



Crystal LTD

**KT5.1 – Temperature Controller for Thermoelectric Assemblies
driving
Instruction manual**

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1. Description

Temperature controller KT5.1 is a device that can drive thermoelectric assembly to stabilize temperature of different systems like battery backup cabinets, instrumentation, chillers etc.

Part number for ordering

KT5.1-48/15,

where: KT5.1 – Controller version;

48 – Nominal Operating Voltage

15 – Maximal Operating Direct Current.

Shipment kit includes parts as it is shown in the Table 1

Table 1

#	Name	Units	Quantity
1	Temperature Controller	pcs.	1
2	Temperature sensor with 1 meter lead wire length.	pcs	2
3	Instruction Manual	pcs	1
4	Package	pcs	1

2. Specification

Specification of the Temperature Controller is shown in the Table 2.

Table 2

Parameter	Units	Parameter value			Note
		Minimal	Nominal	Maximal	
Input operating voltage – power voltage of a thermoelectric assembly	V	18	48	55	
Continuous Output Direct Current in Thermoelectric Modules Circuit	A	–	–	15	
Continuous Output Direct Current in Fans Internal Circuit	A	–	–	5.5	
Continuous Output Direct Current in Fans External Circuit	A	–	–	5.5	
Heat Power dissipated on the Heat Sink (at DC in the Thermoelectric Modules Circuit)	W	–	–	11.3 (15 A)	
Input Power	W	4.1	–	5.6	
Temperature Sensor	Type	–	NTC thermistor	–	
	Temperature measurement range, °C	-55	–	+60	
	R ₂₅ , kOhm	–	10	–	
Temperature measurement Accuracy	°C	–	±0.5	–	

Таблица 2. Continue.

Heat Sink temperature in continuous operating mode at ambient temperature +25 °C and free convection (at DC in the Thermoelectric Modules Circuit)	°C	–	~25 (5 A) ~104 (15 A)	–	
Operating temperature	°C	-30	+25	+60	
Length	mm	139	140	141	
Width	mm	89	90	91	
Height	mm	30	31	32	
Weight	kg	–	0.354	–	

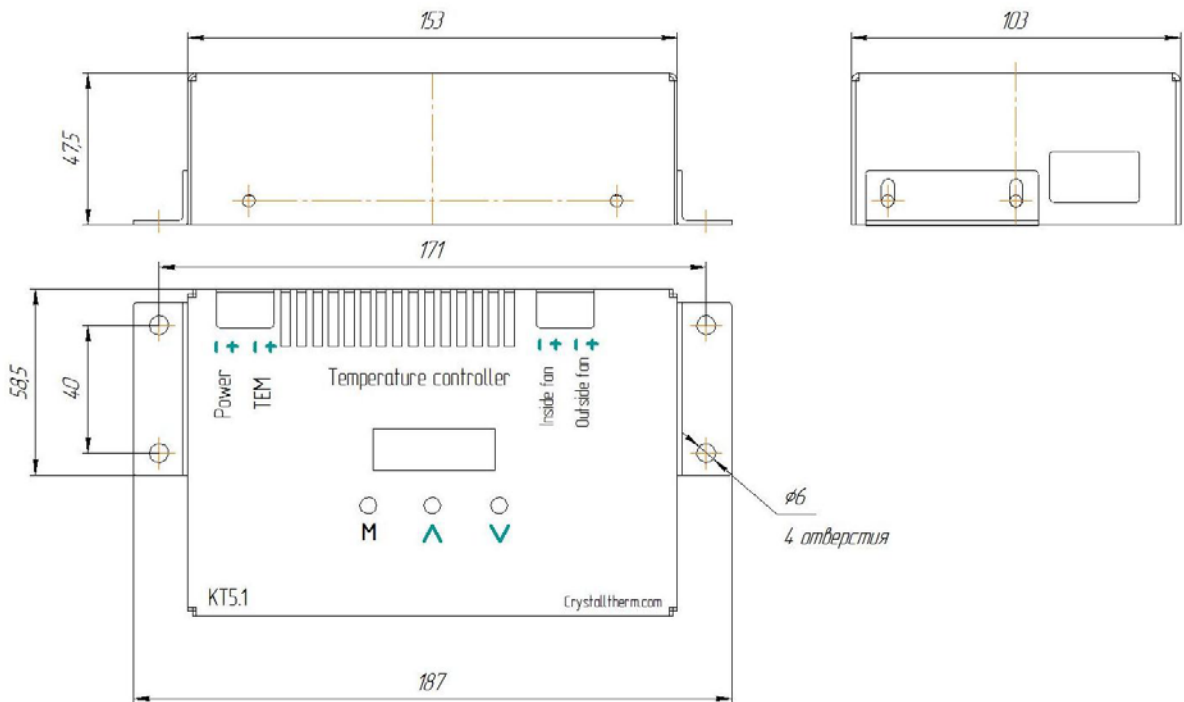
3. View and Circuit Diagram

Controller view and its dimensions are shown in the [Pic. 1.](#)

Circuit Diagram is shown in the [Pic. 2.](#)

External Slots Layout Scheme is shown in the [Pic. 3.](#)

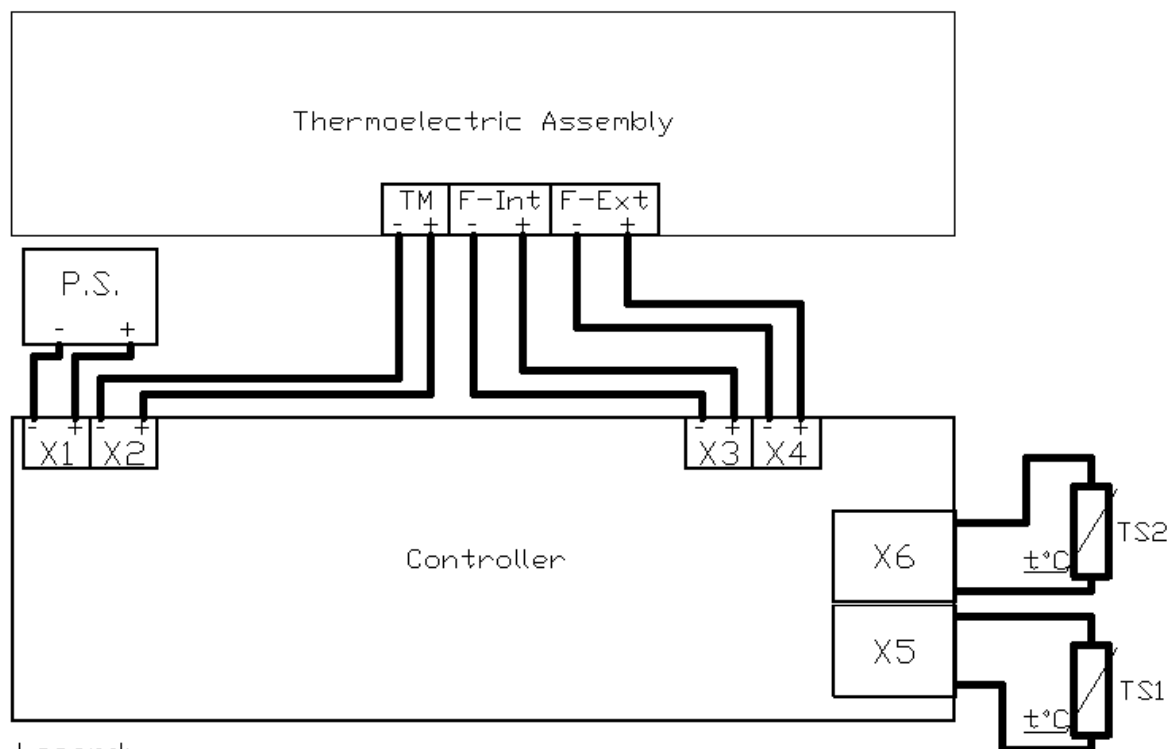
Pic. 1. View of the Controller and Dimensions.



KT5.1

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Pic. 2. Circuit Diagram.



Legend:

P.S. - Thermoelectric Assembly Power Supply;

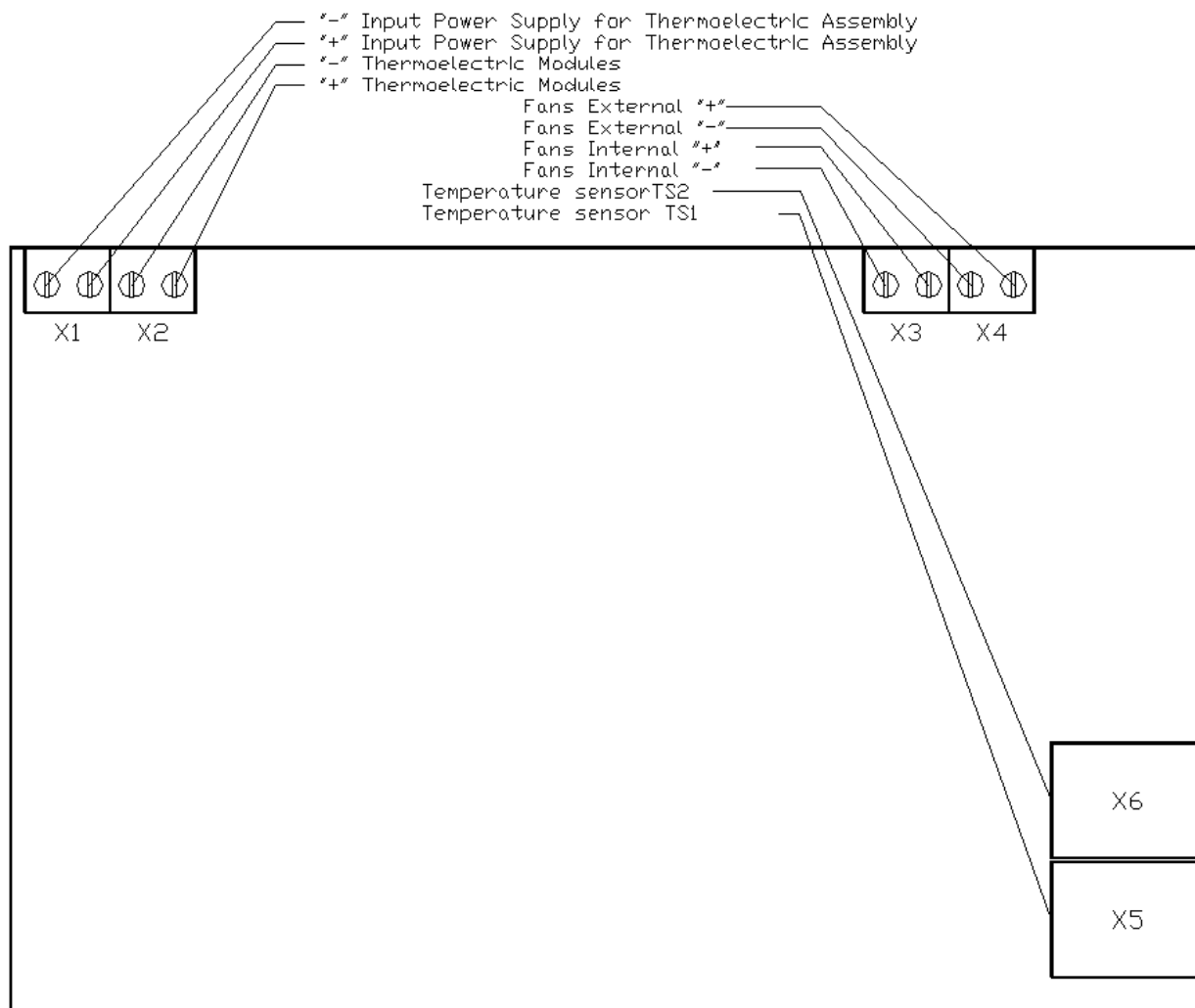
TM - Contacts for Thermoelectric Modules connection;

F-Int - Contacts for Fans Internal connection;

F-Ext - Contacts for Fans External connection;

TS1 - Temperature sensor for measuring temperature to regulate;

TS2 - Temperature sensor for measuring ambient temperature.

Pic. 3. External Slots Layout Scheme.

4. Temperature Regulation Procedure

Controller drives a Thermoelectric Assembly in ON/OFF (relay) mode to stabilize set point temperature in the range $T_{\text{set}} \pm dT$, where dT is Set Point Hysteresis. Heating Mode Function available as well (can be disabled in Menu of the Controller). Temperature to regulate is measured by the sensor TS1 (connected to the X5). Ambient Temperature is measured by the sensor TS2 (connected to the X6). Both sensors are included in the shipment kit. Regulation Procedure is described in the [Table 3](#).

Pic. 4. –Range of the temperature measured by the sensor TS1 (for the [Table 3](#)).

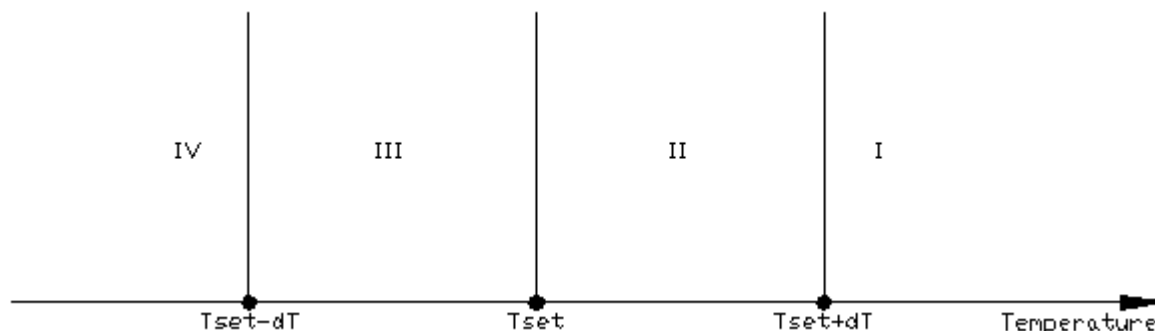


Table 3

#	Measured temperature by TS1 (Pic. 4)	Outputs State of the Controller			Description
		Output X2 (Thermoelectric modules)	Output X3 (Fans Internal)	Output X4 (Fans External)	
1	Break or Short Circuit	OFF	OFF	OFF	Immediate switching OFF of all outputs. Further normal operation on TS1 recovery is applied according to this Table.
2	$T_{set} + dT$, Range I	ON for Cooling	ON	ON	Thermoelectric Modules are ON for Cooling. Fans Internal and External are ON.
3	Set Point T_{set}	OFF	30 seconds OFF after X2 switching OFF	30 seconds OFF after X2 switching OFF	Thermoelectric Modules are OFF on Set Point T_{set} reached. Fans Internal and/or Fans External (see. Item #6 of this Table) are 30 seconds OFF after switching OFF the Thermoelectric Modules.

Table 3. Continue.

4	Range II	ON for Cooling	ON	ON	After Cooling mode switched ON according to the Item #2 of this Table until Set Point T_{set} is reached (Item. #3).
		OFF	ON	ON	If temperature of TS1 > temperature of TS2, and Thermoelectric Modules have not been switched to the Heating Mode in the previous last cycle: Thermoelectric Modules are OFF, Fans Internal and Fans External are ON for passive heat exchange.
		OFF	OFF	OFF	If temperature of TS1 < temperature of TS2.
5	Range III	OFF	OFF	OFF	
6	$T_{set} - dT$, Range IV	ON for Heating	ON	OFF	If Heating Mode Function of the Controller is enabled: Thermoelectric Modules are ON for Heating Mode. Fans Internal is ON and Fans External is OFF.
		OFF	OFF	OFF	If Heating Mode Function of the Controller is disabled all outputs of the Controller are OFF.

5. Display Modes and Controls

Display Modes of the Controller are described in the Table 4.

Table 4

Display Mode	Information Displayed
Main Mode	The temperature measured by TS1 sensor is displayed. In case of TS1 sensor break or short circuit the signs “Serb” or “SErS” are displayed. The ambient temperature from TS2 sensor can also be displayed (see. Table 6).
Menu Mode	Controller parameters settings are displayed (see. Tables 5 , 6)

The following parameters are stored in the EEPROM of the Controller: T_{set} – Set Point, dT – Set Point Hysteresis, Heating Mode Function Enabled/Disabled. The designations of these parameters in the order of appearing in the Menu of the Controller are shown in the Table [5](#).

Table 5

Parameter	Parameter appearance in the Menu of the Controller (showed default values)	Parameter's Setting Range	Minimal/Maximal step of Parameter's setting change
Set Point T_{set}	25.0Y	≥ 5 °C, but ≤ 55 °C	$\pm 0.1/\pm 0.5$ °C
Set Point Hysteresis dT	2.0Γ	≥ 2 °C, but ≤ 20 °C	$\pm 0.1/\pm 0.5$ °C
Heating Mode Function	1H	0H – Heating Mode Function is disabled; 1H – Heating Mode Function is enabled.	–

The Controller's buttons functionality is described in the Table 6.

Table 6

Button	Functionality	Button Operations
«M»	Menu entering for setting the parameters	Press and hold for > 4 seconds and < 8 seconds until one of the parameters displayed (see Table 5). Display enters Menu Mode.
	Parameters choose in the Menu	In the Menu Mode press for ~0.5 second to step to the next parameter. Choosing a parameter is cyclic.
	Save parameters settings in the EEPROM	In the Menu Mode press and hold for > 4 seconds and < 8 seconds. Display turns OFF for 2.5 seconds and enters Main Mode. Controller enters its state according to the Table 3.
	If in the Menu Mode no one button was pressed during 10 seconds display exits Menu Mode to the Main Mode without saving parameters in EEPROM.	

Table 6. Continue.

Λ	In the Main Mode press and hold to display ambient temperature measured by TS2 sensor. Release to display again the temperature to regulate measured by TS1 sensor.
	In the Menu Mode: increases current parameter setting value with current step. When setting Set Point value or Set Pont Hysteresis value, if press and hold > 4 seconds the step of parameter's change increases from +0.1 °C to +0.5 °C, one returns to +0.1 °C upon the button release.
V	In the Menu Mode: decreases current parameter setting value with current step. When setting Set Point value or Set Pont Hysteresis value, if press and hold > 4 seconds the step of parameter's change increases from -0.1 °C to -0.5 °C, one returns to -0.1 °C upon the button release.

6. Connecting Procedure and Powering On

Connect external devices to the Controller according to the Circuit Diagram on the [Pic. 2](#) as follows:

Warning! Carry out connecting procedure with Power Supply (P.S. in the [Pic. 2](#)) switched OFF.

1. Connect Fans Internal to the slot X3 following the polarity;
2. Connect Fans External to the slot X4 following the polarity;
3. Connect Thermoelectric Modules to the slot X2 following the polarity;
4. Connect Input Power Supply to the slot X1 following the polarity;
5. Connect temperature sensor to measure temperature to regulate to the slot X5;
6. Connect temperature sensor to measure ambient temperature to the slot X6;
7. Power on the Input Power Supply.

The following system test procedure is performed in a 5 seconds (countdown from 5 to 0 is displayed at every sign of the display) after powering on the Controller:

- Fans Internal switched ON;
- Then after 2 seconds Fans External switched ON;
- Then after 2 seconds Thermoelectric Modules switched ON for heating;
- Then after 2 seconds Thermoelectric Modules switched OFF;

- Then after 1 second Thermoelectric Modules switched ON for cooling;
- Then after 2 seconds Fans Internal Fans External and Thermoelectric Modules are switched OFF;
- Controller starts to operate according to the [Table 3](#).

7. Operating Conditions

Direct sun radiation and moisture environment must be eliminated at the mount place of the Controller. Free or forced air convection through the heat sink of the Controller must be provided at the mount place. Ambient temperature, operating voltage and current should not exceed its value ranges specified in the [Table 2](#).

8. Warranty

Warranty period is 1 year at the operating conditions specified in the [Section 7](#).