and updated once per minute
	T.AIR.CUR: +31.5˚C – Current measured air temperature T1, T2, T3, T4 – Set minimum air temperature for each channel at which 100% heating power must be applied
	T1, T2, T3, T4 – Set temperature of the heated surface for the 4 temperature maintenance channels
	K1, K2, K3, K4 – Remaining time until the heating control relay switches off for each of the 4 channels, i.e., how many minutes are left before the relay turns off according to the set power percentage
	K1, K2, K3, K4 – Set full cycle time (in minutes) corresponding to 100% power for each of the 4 channels

3. Display Windows for Viewing Settings of the "ROOF/AREA" Algorithm

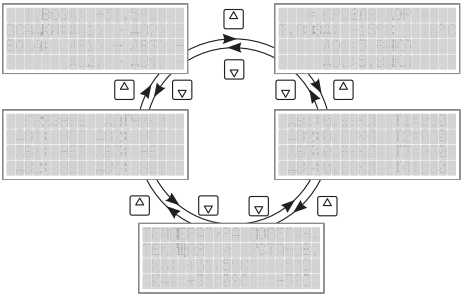
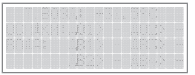
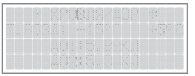
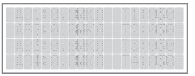
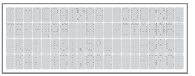
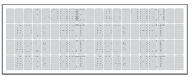


Figure 4.

Table 4.

Information Displayed on the Main Screen of the Controller When Operating in the "ROOF/AREA" Algorithm	
	T.AIR: +31.5˚C – Current measured air temperature PRECIPITATION: DO1 and DO2 – Current measured precipitation level from sensors №1 and №2 WATER: DW1, DW2, DW3, DW4 – Current measured meltwater level from water sensors №1, 2, 3, and 4 The "–" symbol means that the corresponding precipitation or water sensor channel is turned off The "!" symbol indicates that the precipitation or water sensor is dirty and cannot operate; cleaning is required
	T.AIR: -15˚C…+5˚C – Set air temperature range for operation of the de-icing system DO1 and DO2 – Sensor status (ON/OFF) and current configured sensitivity value for the precipitation sensors, channels 1 and 2
	DW1, DW2, DW3, DW4 – Sensor status (ON/OFF) and current configured sensitivity value for the meltwater sensors, channels 1, 2, 3, and 4 T1, T2, T3, T4 – Delay timers for post-heating the system after the meltwater signal disappears from sensors №1, 2, 3, and 4
	K3 and K4 – Current measured surface temperature from the sensors on channels №3 and №4 during snow removal operation on open areas Also shows the setpoint temperature for preheating the surface of open areas
	Presence of Dirty Precipitation and Water Sensors If the precipitation or meltwater sensors become dirty, accurate detection is not possible. In such cases, the sensors must be cleaned of debris to allow free access for precipitation and meltwater

4. Display Windows for Viewing Settings of the "TIMER" Algorithm

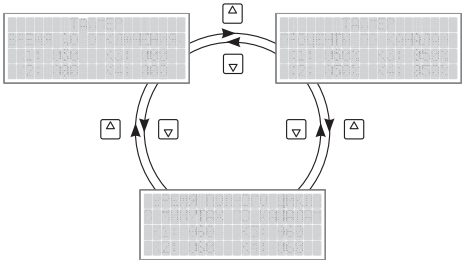
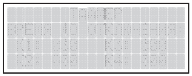
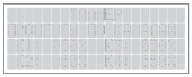
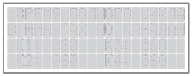


Figure 5.

Table 5.

Information Displayed on the Main Screen of the Controller When Operating in the "TIMER" Algorithm	
	K1, K2, K3, K4 – Time remaining (in minutes) until the load control relay switches off for channels 1, 2, 3, and 4
	K1, K2, K3, K4 – Set power percentage for load control on channels 1, 2, 3, and 4
	K1, K2, K3, K4 – Set full timer cycle duration (in minutes) for 100% power on channels 1, 2, 3, and 4

5. Display Windows for the "METER" Algorithm

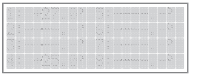
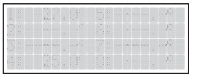


Figure 6.

Table 6.

Information Displayed on the Main Screen of the Controller When Operating in the "METER" Algorithm	
	Display of 8 temperature readings when operating in the "METER" algorithm. There are no additional indication windows, as this algorithm does not include any settings or setpoints.

6. Language Selection Display Windows

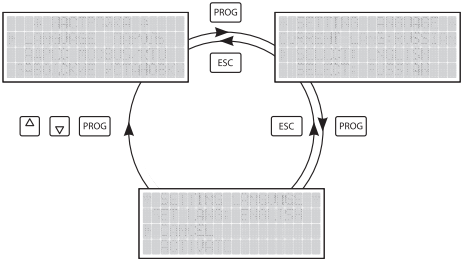


Figure 7. Switching the language to English.

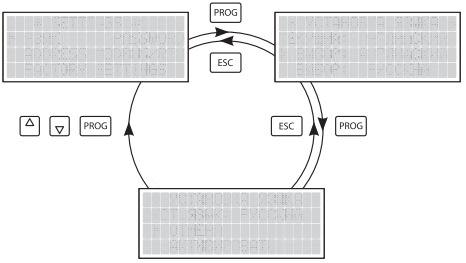


Figure 8. Language change from English to Russian.

1.4. Control Algorithms

The controller supports 5 control algorithms. Selection of algorithms is done through the on-screen menu. For each algorithm, the output relays and sensor terminals have specific functions and assignments depending on the selected mode.

Algorithm Descriptions:

1. **"PIPE"** – Two-position (ON/OFF) control across 4 channels
2. **"PIPE+"** – Proportional control across 4 channels
3. **"ROOF/AREA"** – Control of roof and open-area de-icing systems across 4 zones
4. **"TIMER"** – Power control over 4 independent channels based on time periods
5. **"METER"** – Measurement and display of 8 temperature channels.

To select an algorithm type or to modify temperature and system parameters, the controller includes protection against unauthorized access to settings.

When the "**PROG**" key is pressed, a menu appears that allows the user to enter the correct password for access to the settings. Only after successful password entry can the user access menu windows for modifying temperature and system parameters.

Access password for controller settings: **"117"**.

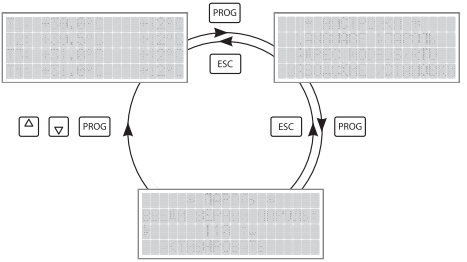


Figure 9. Setting the Password for Accessing Controller Settings.

1.4.1. Algorithm – "PIPE"

The "PIPE" algorithm supports **4 control channels**.

Control is **relay-based** and operates in a **two-position (ON/OFF)** mode. Each channel is configured with a minimum and maximum temperature threshold.
Sensors can be connected using one of two input types:

- TST01 digital sensors (terminals D1 to D4), and/or
- **4–20 mA analog signal inputs** (terminals A1 to A4)

The controller automatically selects the input type to use during operation. Priority is given to the 4–20 mA input (terminals A1 to A4).

If a 4–20 mA sensor is not connected, the controller attempts to read a TST01 sensor on the corresponding input (D1 to D4).
If neither sensor type is connected, the relay for that channel is disabled.
The working temperature range for the 4–20 mA signal is configured in the "Settings" menu under the "4–20 mA Input" section.

To operate the "PIPE" algorithm, the following configurations must be made for each of the 4 channels, along with settings for the emergency relay K5:

1. Switch-on temperature
2. Switch-off temperature
3. Emergency relay K5 settings (used to signal sensor failure)

Control Logic:
Heating is controlled in two positions based on T_on and T_off thresholds:

- During heating, once the current temperature exceeds the switch-off threshold, the corresponding channel's relay turns off
- When the temperature drops below the switch-on threshold, the relay turns back on
- This ON/OFF heating cycle repeats continuously

If a temperature sensor fails, the relay for that channel is disabled.

How to Configure the Temperatures:

1. From the main display window, press the "PROG" key to enter the settings menu
2. Go to "Algorithm Selection" and choose "PIPE"
3. Enter the "PIPE Settings" submenu
4. Configure the ON/OFF temperatures for each of the 4 heating channels
5. After configuring all 4 channels, set up the emergency relay K5 for each channel

The emergency relay K5 is configured by enabling or disabling (ON/OFF) the temperature sensor fault monitoring for each of the four channels.

After completing the configuration, select the "Activate" menu item — this starts the controller in the mode of the selected algorithm.

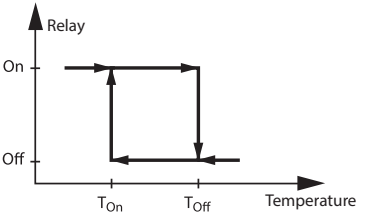


Figure 10. Operating Hysteresis

Table 7. Assignment of Used Relays and Temperature Inputs for the "PIPE" Algorithm

Function	Temperature Inputs		Control Relay	
	TST01	4…20 mA	Number	Terminal Contacts
	Terminal Contact Numbers			
Temperature Channel №1	3	13	Relay №1	42 – 43
Temperature Channel №2	4	14	Relay №2	44 – 45
Temperature Channel №3	5	15	Relay №3	46 – 47
Temperature Channel №4	6	16	Relay №4	48 – 49
Emergency Channel			Relay №5	50 – 51

Note: Terminal numbers for power circuits and common sensor lines are not included in the table

Table 8 Adjustment Range of Temperature Controller Parameters and Default Settings

Parameter	Default Settings	Adjustment Range
Switch-On Temperature T_{on}	10 °C	-100 °C…+600 °C
Switch-Off Temperature T_{off}	15 °C	
Minimum Temperature for 4–20 mA Signal Range	-50 °C	
Maximum Temperature of the Standardized 4–20 mA Signal	200 °C	
Emergency Relay for Temperature Sensor Failure in the "PIPE" Algorithm	OFF	Relay K5

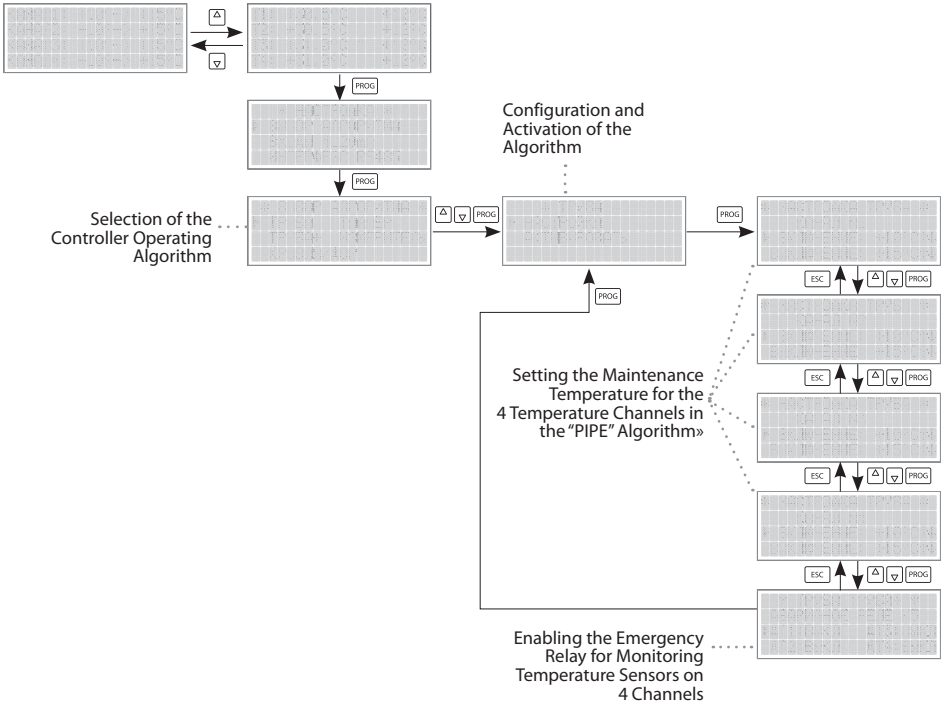


Figure 11. Indication Diagram of the "PIPE" Algorithm

1.4.2. Algorithm – “PIPE+”

The “PIPE+” algorithm includes 4 control channels.

Control is relay-based and proportional to the ambient air temperature.

In addition to monitoring air temperature, the algorithm also supports monitoring the temperature of the heated surface.

If no surface temperature sensor is connected, heating control is based only on the air temperature sensor.

When a surface temperature sensor is connected, the algorithm adjusts air-based control according to the current surface temperature. This also enables visual monitoring of the surface temperature, which is displayed on the main screen of the controller.

- The air sensor is connected to input D1, sensor type TST01.
- Surface temperature sensors are connected only to 4–20 mA current signal inputs, terminals A1 to A4.

If no surface sensor is connected, heating is controlled only by the air temperature according to Algorithm №1.

If a surface temperature sensor is connected, the system operates based on a combination of Algorithm №1 and Algorithm №2.

How It Works:

- The controller measures the air temperature, and based on the configured parameters, calculates the required heating power as a percentage.
- The controller follows Algorithm №1 to calculate this power.

In Algorithm №1:

- If the current air temperature is below the set minimum air temperature (T_air.min), the calculated heating power is always 100%.
- If the current air temperature is above the cutoff temperature (T_surface.off), the calculated power is 0%.
- This is how the controller operates without a surface temperature sensor.

When a surface temperature sensor is connected, the controller adjusts the power percentage calculated by Algorithm №1 using Algorithm №2:

- If the current surface temperature is below the switch-on threshold (T_surface.on), the controller follows Algorithm №2, and the power is set to 100%.
- When the current surface temperature reaches T_surface.on, the controller switches back to Algorithm №1, and the power is calculated based on the air temperature.
- If the surface temperature exceeds the switch-off threshold (T_surface.off), the calculated heating power is 0%, and the heating is completely disabled.

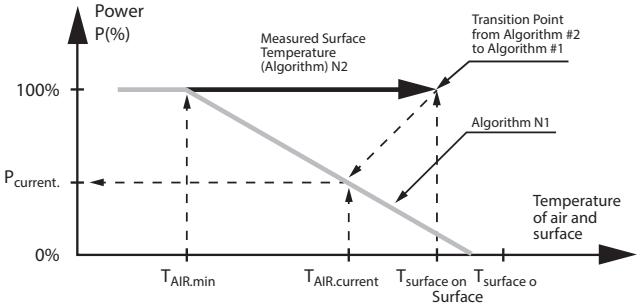


Figure 12. Heating Power Calculation Graph for the "PIPE+" Algorithm

Heating is turned ON/OFF using control relays K1…K4, corresponding to the control channel numbers.

The calculated power percentage determines how long the control relay remains in the ON state relative to the full power control cycle that represents 100% power.

Using this method of power control, the controller regulates the ON duration of the heating system according to the calculated power required for heating operation.

The full power control cycle time is set by the user via the controller menu and can range from 10 to 100 minutes.

- If the calculated heating power is 0%, the control relay will remain OFF
- If the calculated heating power is 100%, the control relay will remain ON continuously

Example:

- Calculated power level: 50%
- Full cycle time: 60 minutes
- Result: The control relay will operate in the following mode:
  - o ON state for 30 minutes
  - o OFF state for 30 minutes

This control cycle will continue as long as the calculated power remains at 50%.

Table 9. Assignment of Used Relays and Temperature Inputs in the "PIPE+" Algorithm

Function	Temperature Inputs		Control relay	
	TST01	4…20 mA	Number	Terminal Contacts
	Connection Terminal Numbers			
Air temperature	3			
Temperature Channel №1		13	Relay №1	42 – 43
Temperature Channel №2		14	Relay №2	44 – 45
Temperature Channel №3		15	Relay №3	46 – 47
Temperature Channel №4		16	Relay №4	48 – 49
Emergency channel			Relay №5	50 – 51

Note: Terminal numbers for power circuits and common sensor lines are not included in the table.

Table 10 Adjustment Range of Temperature Controller Parameters and Factory Settings

Parameter	Default settings	Adjustment Range
Minimum Set Air Temperature $T_{air.min.}$	-20 °C	-55 °C…+60 °C
Minimum Set Surface Temperature $T_{surface.on}$	10 °C	-45 °C…+600 °C
Maximum Set Surface Temperature $T_{surface.off}$	15 °C	
Minimum Temperature of the Standardized 4–20 mA Signal	-50 °C	-100 °C…+600 °C
Maximum Temperature of the Standardized 4–20 mA Signal	200 °C	
Full Cycle Time for 100% Power	60 minutes	30…100 minutes
Emergency Relay for Temperature Sensor Failure	OFF	Relay K5

To configure the temperatures, start from the main display window and enter the settings mode by pressing the "PROG" key.
Next, go to the "Settings" submenu, select "Algorithm Selection", then choose "PIPE+", and open the "Settings" option.
In the "PIPE+ Settings" menu, go through channels 1 to 4 in sequence and configure:

- The minimum air temperature (T_air.min)
- The switch-on (T_surface.on) and switch-off (T_surface.off) surface temperatures

After setting the temperatures for all 4 channels, proceed to configure the emergency relay K5 for each channel.

If a surface sensor is used, you must enable the K5 emergency relay for that channel if you want to monitor the surface temperature sensor for faults.

If the air temperature sensor fails, the emergency relay K5 is activated, and the heating control relays are turned off in all four channels.

If the surface temperature sensor fails, the emergency relay K5 is activated, but heating control continues based on the air temperature sensor signal (Algorithm №1, see Figure 12).

After completing the configuration, select the "Activate" menu item — this starts the controller in the mode of the selected algorithm.

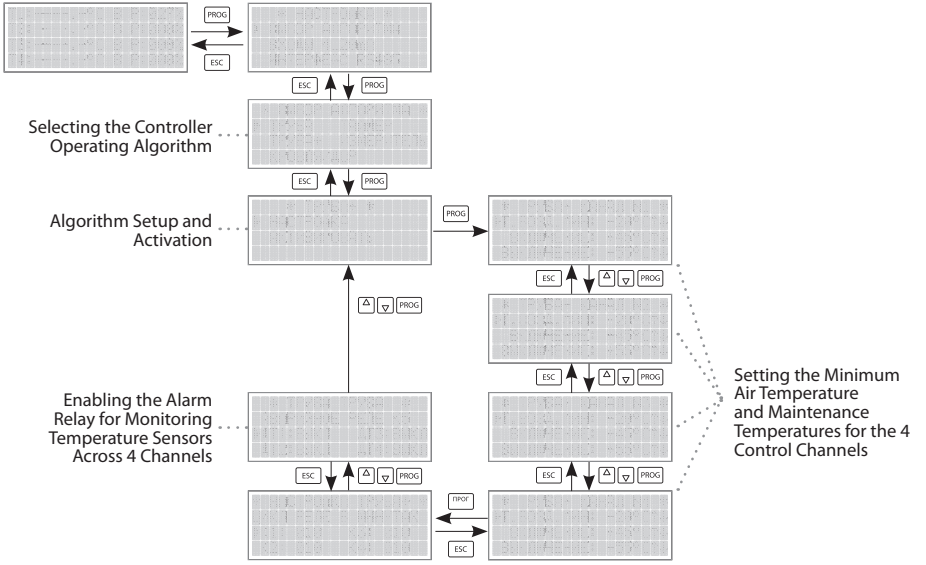


Figure 13. Indicator Diagram of the 'PIPE+' Algorithm"

1.4.3. Algorithm – "ROOF/GROUND"

The RTM-2000 electronic temperature controller, when operating under the "ROOF/GROUND" algorithm, is designed to function as part of roof de-icing systems, including trays, gutters, drip edges, and downpipes, with the purpose of clearing their surfaces from atmospheric precipitation and preventing ice formation. In addition to roof precipitation removal, the "ROOF/GROUND" algorithm also provides functionality for de-icing open outdoor areas.

The "ROOF/GROUND" algorithm allows the following:

- Connection of temperature, precipitation, and meltwater sensors to measure respective parameters such as ambient air temperature, presence of atmospheric precipitation, and meltwater in the drainage system;
- Operation in both automatic and manual modes—system operation is possible regardless of the sensor status;
- Independent control of four different heating circuits (roof heating, downpipe heating);
- Display of operation modes as well as sensor and relay statuses on the LCD screen;
- Configuration of system parameters and operation modes using the control keys on the front panel.

The need for de-icing systems typically arises during the cold seasons, especially during thaws when intensive ice formation occurs. Operation of the system at low ambient temperatures (below -15 °C) is not practical. First, at such low temperatures, ice formation generally does not occur, and the moisture content on the roof drops significantly. Second, snowfall intensity also decreases as temperatures fall. Third, melting snow and draining meltwater over long distances requires substantial energy consumption. For proper system performance, the setup must include a controller capable of automatically managing the heating activation and deactivation.

The RTM-2000 temperature controller supports all existing configurations of de-icing systems utilizing heating cables. Its extensive configuration options allow adaptation to specific local climate conditions and enable efficient use of thermal energy, resulting in up to 40% energy savings.

Operating Principle and Heating System Configuration in the "ROOF/GROUND" Algorithm

Heating Zone Configurations and Sensor Requirements in the "ROOF/GROUND" Algorithm

The electric heating system can be configured in three different ways based on the distribution of heating zones:

1. Roof heating across all four zones.
2. Roof heating across three zones, with one monitored open-area zone.
3. Roof heating across two zones, with two monitored open-area zones.

The configuration is determined by the presence or absence of TST01 temperature sensors connected to zones No. 3 and No. 4. If a temperature sensor is connected for an open-area zone, the controller not only monitors the presence or absence of precipitation and meltwater but also controls surface temperature, maintaining a setpoint regardless of environmental conditions.

The principle of open-area de-icing operation is based on maintaining a slightly sub-zero surface temperature before the onset of precipitation or meltwater. Once precipitation or meltwater is detected, the system rapidly initiates ice removal.

To operate the de-icing system, the following sensor kit is required:

1. TST01 temperature sensor for measuring ambient air temperature.
   - Connection input: "D1"
2. Precipitation sensor (models: TSP01, TSP02, and TSP03D) for detecting atmospheric precipitation.
   - Connection inputs: "O1" and "O2"
3. Meltwater detection sensor TSW01 for each of the four channels.
   - Connection inputs: "W1", "W2", "W3", and "W4"

Operating Principle of the "ROOF/GROUND" De-Icing System

The RTM-2000 temperature controller continuously monitors ambient air temperature using the TST01 air temperature sensor connected to input "D1". When the ambient temperature enters the predefined operating range—between the configured minimum and maximum air temperature thresholds, during which ice formation is possible—the relay "K5" is activated. This supplies power to the contacts of relays "K1", "K2", "K3", and "K4" in the standard controller setup, thereby removing the lock from all power circuits in the control cabinet.

At this point, the controller begins polling the connected precipitation sensors on inputs "O1" and "O2", as well as the meltwater sensors on inputs "W1", "W2", "W3", and "W4", provided that both types of sensors are installed and enabled via the controller's menu.

When moisture is detected by the precipitation sensor on inputs "O1" and/or "O2", the controller activates the heating relays "K1", "K2", "K3", and "K4". These relays remain engaged as long as a precipitation signal is present on either input. Once precipitation stops and the signal disappears from inputs "O1" and "O2", the controller analyzes the meltwater sensor inputs "W1", "W2", "W3", and "W4", waiting for the meltwater signals to cease on each channel. During this time, the corresponding heating relays remain active:

- "W1" corresponds to relay "K1"
- "W2" corresponds to relay "K2"
- "W3" corresponds to relay "K3"
- "W4" corresponds to relay "K4"

Once the meltwater signals disappear from inputs "W1" through "W4", the controller initiates shutdown delay timers "T1", "T2", "T3", and "T4" (in minutes) for each respective channel. When each countdown is complete, the corresponding relay output is turned off. If the delay time is set to 0 minutes, the relay will switch off immediately after the meltwater signal disappears.

If no precipitation is detected on "O1" and "O2", but meltwater is detected on inputs "W1" through "W4", the controller will activate the corresponding relay(s). The relay will then switch off only after the meltwater signal disappears and the associated delay timer expires.

To enable temperature control of open areas, temperature sensors of type TST01 must be connected to inputs "D3" and "D4". When connected, the output relays "K3" and "K4" are used to maintain the target temperature of the heated surfaces. Once the configured temperature is reached on channels "D3" and "D4", relays "K3" and "K4" switch to standard operation mode governed by the precipitation and meltwater sensor signals, according to the previously described logic.

If manual system activation is required, the system can be forced into de-icing mode ("Defrost") by closing the dry contact terminals on input "IN1" (contacts 37 and 38). This will engage all four heating zones regardless of the presence or absence of precipitation or meltwater.

During the "Defrost" mode, relay "K0" is activated to power an indicator lamp located on the control cabinet's front panel (see typical wiring diagram).

Table 11. Assignment of Relays, Precipitation and Water Sensors, and Temperature Inputs for the "ROOF/GROUND" Algorithm

Function	Temperature Inputs	Control Relay	
	TST01	Number	Terminal Contacts
	Terminal Contact Numbers		
Ambient Air Temperature	3	Relay №5	50 – 51
Heated Surface Temperature, Zone No.3	5	Relay №3	46 – 47
Heated Surface Temperature, Zone No.4	6	Relay №4	48 – 49
Precipitation Sensor Input «O1»	21	Relay №1, 2, 3, 4	
Precipitation Sensor Input «O2»	22		
Meltwater Presence Sensor, Input «B1»	23	Relay №1	42 – 43
Meltwater Presence Sensor, Input «B2»	24	Relay №2	44 – 45
Meltwater Presence Sensor, Input «B3»	25	Relay №3	46 – 47
Meltwater Presence Sensor, Input «B4»	26	Relay №4	48 – 49
External "Defrost" Signal. «Bx1»	37, 38		

Note: Terminal numbers for power supply circuits and common sensor circuits are not listed in the table.

Table 12. Temperature Controller Parameter Ranges and Factory Settings

Parameter Name	Default Settings	Adjustment Range
Minimum Set Air Temperature $T_{air.min}$	-15 °C	-50 °C…+65 °C
Maximum Set Air Temperature $T_{air.max}$	5 °C	
Surface Maintenance Temperature (Channels No. 3 and No. 4)	-5 °C	-20 °C…+20 °C
Heating Shutdown Delay Timer Range	30 minutes	0…180 minutes
Preheating Time Upon Entering the Set Air Temperature Range	180 minutes	
Defrost Mode Indication Channel	Relay K0	
De-Icing Zone Control Relays No. 1…4	Relay K1…K4	
Air Temperature Range Relay	Relay K5	

This control principle enables the RTM-2000 temperature controller to implement a combined roof and open-area de-icing system by equipping it with the appropriate precipitation, water, and temperature sensors.

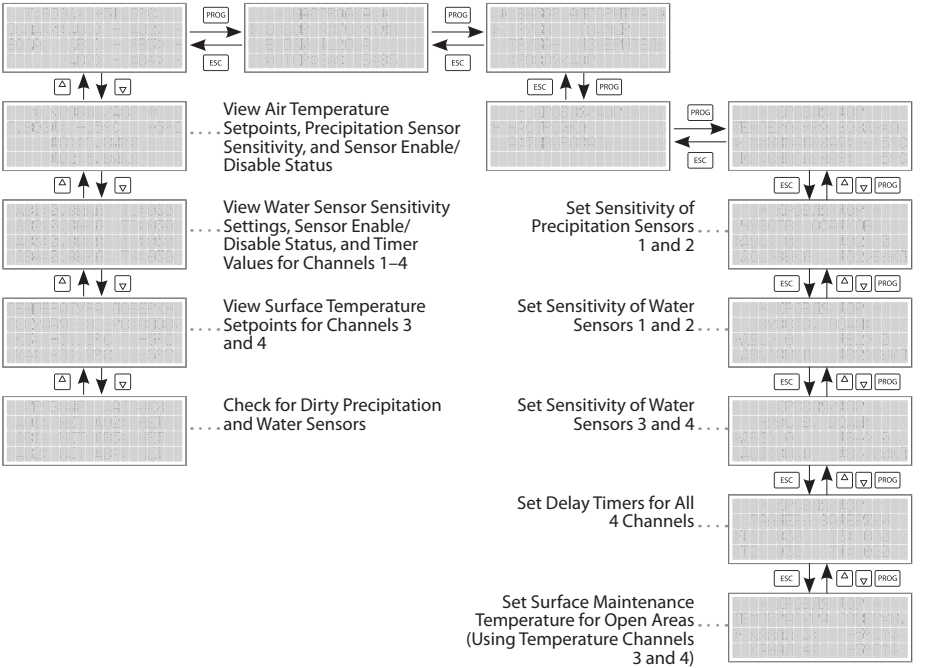


Figure 14. Indicator Diagram of the "ROOF/GROUND" Algorithm

1.4.4. Algorithm – "TIMER"

The RTM-2000 electronic temperature controller, when operating in the "TIMER" algorithm mode, is designed for use in electric cable heating systems. The timer mode allows the user to manually set the required power level as a percentage.

Operating Principle of the Controller in "TIMER" Mode

The operating principle is based on manual configuration of the required power level for each of the four control channels. The user sets both the desired power percentage and the full cycle duration (in minutes) corresponding to 100% power.

The control relay for each corresponding channel remains ON for a time interval proportional to the configured power percentage relative to the full 100% cycle time.

Example:

If the configured power level is 50% and the full cycle time is 30 minutes, the relay operation will be: Relay ON for 15 minutes –> Relay OFF for 15 minutes –> then the cycle repeats.

The RTM-2000 temperature controller operating in "TIMER" mode can serve as an emergency backup mode for the heating system in the event that all temperature sensors fail, and it remains in use until the fault is resolved and/or the sensors are replaced.

Table 13. Temperature Controller Parameter Adjustment Ranges and Factory Settings

Parameter name	Default settings	Adjustement range
Full Cycle Duration Range at 100% Power	60 minutes	10…100 minutes
Set Power Level Percentage	50 %	10…90 %.

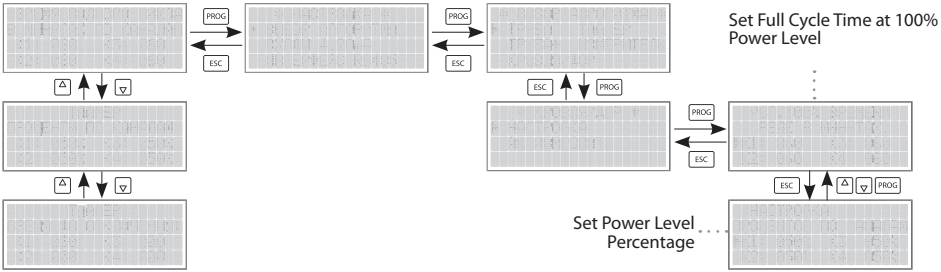


Figure 15. Indicator Diagram of the "TIMER" Algorithm

1.4.5. Algorithm – "MEASUREMENT"

When operating in the "MEASUREMENT" algorithm mode, the RTM-2000 electronic temperature controller is designed to measure and display eight temperature values. In this mode, all relay control channels are deactivated, and no heating control is performed.

To enable temperature measurement across all eight channels, both of the controller's temperature input blocks must be used.

Table 14. Assignment of Temperature Inputs Used in the "MEASUREMENT" Algorithm

Function	**Temperature Inputs**		**Control relay**	
	TST01	4…20mA	Number	Terminal Contacts
	Connection Terminal Numbers			
Temperature Channel No.1	3			
Temperature Channel No.2	4			
Temperature Channel No.3	5			
Temperature Channel No.4	6			
Temperature Channel No.5		13		
Temperature Channel No.6		14		
Temperature Channel No.7		15		
Temperature Channel No.8		16		

Note: Terminal numbers for power supply circuits and common sensor circuits are not listed in the table.

Table 15. Temperature Controller Parameter Adjustment Ranges and Factory Settings

Parameter name	**Default settings**	**Adjustment range**
Temperature Measurement Channels – Total: 8 Channels	4 Channels for TST01 Sensor 4 Channels for 4–20 mA Sensor	
Control relay	All Relays Are Disabled	

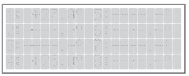


Figure 16. Display Window in "MEASUREMENT" Algorithm Mode

2. INSTALLATION AND OPERATION

2.1. Controller Design

The PTM-2000 temperature controller is designed for installation in an electrical cabinet on a 35 mm DIN rail. It occupies 9 modules in width.
The controller has an IP20 protection rating in accordance with GOST 14254.
Power supply connection, temperature sensor input, and heating load output are made using terminals mounted on the controller's circuit board. All terminals support connection of conductors with a cross-section of at least 2.5 mm^2.
Overall dimensions of the temperature controller: 160 × 90 × 60 mm.

2.2. Operating Conditions

The controller operates in an ambient temperature range of +0 °C to +45 °C. Power supply: 90–245 V AC, 50–60 Hz.
Permissible voltage deviation: -15% to +10%. Relative humidity at +35 °C must not exceed 90%.
Installation must be performed at an ambient temperature of at least +5 °C.

2.3. Connection

The PTM-2000 temperature controller is intended to be installed on a DIN rail in a control cabinet. A special latch on the back cover is provided for this purpose. Heating sections and starters of the heating system should be connected after their installation and verification. Power to the controller is supplied through a circuit breaker after checking all connections.

To connect the temperature controller:

- Install the controller in the control cabinet.
- Connect temperature, water, and precipitation sensors.
- Connect the load (heating sections), using external relays if necessary.
- Connect the power supply wires.
- Apply supply voltage.
- Check and adjust the controller settings if necessary.

2.3.1. Input Circuits of the Temperature Controller

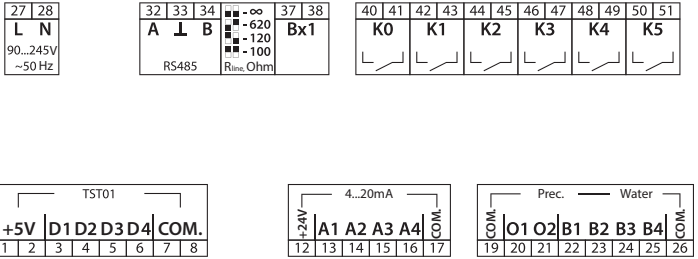


Figure 17. Device Terminal Marking

The controller's input measurement circuits are divided into two categories: temperature inputs and control inputs:

1. Temperature Inputs

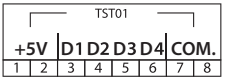
The controller provides two types of temperature inputs, with four channels for each type.

- The first type is a digital temperature sensor TST01, which uses a DS1820 sensing element.
- The second type is an analog temperature input for a standard 4–20 mA current signal.

1.1. TST01 Temperature Sensor Input

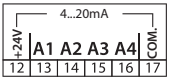
The temperature sensor is connected to the controller using a three-wire configuration, transmitting the following signals: +5 V, Data, and Ground. Wiring must follow the labeling on both the sensor and the controller terminals.

TST01 Temperature Sensor Input.



- Terminals 1, 2 – +5V power supply for the TST01 sensor (red wire of the TST01 cable),
- Terminals 3, 4, 5, 6 – Data signal (white wire of the TST01 sensor),
- Terminals 7, 8 – Ground (blue wire of the TST01 sensor cable).

4–20 mA Standard Signal Input



- Terminal 12 – 24 V output for powering the transmitter
- Terminals 13, 14, 15, 16 – 4–20 mA signal input terminals.
- Terminal 17 – Ground, used when transmitters are powered externally.

1.2. 4–20 mA Standard Signal Input

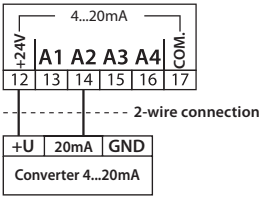
The 4–20 mA standard signal input supports multiple wiring configurations, enabling compatibility with a wide range of transmitter models from various manufacturers. The specific connection scheme is determined by the transmitter manufacturer.

Wiring configurations vary based on the number of conductors used—ranging from 2 to 4 wires—and whether a 24 V power supply for the transmitter is provided externally or internally.

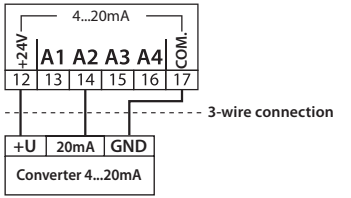
The following diagrams illustrate four possible wiring options for temperature transmitters, depending on manufacturer requirements.

Note: The primary temperature transducers are not shown in the diagrams. Refer to the transmitter manufacturer's documentation for detailed connection instructions.

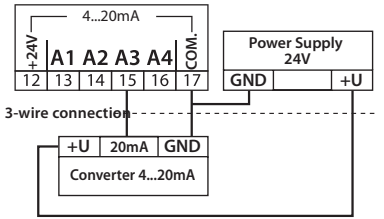
2-Wiring Diagram with Internal 24 V Power Supply



3-Wire Connection Diagram with Internal 24 V Power Supply



3-wire connection diagram with external 24 V Power supply



4-wire connection diagram with external 24 V Power supply

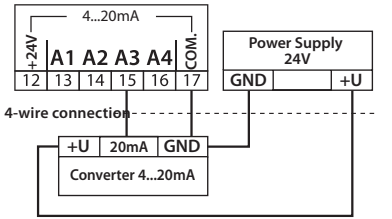
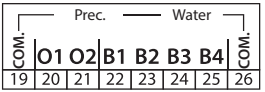


Figure 18. Connection Diagrams for 4–20 mA Signal Transmitters

2. Analog Inputs for Precipitation and Water Sensors (denoted as DO and DV, respectively)

2.1. Inputs for Precipitation Sensors.

2.2 Inputs for Water Sensors.



- Terminals 19 and 26 – Common terminals for connecting both precipitation and water sensors
- Terminals 20 and 21 – Terminals for connecting Precipitation Sensors No. 1 and No. 2, respectively
- Terminals 22, 23, 24, 25 – Terminals for connecting Water Sensors No. 1, 2, 3, and 4

Precipitation sensors (models TSP01, TSP02, and TSP03D) are connected to terminals 20 and 21 according to their specifications.

Water sensors (model TSW01) are connected to terminals 22, 23, 24, and 25.

3. Discrete Input "Defrost"

This discrete input is used when operating under the "ROOF/GROUND" algorithm. It is designed to initiate forced heating of roof surfaces, gutters, and other heated roof elements.

The input is activated by dry contact closure (e.g., latching button, relay contacts, etc.) – typically connected to a switch mounted on the door of the electrical heating control cabinet.

An indicator lamp labeled "Defrost" is also usually installed on the cabinet door. The lamp is powered from relay K0, according to the standard wiring diagram of the ROOF/GROUND algorithm.

4. Controller Power Supply Input

The controller operates on a single-phase power supply with a voltage range of 90–245 V, 50–60 Hz.

- The phase wire is connected to terminal 27
- The neutral wire is connected to terminal 28

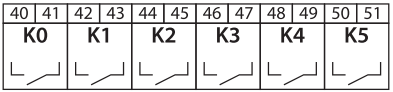
The number of input circuits is detailed in the table of main technical specifications of the temperature controller.

2.3.2. Relay Output Control Channels

The controller includes six relay output channels with normally open contacts.

- Relays K1, K2, K3, and K4 are used to control the heating load.
  Load current: up to 6 A at 230 V AC, 50–60 Hz
- Relay K5 is a fault relay, used for signaling sensor malfunctions.
  It can also be used for remote monitoring of sensor status.
  Load current: 6 A at 230 V AC, 50–60 Hz
- Relay K0 is used in the ROOF/GROUND algorithm to indicate the "Defrost" mode.
  An indicator lamp, mounted on the control cabinet door, is connected to relay K0.
  Load capacity of relay K0: 3 A at 230 V AC, 50–60 Hz

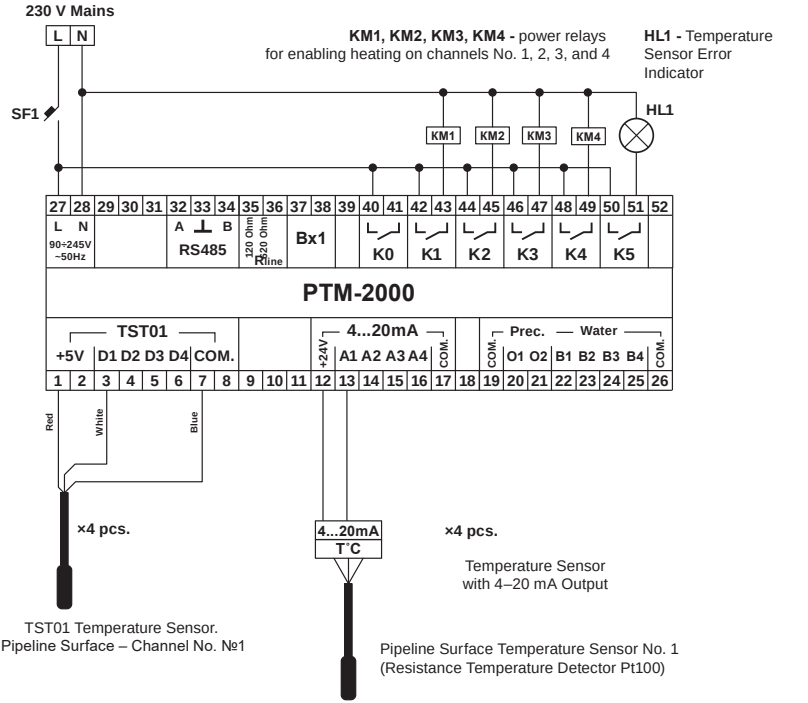
The figure below shows the terminal connections for relays K0 through K5.



Attention !

The relay output channels used for heating control have different functions depending on the selected operating algorithm.
Please refer carefully to the relevant chapters describing each algorithm to understand the specific purpose of each relay channel.

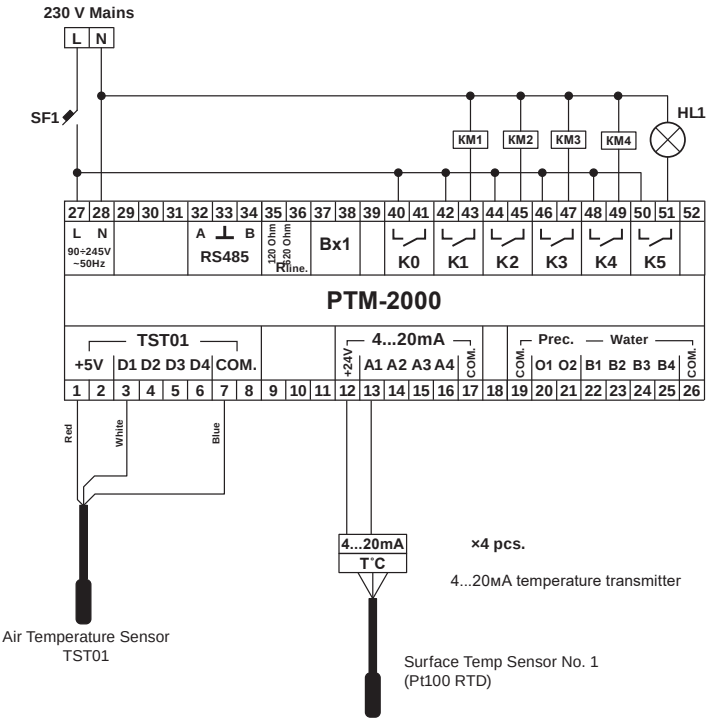
"PIPE" Algorithm



When operating in the "PIPE" algorithm, either TST01 temperature sensors or sensors with temperature transmitters providing a standard 4–20 mA output are used. The 4–20 mA input has priority over the TST01 input.

Figure 19. Typical Connection Diagram for the "PIPE" Algorithm

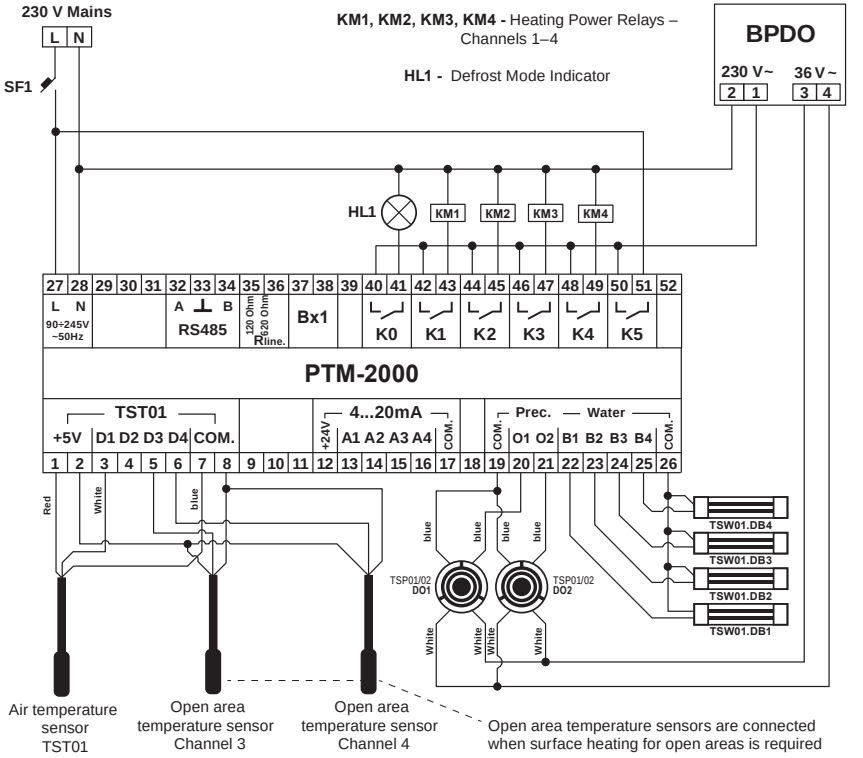
"PIPE+" Algorithm



When operating in the "PIPE+" algorithm, Input No. 1 for the TST01 temperature sensor is used to measure the ambient air temperature.
Inputs No. 1, 2, 3, and 4 with 4–20 mA current signal are used to monitor the surface temperature of pipelines No. 1, 2, 3, and 4, respectively.

Figure 20. Typical Connection Diagram for the "PIPE+" Algorithm

"ROOF / GROUND" Algorithm



When operating in the "ROOF / GROUND" algorithm, Input No. 1 for the TST01 temperature sensor is used to measure the ambient air temperature

Figure 21. Typical Connection Diagram for the "ROOF / GROUND" Algorithm

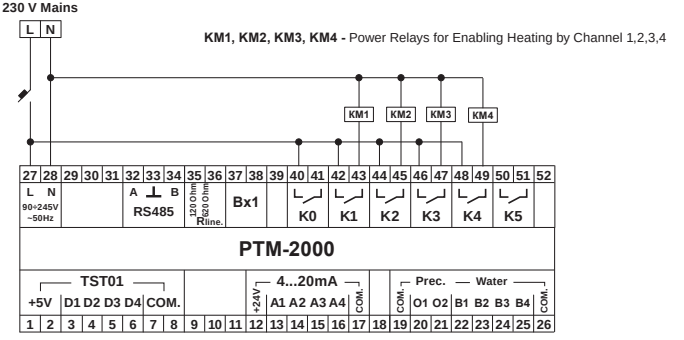


Figure 22. Typical Connection Diagram for the "TIMER" Algorithm

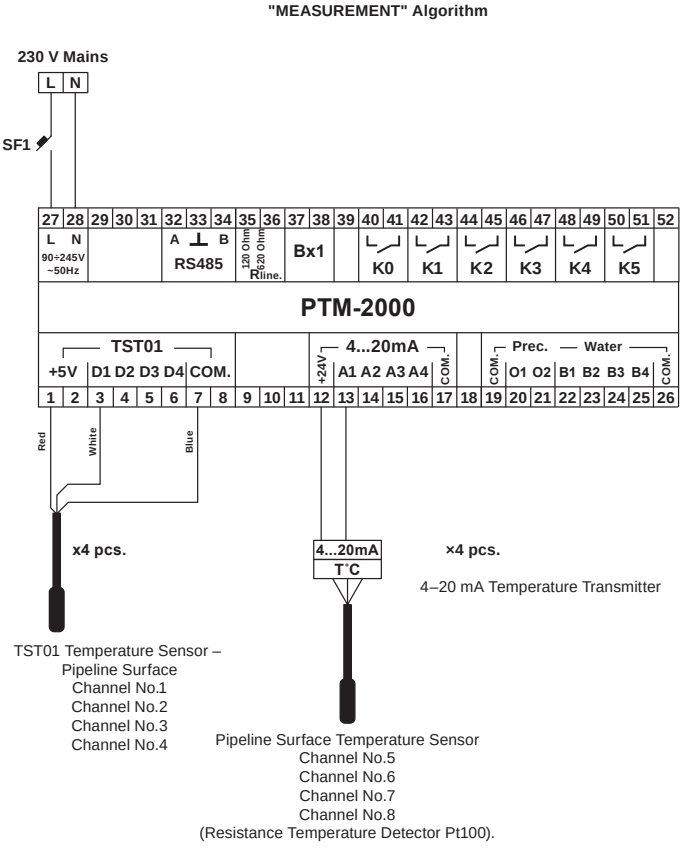


Figure 23. Typical Connection Diagram for the "MEASUREMENT" Algorithm

2.4. RS485 Communication Interface

The controller is equipped with a digital, galvanically isolated RS485 communication interface.
The isolation voltage is 1000 V DC. The interface uses the following signals for connection: A, B, and GND.
An internal resistor provides the option to connect line termination resistance, with the following selectable values: 620 Ohm, 120 Ohm, 100 Ohm, or Disabled.
Line termination is configured using a DIP switch consisting of two switches (1 and 2) with ON/OFF positions.
The table below shows the RS485 terminal numbers and switch positions corresponding to the selected line resistance values:

Table. 16.

The DIP switch is located next to the RS485 interface connection terminals 	
1-OFF_2-OFF	Disabled
1-ON_2-OFF	620 Ohm
1-OFF_2-ON	120 Ohm
1-ON_2-ON	100 Ohm

The data transmission speed can be configured via the controller's menu or remotely via the RS485 interface.
The standard baud rates supported are: 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 76800, 115200 bps.
The communication protocol used is MODBUS/RTU.
To change the current communication speed, navigate to the menu item: "RS485 INTERFACE" and select the desired baud rate.
Using the RS485 interface, the controller allows remote monitoring from a SCADA system, providing access to:

- All temperature parameters (both current and setpoints)
- Current operating parameters
- Status of the controller's relay outputs

The controller also allows remote modification of temperature setpoints, timer settings, and RS485 communication parameters via the interface.

An additional function of the RS485 interface is firmware updating of the controller.

Details regarding firmware updates and version changes can be found in the section titled "Firmware Update."

The data transmission speed for the interface is configured through the controller's menu

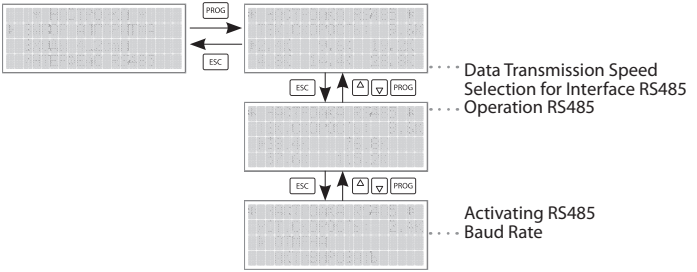


Figure 24. "INTERFACE" Indication Diagram.

2.4.1. Data Transmission Protocol. Internal Memory Map of the Controller

The PTM-2000 temperature controller supports the RS485 interface for communication with monitoring systems and can be easily integrated into existing SCADA systems.

The controller operates using the MODBUS/RTU communication protocol.

The memory map registers contain:

- All available current operating parameters of the controller
- Non-volatile memory parameters (user settings)
- Remote heating control registers

The remote heating control registers are designed for manual or remote control of the controller's four channels.

This functionality allows the controller to operate in manual mode, enabling remote activation/ deactivation of individual heating channels

The implemented MODBUS function codes are listed in Table 17.
Number notation: 0×0000 – numbers are represented in hexadecimal format.

Table 17. MODBUS Function Codes

Code	Name	Action
0×03	READ HOLDING REGISTERS	Reading the current parameters of one or more holding registers
0×10	FORCE MULTIPLE REGISTERS	Set new parameters to multiple consecutive registers

Main Communication Interface Parameters:

1. RS485 transmission medium
2. Baud rate – 9600 bps (default factory setting)
3. Operating mode – RTU (8-bit)
4. CRC16 checksum polynomial – 0×A001
5. Checksum transmission order – first byte: LOW, followed by HIGH
6. When accessed with the MODBUS address 0×00, the controller always responds, regardless of its actual address. In the response, the controller's assigned address is used in the address field.
7. The default MODBUS address of the controller is 255 (factory setting)..

Controller Memory Structure

The controller contains two memory areas:

- RAM (volatile memory)
- EEPROM (non-volatile memory)

Memory is structured via the address space:

1. RAM range: 0×0000…0×0100
2. EEPROM range: 0×0100…0×0200

- RAM stores current measurement values and real-time controller parameters.
- EEPROM stores user-defined configuration parameters.

Table 18: "Controller Memory Map" lists all register addresses used for reading and writing.
The RAM area is read-only, while EEPROM allows both reading and writing.

Table 18. Memory card

RAM Memory Area Only the following read command is supported: 0×03 – READ HOLDING REGISTERS		
The RAM memory area contains: Current measured temperature values, Measured water and precipitation sensor levels, Parameter values read from non-volatile EEPROM memory. For convenience, the left column of the table lists the names of the variables associated with each register. All registers are of type signed int, with a size of 16 bits.		
Register Name	**Memory Cell Address**	**Data Description**
Temp_Ch1_Mic	0×00	Current temperature from TST01 input No. 1
Temp_Ch1_Mic_10	0×01	Decimal value from TST01 input No. 1
Mull_Temp_Ch1_mic	0×02	Temperature scaling factor for TST01 input No. 1
Sost_Ch1_Mic	0×03	Status register of measurement channel TST01 input "D1" – sensor fault check 0×00 – Sensor OK 0×01 – Sensor fault detected
Temp_Ch2_Mic	0×04	Current temperature from TST01 input No. 2
Temp_Ch2_Mic_10	0×05	Decimal value from TST01 input No. 2
Mull_Temp_Ch2_mic	0×06	Temperature scaling factor for TST01 input No. 2
Sost_Ch2_Mic	0×07	Status register of measurement channel TST01 input "D2" – sensor fault check 0×00 – Sensor OK 0×01 – Sensor fault detected
Temp_Ch3_Mic	0×08	Current temperature from TST01 input No.3
Temp_Ch3_Mic_10	0×09	Decimal value from TST01 input No. 3
Mull_Temp_Ch3_mic	0×0A	Temperature scaling factor for TST01 input No. 3
Sost_Ch3_Mic	0×0B	Status register of measurement channel TST01 input "D3" – sensor fault check 0×00 – Sensor OK 0×01 – Sensor fault detected
Temp_Ch4_Mic	0×0C	Current temperature from TST01 input No 4
Temp_Ch4_Mic_10	0×0D	Decimal value from TST01 input No. 4
Mull_Temp_Ch4_mic	0×0E	Temperature scaling factor for TST01 input No. 4
Sost_Ch4_Mic	0×0F	Status register of measurement channel TST01 input "D4" – sensor fault check 0×00 – Sensor OK 0×01 – Sensor fault detected
Temp_Ch1_420	0×10	Measured and calculated temperature from 4–20 mA input, Channel No. 1

Temp_Ch1_420_10	0×11	Decimal value of measured and calculated temperature from 4–20 mA input, Channel No. 1
Mull_Temp_Ch1_420	0×12	Temperature scaling factor for 4–20 mA input, Channel No. 1
Sost_Temp_Ch1_420	0×13	Status register of 4–20 mA input channel "A1" – sensor fault check 0×00 – Sensor OK 0×01 – Sensor fault detected
Temp_Ch2_420	0×14	Temperature scaling factor for 4–20 mA input, Channel No 2
Temp_Ch2_420_10	0×15	Decimal value of measured and calculated temperature from 4–20 mA input, Channel No.2
Mull_Temp_Ch2_420	0×16	Temperature scaling factor for 4–20 mA input, Channel No 2
Sost_Temp_Ch2_420	0×17	Status register of 4–20 mA input channel "A2" – sensor fault check 0×00 – Sensor OK 0×01 – Sensor fault detected
Temp_Ch3_420	0×18	Measured and calculated temperature from 4–20 mA input, Channel No. 3
Temp_Ch3_420_10	0×19	Decimal value of measured and calculated temperature from 4–20 mA input, Channel No 3
Mull_Temp_Ch3_420	0×1A	Temperature scaling factor for 4–20 mA input, Channel No 3
Sost_Temp_Ch3_420	0×1B	Status register of 4–20 mA input channel "A3" – sensor fault check 0×00 – Sensor OK 0×01 – Sensor fault detected
Temp_Ch4_420	0×1C	Measured and calculated temperature from 4–20 mA input, Channel No. 4
Temp_Ch4_420_10	0×1D	Decimal value of measured and calculated temperature from 4–20 mA input, Channel No.4
Mull_Temp_Ch4_420	0×1E	Temperature scaling factor for 4–20 mA input, Channel No 4
Sost_Temp_Ch4_420	0×1F	Status register of 4–20 mA input channel "A4" – sensor fault check 0×00 – Sensor OK 0×01 – Sensor fault detected

Global_Temper_Air	0×20	Current global measured temperatures used by all algorithms. Temperature is represented as an integer part and a decimal part. Air temperature. Channels: No. 1, 2, 3, 4
Global_Temper_10_Air	0×21	
Global_Temper_Ch1	0×22	
Global_Temper_10_Ch1	0×23	
Global_Temper_Ch2	0×24	
Global_Temper_10_Ch2	0×25	
Global_Temper_Ch3	0×26	
Global_Temper_10_Ch3	0×27	
Global_Temper_Ch4	0×28	
Global_Temper_10_Ch4	0×29	
Current_Temp_Set_Ch1_On_Tstab	0×2A	Set surface maintenance temperature for the PIPE algorithm — activation and deactivation temperatures. Channels: No. 1, 2, 3, 4 Read values retrieved from EEPROM memory
Current_Temp_Set_Ch1_Off_Tstab	0×2B	
Current_Temp_Set_Ch2_On_Tstab	0×2C	
Current_Temp_Set_Ch2_Off_Tstab	0×2D	
Current_Temp_Set_Ch3_On_Tstab	0×2E	
Current_Temp_Set_Ch3_Off_Tstab	0×2F	
Current_Temp_Set_Ch4_On_Tstab	0×30	
Current_Temp_Set_Ch4_Off_Tstab	0×31	
Current_Temp_Set_Air_Min_Pstab_Ch1	0×32	Set minimum air temperature for the PIPE+ algorithm. Channels: No. 1, 2, 3, 4 Read values retrieved from EEPROM memory
Current_Temp_Set_Air_Min_Pstab_Ch2	0×33	
Current_Temp_Set_Air_Min_Pstab_Ch3	0×34	
Current_Temp_Set_Air_Min_Pstab_Ch4	0×35	
Current_Temp_Set_Ch1_On_Pstab	0×36	Set surface maintenance temperature for the PIPE+ algorithm — activation and deactivation temperatures. Channels: No. 1, 2, 3, 4 Read values retrieved from EEPROM memory
Current_Temp_Set_Ch1_Off_Pstab	0×37	
Current_Temp_Set_Ch2_On_Pstab	0×38	
Current_Temp_Set_Ch2_Off_Pstab	0×39	
Current_Temp_Set_Ch3_On_Pstab	0×3A	
Current_Temp_Set_Ch3_Off_Pstab	0×3B	
Current_Temp_Set_Ch4_On_Pstab	0×3C	
Current_Temp_Set_Ch4_Off_Pstab	0×3D	

Current_Temp_Set_Low_420_Ch1	0×3E	Set temperatures for the operation of the 4–20 mA analog input. Upper and lower limits of the measurement range. For 4–20 mA measurement channels No. 1, 2, 3, and 4 Read values retrieved from EEPROM memory
Current_Temp_Set_High_420_Ch1	0×3F	
Current_Temp_Set_Low_420_Ch2	0×40	
Current_Temp_Set_High_420_Ch2	0×41	
Current_Temp_Set_Low_420_Ch3	0×42	
Current_Temp_Set_High_420_Ch3	0×43	
Current_Temp_Set_Low_420_Ch4	0×44	
Current_Temp_Set_High_420_Ch4	0×45	
Current_Set_Teploskat_Air_Min	0×46	Set minimum and maximum air temperature for the "ROOF/GROUND" operation algorithm. Read values retrieved from EEPROM memory
Current_Set_Teploskat_Air_Max	0×47	
Current_Set_Teploskat_Osad_Ch1	0×48	Set sensitivity level of the precipitation sensor for control channels No. 1 and No. 2 (inputs "O1" and "O2"). Read values retrieved from EEPROM memory
Current_Set_Teploskat_Osad_Ch2	0×49	
Current_Set_Teploskat_Osad_On_Off_Ch1	0×4A	Enabled/disabled state of the precipitation sensor for inputs "O1" and "O2". Read values retrieved from EEPROM memory
Current_Set_Teploskat_Osad_On_Off_Ch2	0×4B	
Current_Set_Teploskat_Water_Ch1	0×4C	Set sensitivity level of the water sensor for control channels No. 1, 2, 3, and 4 For inputs: "DB1", "DB2", "DB3", and "DB4" Read values retrieved from EEPROM memory
Current_Set_Teploskat_Water_Ch2	0×4D	
Current_Set_Teploskat_Water_Ch3	0×4E	
Current_Set_Teploskat_Water_Ch4	0×4F	
Current_Set_Teploskat_Water_On_Off_Ch1	0×50	Water sensor state for the "ROOF/GROUND" algorithm. Channels: No. 1, 2, 3, 4 Read values retrieved from EEPROM memory
Current_Set_Teploskat_Water_On_Off_Ch2	0×51	
Current_Set_Teploskat_Water_On_Off_Ch3	0×52	
Current_Set_Teploskat_Water_On_Off_Ch4	0×53	
Current_Set_Teploskat_Time_Delay_Ch1	0×54	Current set delay time per channel for the "WARM ROOF" algorithm. Channels: No. 1, 2, 3, 4 Read values retrieved from EEPROM memory
Current_Set_Teploskat_Time_Delay_Ch2	0×55	
Current_Set_Teploskat_Time_Delay_Ch3	0×56	
Current_Set_Teploskat_Time_Delay_Ch4	0×57	
Current_Set_Teplodor_Temp_Ch3	0×58	Set surface control temperature for the "ROOF/GROUND" operation algorithm. Control channels: No. 3 and 4 Read values retrieved from EEPROM memory
Current_Set_Teplodor_Temp_Ch4	0×59	
Current_Osad_Ch1	0×5A	Current measured values from precipitation sensors. Inputs: "O1" and "O2"
Current_Osad_Ch2	0×5B	

Current_Water_Ch1	0×5C	Current measured values from water sensors. Inputs: "B1", "B2", "B3", and "B4"
Current_Water_Ch2	0×5D	
Current_Water_Ch3	0×5E	
Current_Water_Ch4	0×5F	
Timer_Water_Skat_Air	0×60	Air preheat timer (self-use timer)
Timer_Water_Skat_Ch1	0×61	Delay countdown timer in the "ROOF/GROUND" control algorithm for managing control channels No. 1, 2, 3, and 4
Timer_Water_Skat_Ch2	0×62	
Timer_Water_Skat_Ch3	0×63	
Timer_Water_Skat_Ch4	0×64	
Timer_Water_Dor_Air	0×65	Internal service registers
Timer_Water_Dor_Ch1	0×66	
Timer_Water_Dor_Ch2	0×67	
Timer_Water_Dor_Ch3	0×68	
Timer_Water_Dor_Ch4	0×69	
Timer_Full_Cycle_Ch1	0×6A	For the "PIPE+" algorithm: Timer for calculating the full 100% operation cycle time and timer for calculating relay ON duration Channels No. 1, 2, 3, 4
Timer_On_Cycle_Ch1	0×6B	
Timer_Full_Cycle_Ch2	0×6C	
Timer_On_Cycle_Ch2	0×6D	
Timer_Full_Cycle_Ch3	0×6E	
Timer_On_Cycle_Ch3	0×6F	
Timer_Full_Cycle_Ch4	0×70	
Timer_On_Cycle_Ch4	0×71	
T_Timer_Full_Cycle_Ch1	0×72	For the "TIMER" algorithm: Timers for calculating the full 100% operation cycle duration and timers for calculating relay ON duration Channels: No. 1, 2, 3, 4
T_Timer_On_Cycle_Ch1	0×73	
T_Timer_Full_Cycle_Ch2	0×74	
T_Timer_On_Cycle_Ch2	0×75	
T_Timer_Full_Cycle_Ch3	0×76	
T_Timer_On_Cycle_Ch3	0×77	
T_Timer_Full_Cycle_Ch4	0×78	
T_Timer_On_Cycle_Ch4	0×79	
Time_Full_Cycle_Ch1	0×7A	Set full cycle time, "PIPE+" algorithm. Channels: No. 1, 2, 3, 4
Time_Full_Cycle_Ch2	0×7B	
Time_Full_Cycle_Ch3	0×7C	
Time_Full_Cycle_Ch4	0×7D	

T_Time_Full_Cycle_Ch1	0×7E	Set full cycle time at 100% power for the "TIMER" algorithm. Channels: No. 1, 2, 3, 4
T_Time_Full_Cycle_Ch2	0×7F	
T_Time_Full_Cycle_Ch3	0×80	
T_Time_Full_Cycle_Ch4	0×81	
T_Current_Percent_Ch1	0×82	Set time value according to the configured power percentage For the "TIMER" algorithm. Channels: No. 1, 2, 3, 4
T_Current_Percent_Ch2	0×83	
T_Current_Percent_Ch3	0×84	
T_Current_Percent_Ch4	0×85	
Current_Percent_Ch1	0×86	Current power percentage for the 4 channels in the PIPE+ algorithm. Channels: No. 1, 2, 3, 4
Current_Percent_Ch2	0×87	
Current_Percent_Ch3	0×88	
Current_Percent_Ch4	0×89	
Current_Speed_RS485	0×8A	Current configured RS485 interface communication speed
Speed_RS485_Set_Lcd	0×8B	Currently selected (but not yet applied) RS485 communication speed
Number_Modbus_RS485	0×8C	Current device address on the MODBUS network
Number_Modbus_RS485_Set_Lcd	0×8D	Internal service registers
Input_First_Snow	0×8E	Current defrost input state: 0×0000 – NO defrost, 0×FFFF – DEFROST active
Data_On_Off_1	0×8F	Status of one of the 4 inputs for ON/OFF state detection. PIPE, PIPE+ algorithms. Channels: No. 1, 2, 3, 4
Data_On_Off_2	0×90	
Data_On_Off_3	0×91	
Data_On_Off_4	0×92	
Type_Lang	0×93	Menu language selection for the controller
	0×94	Internal service registers
	0×95	
	0×96	
	0×97	
	0×98	
	0×99	
	0×9A	
	0×9B	
	0×9C	
	0×9D	
	0×9E	

Manual_Ctrl_Teploskat	0×9F	Current state of automatic/manual control for the "ROOF/GROUND" algorithm
Manual_Ctrl_Channel_1	0×A0	Control channel status register indicating “automatic/manual” control mode for relay channels No. 1, 2, 3, 4 0 – automatic control, 1 – manual control
Manual_Ctrl_Channel_2	0×A1	
Manual_Ctrl_Channel_3	0×A2	
Manual_Ctrl_Channel_4	0×A3	
Delta_Alarm_Temp_Ch_1	0×A4	Delta Value for Detecting Underheating / Overheating (Channels 1,2,3,4)
Delta_Alarm_Temp_Ch_2	0×A5	
Delta_Alarm_Temp_Ch_3	0×A6	
Delta_Alarm_Temp_Ch_4	0×A7	
Alarm_Heat_Cold_Ch_1	0×A8	Overheating or Underheating Status for 4 Channels with PIPE / PIPE + Control Algorithms Channel numbers: 1, 2, 3, 4 0 – Normal condition; no overheating or underheating detected. 1 – Overheating or underheating detected.
Alarm_Heat_Cold_Ch_2	0×A9	
Alarm_Heat_Cold_Ch_3	0×AA	
Alarm_Heat_Cold_Ch_4	0×AB	
Manual_Sost_Rele_1	0×AC	Relay Control Status Register for Manual Relay Control 0 – Relay is OFF. 1 – Relay is ON. Regardless of the active algorithm. Channels No. 1, 2, 3, 4.
Manual_Sost_Rele_2	0×AD	
Manual_Sost_Rele_3	0×AE	
Manual_Sost_Rele_4	0×AF	
Global_Sost_Rele_0	0×B0	Relay Control Status Register for Manual Relay Control 0 – Relay is OFF. 1 – Relay is ON. Regardless of the active algorithm. Channels No. 1, 2, 3, 4.
Global_Sost_Rele_1	0×B1	
Global_Sost_Rele_2	0×B2	
Global_Sost_Rele_3	0×B3	
Global_Sost_Rele_4	0×B4	
Global_Sost_Rele_5	0×B5	

EEPROM Memory Area

The following commands are used:
«0×03 – READ HOLDING REGISTERS»,
«0×10 – FORCE MULTIPLE REGISTERS»

Register Name	Memory Cell Address	Data Description
Addres_Set_Temp_Low_420_Ch1	0×0100	Set temperatures for operation of the measuring input with a standardized 4–20 mA signal. Upper and lower measurement range values. By measurement channels of the standardized 4–20 mA signal. Channels: No. 1, 2, 3, 4. Factory setting: Low_420 = –50°C, High_420 = +200°C
Addres_Set_Temp_High_420_Ch1	0×0101	
Addres_Set_Temp_Low_420_Ch2	0×0102	
Addres_Set_Temp_High_420_Ch2	0×0103	
Addres_Set_Temp_Low_420_Ch3	0×0104	
Addres_Set_Temp_High_420_Ch3	0×0105	
Addres_Set_Temp_Low_420_Ch4	0×0106	
Addres_Set_Temp_High_420_Ch4	0×0107	
Addres_Set_Temp_Tstab_On_Ch1	0×0108	Set surface maintenance temperature for the PIPE algorithm. Turn-on temperature and turn-off temperature. Channels: No. 1, 2, 3, 4. Factory settings: Tstab_On = +10°C, Tstab_Off = +15°C.
Addres_Set_Temp_Tstab_Off_Ch1	0×0109	
Addres_Set_Temp_Tstab_On_Ch2	0×010A	
Addres_Set_Temp_Tstab_Off_Ch2	0×010B	
Addres_Set_Temp_Tstab_On_Ch3	0×010C	
Addres_Set_Temp_Tstab_Off_Ch3	0×010D	
Addres_Set_Temp_Tstab_On_Ch4	0×010E	
Addres_Set_Temp_Tstab_Off_Ch4	0×010F	
Addres_Set_Temp_Pstab_On_Ch1	0×0110	Set surface maintenance temperature for the PIPE+ algorithm. Turn-on temperature and turn-off temperature. Channels: No. 1, 2, 3, 4. Factory settings: Pstab_On = +10°C, Pstab_Off = +15°C.
Addres_Set_Temp_Pstab_Off_Ch1	0×0111	
Addres_Set_Temp_Pstab_On_Ch2	0×0112	
Addres_Set_Temp_Pstab_Off_Ch2	0×0113	
Addres_Set_Temp_Pstab_On_Ch3	0×0114	
Addres_Set_Temp_Pstab_Off_Ch3	0×0115	
Addres_Set_Temp_Pstab_On_Ch4	0×0116	
Addres_Set_Temp_Pstab_Off_Ch4	0×0117	

Addres_Set_Temp_Pstab_Air_Min_Ch1	0×0118	Register for setting minimum air temperature. Algorithm: "PIPE+". Channels: No. 1, 2, 3, 4. Factory setting: Air_Min = –20°C Allowed value range: –50°C to +60°C.
Addres_Set_Temp_Pstab_Air_Min_Ch2	0×0119	
Addres_Set_Temp_Pstab_Air_Min_Ch3	0×011A	
Addres_Set_Temp_Pstab_Air_Min_Ch4	0×011B	
Addres_Set_Temp_Pstab_Time_Ch1	0×011C	Register for setting the time period in minutes for 100% power. Algorithm: "PIPE+". Channels: No. 1, 2, 3, 4. Allowed value range: 10…100 minutes. Factory setting: Pstab_Time = 60 minutes.
Addres_Set_Temp_Pstab_Time_Ch2	0×011D	
Addres_Set_Temp_Pstab_Time_Ch3	0×011E	
Addres_Set_Temp_Pstab_Time_Ch4	0×011F	
Addres_Set_Timer_Time_Ch1	0×0120	Register for setting the time period in minutes for 100% power. Algorithm: "TIMER". Channels: No. 1, 2, 3, 4. Allowed value range: 10…100 minutes. Factory setting: Pstab_Time = 60 minutes.
Addres_Set_Timer_Time_Ch2	0×0121	
Addres_Set_Timer_Time_Ch3	0×0122	
Addres_Set_Timer_Time_Ch4	0×0123	
Addres_Set_Timer_Percent_Ch1	0×0124	Register for setting the power percentage. Algorithm: "TIMER". Channels: No. 1, 2, 3, 4. Factory setting: Timer_Percent = 50%.
Addres_Set_Timer_Percent_Ch2	0×0125	
Addres_Set_Timer_Percent_Ch3	0×0126	
Addres_Set_Timer_Percent_Ch4	0×0127	
Addres_Set_Channel_On_Off_1	0×0128	Register for enabled/disabled temperature sensor monitoring. Algorithm: "PIPE" and "PIPE+". Channels: No. 1, 2, 3, 4. 0xFF – Channels enabled (default value); 0x00 – Channels disabled. Factory setting: Set_Channel_On_Off = 0x00. These registers control relay "K5," which signals a sensor fault. Note: If a channel is enabled but the sensor for that channel is not connected, relay "K5" will be turned on.
Addres_Set_Channel_On_Off_2	0×0129	
Addres_Set_Channel_On_Off_3	0×012A	
Addres_Set_Channel_On_Off_4	0×012B	
Addres_Type_Work_Device	0×012C	Register for setting the controller operation algorithm variant: 0x00 – algorithm "MEASURER". 0x01 – algorithm "PIPE". 0x02 – algorithm "PIPE+". 0x03 – algorithm "ROOF/ROAD". 0x04 – algorithm "TIMER"

<table>
<tr><td>Addres_Speed_RS485</td><td>0×012D</td><td>Register for setting the data communication speed on the RS485 interface.
<table><tr><th>Bit rate (bits per second)</th><th>Register Value</th></tr><tr><td>Speed_RS485_2400</td><td>0×00</td></tr><tr><td>Speed_RS485_4800</td><td>0×01</td></tr><tr><td>Speed_RS485_9600</td><td>0×02</td></tr><tr><td>Speed_RS485_14400</td><td>0×03</td></tr><tr><td>Speed_RS485_19200</td><td>0×04</td></tr><tr><td>Speed_RS485_28800</td><td>0×05</td></tr><tr><td>Speed_RS485_38400</td><td>0×06</td></tr><tr><td>Speed_RS485_57600</td><td>0×07</td></tr><tr><td>Speed_RS485_76800</td><td>0×08</td></tr><tr><td>Speed_RS485_115200</td><td>0×09</td></tr></table>Factory setting: Speed_RS485 = 0x02, 9600 bits per second.</td></tr>
<tr><td>Addres_Number_Modbus</td><td>0×012E</td><td>Register for device address in the MODBUS/RTU network.
Factory setting: Number_Modbus = 0xFF.
Allowed value range: 0x01…0xFF.</td></tr>
<tr><td>Addres_Teploskat_Air_Min</td><td>0×012F</td><td rowspan="2">Registers for setting the minimum and maximum air temperature. Algorithm: "ROOF/ROAD".
Factory settings:
Air_Min = –15°C
Air_Max = +5°C</td></tr>
<tr><td>Addres_Teploskat_Air_Max</td><td>0×0130</td></tr>
<tr><td>Addres_Teploskat_Sens_Osad_Ch1</td><td>0×0131</td><td rowspan="2">Registers for setting precipitation sensor sensitivity. Algorithm: "ROOF/ROAD".
For inputs: "O1"… "O4".
Possible value range: 0…9 units.
Value "0" – maximum sensitivity level. Value "9" – minimum sensitivity level.
Factory setting: Sens_Osad = 0x05.</td></tr>
<tr><td>Addres_Teploskat_Sens_Osad_Ch2</td><td>0×0132</td></tr>
<tr><td>Addres_Teploskat_Sens_Water_Ch1</td><td>0×0133</td><td rowspan="4">Registers for setting precipitation sensor sensitivity. Algorithm: "ROOF/ROAD".
For inputs: "B1"… "B4".
Allowed sensitivity value range: 0x00…0x09. Value "0" — maximum sensitivity level.
Value "9" — minimum sensitivity level.
Factory setting: Sens_Water = 0x05.</td></tr>
<tr><td>Addres_Teploskat_Sens_Water_Ch2</td><td>0×0134</td></tr>
<tr><td>Addres_Teploskat_Sens_Water_Ch3</td><td>0×0135</td></tr>
<tr><td>Addres_Teploskat_Sens_Water_Ch4</td><td>0×0136</td></tr>
</table>

Addres_Teploskat_Time_Delay_Ch1	0×0137	Registers for heating shut-off delay time (overheating time). Algorithm: "ROOF/ROAD". Channels No. 1, 2, 3, 4. Allowed value range: 0…180 minutes. Adjustment step: 10 minutes. Factory setting: Sens_Osad (Precepitations) = 30 minutes.
Addres_Teploskat_Time_Delay_Ch2	0×0138	
Addres_Teploskat_Time_Delay_Ch3	0×0139	
Addres_Teploskat_Time_Delay_Ch4	0×013A	
Addres_Teploskat_Sens_Osad_On_Off_Ch1	0×013B	Register for enabling/disabling precipitation sensors on inputs "O1" and "O2". Algorithm: "ROOF/ROAD". Values: 0x00 – sensor disabled 0xFF – sensor enabled Factory setting: Sens_Osad_On_Off = 0x00.
Addres_Teploskat_Sens_Osad_On_Off_Ch2	0×013C	
Addres_Teploskat_Sens_Water_On_Off_Ch1	0×013D	Register for enabling/disabling meltwater sensors "B1"… "B4". Values: 0x00 – sensor disabled 0xFF – sensor enabled Factory setting: Sens_Water_On_Off = 0x00. Algorithm: "ROOF/ROAD"
Addres_Teploskat_Sens_Water_On_Off_Ch2	0×013E	
Addres_Teploskat_Sens_Water_On_Off_Ch3	0×013F	
Addres_Teploskat_Sens_Water_On_Off_Ch4	0×0140	
Addres_Teplodor_Sens_Temp_Ch3	0×0141	Register for setting the temperature to maintain open areas. Algorithm: "ROOF/ROAD". Temperature channels: No. 3, No. 4, sensor type TST01. Factory setting: Teplodor_Sens_Temp = –5°C.
Addres_Teplodor_Sens_Temp_Ch4	0×0142	
Addres_Mull_Temp_Ch1_mic	0×0143	Register address for storing the temperature multiplier for TST01 inputs, "D1"..."D4" 0×00 – the temperature value is multiplied by 1. 0×01 – the temperature value is multiplied by 10. 0×02 – the temperature value is multiplied by 100. Channels No. 1, 2, 3, 4. Factory setting: Mull_Temp_Ch_mic = 0×00.
Addres_Mull_Temp_Ch2_mic	0×0144	
Addres_Mull_Temp_Ch3_mic	0×0145	
Addres_Mull_Temp_Ch4_mic	0×0146	
Addres_Mull_Temp_Ch1_420	0×0147	Register address for storing the temperature multiplier for 4…20 mA inputs, "A1"..."A4" 0×00 – the temperature value is multiplied by 1. 0×01 – the temperature value is multiplied by 10. 0×02 – the temperature value is multiplied by 100. Channels No. 1, 2, 3, 4. Factory setting: Mull_Temp_Ch_420 = 0×00.
Addres_Mull_Temp_Ch2_420	0×0148	
Addres_Mull_Temp_Ch3_420	0×0149	
Addres_Mull_Temp_Ch4_420	0×014A	

Addres_Delta_Alarm_Temp_Ch_1	0×014B	Register address for storing the temperature delta for "overheating / underheating" of the heated object. Algorithm: "PIPE" and "PIPE+". Channels: No. 1, 2, 3, 4. Factory setting: Delta_Alarm_Temp = 30°C. Allowed value range: 0…30°C.
Addres_Delta_Alarm_Temp_Ch_2	0×014C	
Addres_Delta_Alarm_Temp_Ch_3	0×014D	
Addres_Delta_Alarm_Temp_Ch_4	0×014E	
Addres_Manual_Ctrl_Channel_1	0×014F	Register address for managing the channel state for "manual or automatic" control. Channels: No. 1, 2, 3, 4. Values: 0×00 – automatic control according to the selected algorithm. 0×01 – manual control via RS485. Factory setting: Manual_Ctrl_Channel = 0×00. Not applicable for the "ROOF/GROUND" algorithm.
Addres_Manual_Ctrl_Channel_2	0×0150	
Addres_Manual_Ctrl_Channel_3	0×0151	
Addres_Manual_Ctrl_Channel_4	0×0152	
Addres_Manual_Ctrl_Teploskat	0×0153	Register address for controlling the channel state in terms of "manual or automatic" control. Values: 0×00 – automatic control according to the selected algorithm. 0×01 – manual control via RS485. Factory setting: Manual_Ctrl_Channel = 0×00. Only applicable for the "ROOF/GROUND" algorithm.
	0×0154	Not in use
Addres_Type_Lang	0×0155	Register for setting the menu language type of the controller. Values: 0×00 – English-language controller menu

2.4.2. Firmware Update

The firmware update of the RTM-2000 temperature controller is performed via the RS485 interface terminals, terminal numbers: 32, 33, and 34.

The following software and equipment are required for the update:

- Chip45boot2 GUI V1.12 software
- RS232 (USB) to RS485 interface converter
- Firmware file

Procedure:

1. Connect the RTM-2000 temperature controller to the interface converter using RS485 terminals 32, 33, and 34.
2. Connect the interface converter to a personal computer.
3. Power on the RTM-2000 temperature controller.
4. Launch the "Chip45boot2 GUI V1.12" software (see Fig. 25);

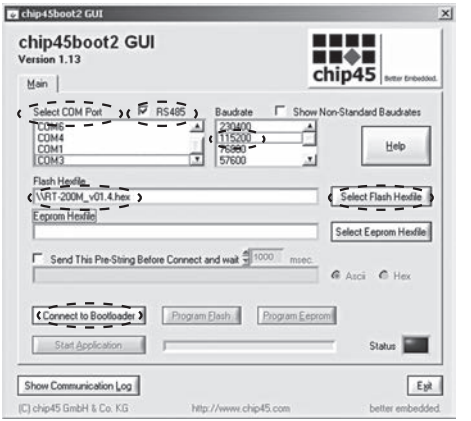


Figure 25.

5. Set all the parameters as shown in Figure 25:
   5.1 Select the appropriate COM port number.
   5.1 Check the RS485 option.
   5.1 Set the port speed to 115200 bps.
6. Click the "Select Flash Hexfiles" button and choose the latest firmware file for the RTM-2000 temperature controller: RTM-2000_vX.X.hex, see Figure 25;
7. Go to the "Factory Settings" menu and position the cursor on "Version Selection," see Figure 26;

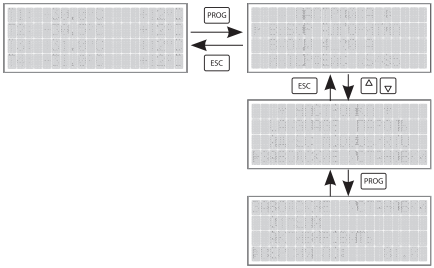


Figure 26.

8. Press the "PROG" button on the controller. A new window will appear on the controller display (see Fig. 27);

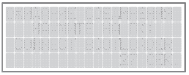


Figure 27.

9. Within 30 seconds, click the "Connect to Bootloader" button (see Fig. 25);
10. Verify that the program is connected to the controller — the message "Connected" and a green indicator should appear (see Fig. 28);

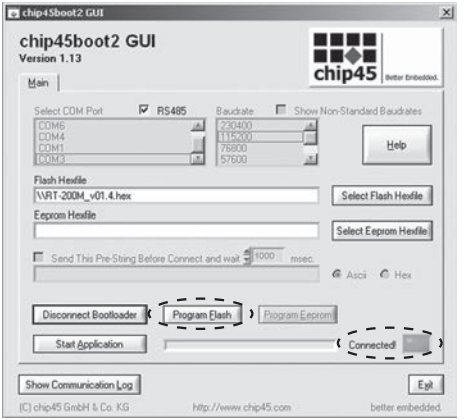


Figure 28.

11. A window will appear on the controller display (see Fig. 29);

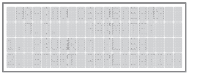


Figure 29.

12. Press button «Program Flash»;

13. Monitor the loading process for any "freezing" — the status should show "Uploading" along with a yellow indicator (see Fig. 30);
14. Ensure the upload is complete — a full blue progress bar and the message "DONE!" with a green indicator should appear (see Fig. 31);
15. Click "Start Application" (see Fig. 31).

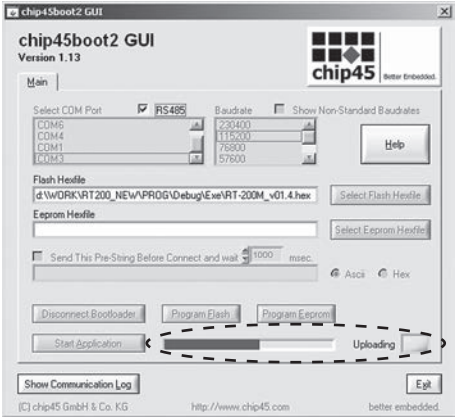


Figure 30.

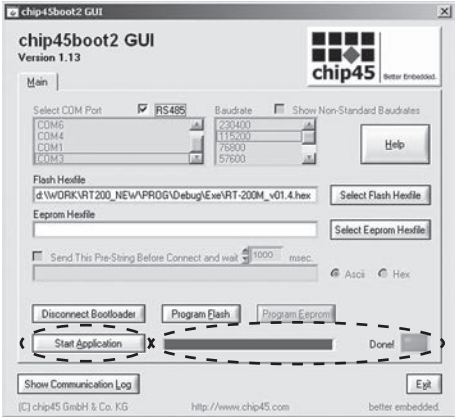


Figure 31.

16. A window will appear on the controller display (see Fig. 32);

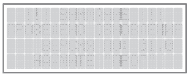


Figure 32.

17. Make sure the updated firmware version number is displayed on the controller screen;
18. Press the "PROG" button on the controller. The firmware update is complete.

3. TECHNICAL SPECIFICATIONS

Supply Voltage	90…245 V, ~50…60 Hz.
Power Consumption	Not more than 12 W
Relay Output Channels	6 channels: – 4 control channels – 1 alarm channel – 1 indication channel
Control relay load current	6A / 230V, ~50…60Hz: relay K1...K5.
Indicator channel relay load current	3A / 230V, ~50…60Hz: relay K0.
Relay contact type	Normally open.
Number of temperature measurement channel	8 channels: – 4 TST01 sensors Sensing element: DS18S20 – 4 analog signals: 4…20 mA
TST01 sensor cable length	Maximum: 100m.
TST01 temperature measurement range	-55 °C … +125 °C
TST01 temperature measurement accuracy	0,5 °C
4…20 mA signal cable length:	Up to 1000 meters.
4…20 mA signal measurement range	-100 °C … +600 °C
ADC resolution for 4…20 mA signal:	12-bit
Temperature measurement accuracy from 4…20 mA signal	0,1°C
Power supply output for 4…20 mA transmitter	24 V / 150 mA (short-circuit protection)
Load for 4…20 mA current signal:	Built-In.
Load resistance for 4…20 mA signal:	120 Ohm.
Number of channels for water and precipitation sensors (WS and PS respectively)	6 channels – 2 persipitation sensor. – 4 water sensor
Resistance range for WS and PS measurement	120 kOhm … 2,2 MOhm.
Number of sensitivity levels for WS and PS sensors	9 levels
Number of digital inputs	1 input
Communication interface	RS485
Galvanic isolation of RS485 interface	1000 V, constant voltage

Communication protocol	MOD_BUS / RTU.
Data transfer rate via RS485 interface	bit/sec: 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 76800, 115200.
RS485 interface line termination resistance	620 Ohm, 120 Ohm, 100 Ohm, and disabled
Control algorithms	PIPE, PIPEA+, ROOF/ROAD, Timer, Measurement
Temperature setpoint accuracy	1 °C
Temperature setpoint range – PIPE	-100 °C … +600 °C
Alarm relay for temperature sensor failure – PIPE	Relay K5.
Temperature setpoint range – PIPE+: By air: By surface:	 -55 °C … +60 °C -45 °C … +600 °C
Full cycle time range for 100% power – PIPE+	30 … 100 minutes
Alarm relay for temperature sensor failure – PIPE+	Relay K5.
Temperature setpoint range – ROOF/GROUND: By air: By surface:	 -50 °C … +65 °C -20 °C … +20 °C
Heating shutdown delay timer range	0 … 180 minutes
Preheating time upon entering the specified air temperature range	180 minutes
Defrost mode indication channel	Relaye K0.
Anti-icing zone control relay:	Relay K1…K4
Air temperature range relay	Relay K5
TIMER mode parameter setting ranges: Full cycle duration: Power setting percentage:	 10 … 100 minutes. 10 … 90 %.

Number of temperature measurement channels – MEASUREMENT	8 channels, 4 TST01 sensor channels 4 analog 4…20 mA sensor channels
Control relay	All channels are not in use.
Backlit indicator	Character display, "FSTN". 4 lines, 20 characters per line.
Indicator backlight color	White
Cross-section of conductors for connection to the controller terminals	Up to 2,5 mm^2.
Enclosure protection rating	IP20
Operating temperature range	+0 °C … +45 °C
Overall dimensions	160 × 90 × 60 mm
Mounting type	DIN rail, 35 mm Size: 9 modules
Housing color	Light gray housing Black base enclosure
Weight	Not more than 450 g
Service life	At least 10 years

4. CONFIGURING THE 4–20 MA STANDARD SIGNAL INPUT

Before using the 4–20 mA standard signal inputs, the temperature measurement range must be configured.

In the "Settings" menu, set the corresponding temperature values for 4 mA and 20 mA signals.

The correct temperature values are specified in the datasheet/user manual of the temperature transmitter being used.

If incorrect values are set, the input readings will be inaccurate.

The menu diagram for configuring the 4–20 mA signal inputs is shown in Figure 33.

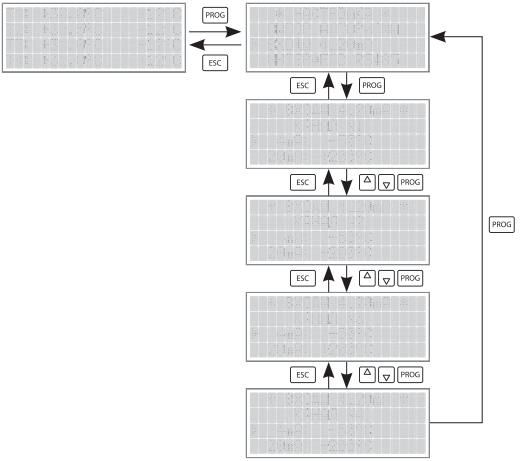


Figure 33.

5. RESTORING FACTORY SETTINGS

The PTM-2000 controller includes a function for restoring factory settings.

If necessary, all current user-defined temperature setpoints and hardware settings can be reset to factory defaults.

The factory settings correspond to the parameters specified in the descriptions of each algorithm, as shown in Tables 8, 10, 12, and 13.

The menu diagram for restoring factory settings is shown in Figure 34.

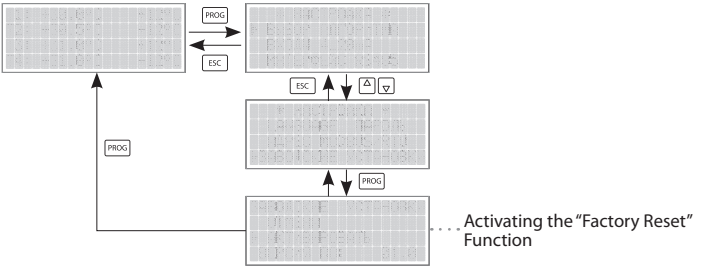


Figure 34.

6. SAFETY MEASURES

The temperature controller complies with the technical regulations:

- TR CU 004/2011 "On the Safety of Low-Voltage Equipment"
- TR CU 020/2011 "Electromagnetic Compatibility of Technical Means"
- TR EAEU 037/2016 "On the Restriction of the Use of Hazardous Substances in Electrical and Radio Equipment"

The temperature controller must be connected by a qualified electrician.
All installation and wiring work must be performed with the power supply disconnected.

7. MAINTENANCE

The temperature controller must be serviced at least once a year.

Maintenance includes checking electrical connections and cleaning dust and dirt from the terminal contacts.

During installation or maintenance, the device must be disconnected from the mains.

Connection, configuration, and servicing must be performed by qualified personnel only.

8. TRANSPORTATION AND STORAGE

8.1. The PTM-2000 temperature controller may be transported by any type of vehicle, in accordance with applicable transportation regulations.

8.2. Transportation and storage must be carried out in the original packaging.

8.3. It is prohibited to transport the controller packaging together with active chemicals, cement or coal dust.

8.4. During transportation, measures must be taken to protect the package from precipitation, direct sunlight, radioactive exposure, and direct contact with seawater.

8.5. The PTM-2000 temperature controller may be transported at ambient temperatures from –50 °C to +50 °C.

8.6. Transportation without packaging as part of a larger assembly is permitted only under the conditions specified in section 4.5.

8.7. After transport at sub-zero temperatures, the controller must be kept unpackaged under operating conditions for at least 3 hours before powering on.

8.8. When stored in warehouse conditions, the ambient temperature must be between +5 °C and +35 °C with relative humidity not exceeding 80% at 20 °C.

9. WARRANTY OBLIGATIONS

The warranty period is 2 years from the date of sale.

During the warranty period, the buyer has the right to request repair or replacement in the event of manufacturing defects, provided all operating instructions have been properly followed.

10. CLAIMS

If any faults occur within the warranty period, the buyer must promptly submit a claim to the importer.

11. DISPOSAL

The product and its packaging do not pose an environmental hazard.
Disposal regulations acc. to European Directive 2002/96/EU:
Defective electrical units never dispose in household waste! In case of malor non-function, those need to be disposed seperately.
Please require public discharge point from your urban administration or district authority.
Only this will guarantee proper recycling and environment protection.
Reason for special marking of the equipment.
Dispose the equipment correctly sorted. Cardboard and paper in wastepaper reuse, plastic foils in plastic recycling.
Releasing of toxic liquids or gases into atmosphere is forbidden!
No disposal of electrical devices in consumer waste. Use specific collection points. Please require public discharge point from your urban administration or district authority. In case of disposal in dumps or burrows, danger develops by leaking of hazardous substances into groundwater, returning into food chain, and endangering your health.
Weee-Reg.-Nr/Weee Reg. No: DE14335428.

12. PACKAGE CONTENTS

1. PTM-2000 Electronic Temperature Controller
2. User Manual (combined with product passport)
3. Packaging.

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