

TCY-MT-U Series Intelligent Temperature Controller

Features

- Temperature PID control for HVAC systems.
- Up to 2 modulating outputs for DC 0...10V with 10mV resolution.
- 1 internal temperature sensor and up to 2 external sensor inputs
- Multiple remote control functions on external input
- Password protected programmable user and control parameters
- Blue backlight

Applications

- Various temperature control applications
- Stand alone VAV control for pressure independent actuators
- Water Only Systems: Radiator, floor heating or chilled ceilings
- Individual room control for offices, residential, hotel rooms, meeting rooms, etc.



General Description

The TCY-MT-U is a stand-alone electronic universal controller with one temperature control loop. It may use up to 2 PID sequences. The TCY-MT-U features one internal NTC temperature sensor, up to two external sensor inputs and up to two analog outputs. The configuration has been reduced to a minimum to allow for a simple and off the shelf usage. For more advanced features and current in- and outputs the TCI product range is recommended. The TCY-MT-U can be configured using the standard operation terminal. No special tool or software is required.

Name

T C Y - M T 2 - (U)

Housing:	U = Vertical (2x4") housing, Standard is square housing
Function:	2 = 2 = 2-Pipe, 4 = 4-Pipe
Input:	T = Temperature, H = Humidity
Output:	M = Modulating, B = Binary
Series:	TCY

Ordering

Item Name	Item code	Control Type	Key-data
TCY-MT2-U-W1	40-10 0044-1	Cooling only	Compact PID controller with: 2 TI, 1 AO
TCY-MT2-U-W2	40-10 0044-2	Heating only	
TCY-MT2-U	40-10 0044	2-Pipe system	
TCY-MT4-U	40-10 0046	4-Pipe system	1 TI, 2 AO

Accessories

S-Tn10-2	40-20 0001	Flying lead sensor with 2 m cable
SD-Tn10-12-2	40-20 0002	Flying lead duct sensor 12cm immersion depth, 2m cable
SD-Tn10-20-2	40-20 0003	Flying lead duct sensor 20cm immersion depth, 2m cable
SDB-Tn10-12	40-20 0051	Duct sensor with housing, 12cm immersion depth
SDB-Tn10-20	40-20 0004	Duct sensor with housing, 20cm immersion depth
SOA-Tn10	40-20 0006	Outdoor sensor

Selection of actuators and sensors

Temperature Sensors:

Use only our approved NTC sensors to achieve maximum accuracy. Recommended is SDB-Tn10-20 as Duct sensor, SRA-Tn10 as Room sensor and SDB-Tn10-20 with AMI-S10 as immersion sensor.

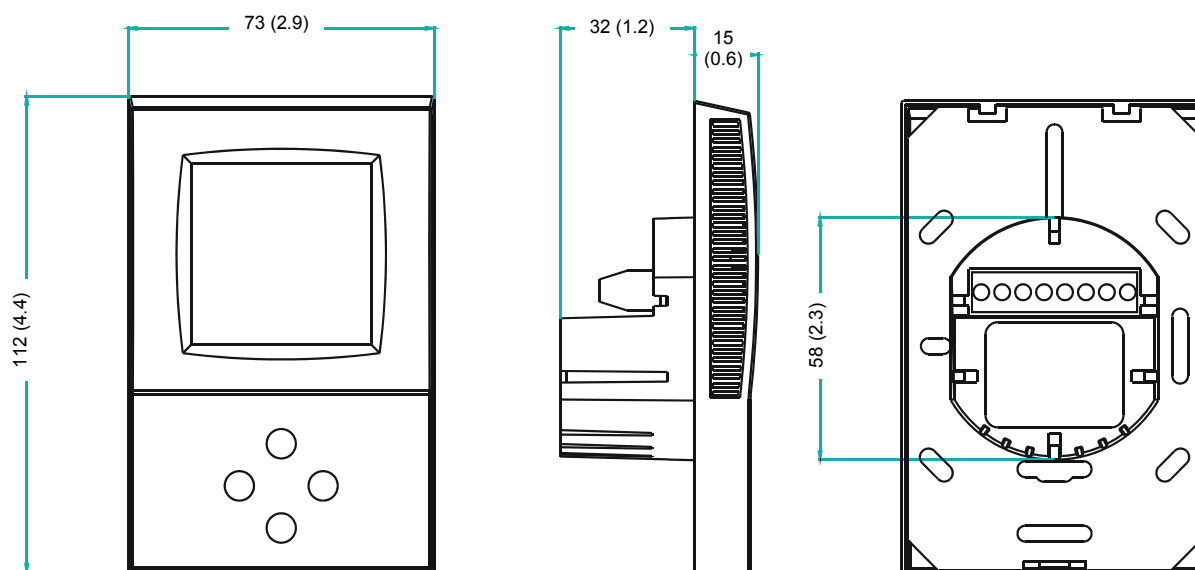
Modulating Actuators:

Choose actuators with an input signal type of 0-10V DC or 2-10V DC.

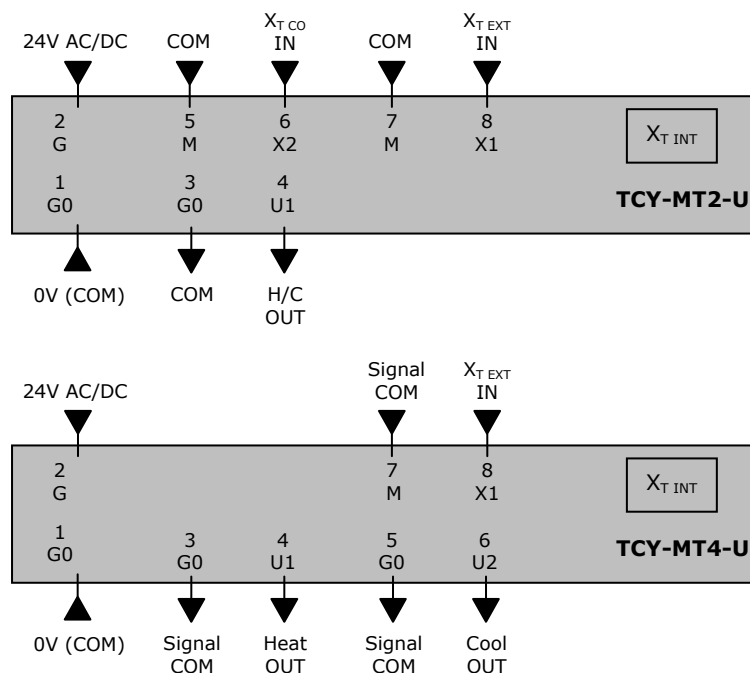
Technical specifications

Power Supply	Operating Voltage	24 V AC/DC $\pm$ 10 %, 50...60 Hz
	Power Consumption	Max. 1.5 VA
	Electrical Connection	Terminal Connectors, wire 0.34...2.5 mm ² (AWG 24...12)
Signal inputs	Temperature Input	
	Range	0...50 °C (32...122 °F)
	Accuracy	0.5 K
Signal outputs	Analog Outputs	AO1, For TCY-MT4-U AO2
	Output Signal	DC 0...10 V
	Resolution	9.76 mV (10 bit)
	Maximum Load	2 mA
Environment	Operation	To IEC 721-3-3
	Climatic Conditions	class 3 K5
	Temperature	0...50 °C (32...122 °F)
	Humidity	<95 % r.H. non-condensing
	Transport & Storage	To IEC 721-3-2 and IEC 721-3-1
	Climatic Conditions	class 3 K3 and class 1 K3
	Temperature	-25...70 °C (-13...158 °F)
	Humidity	<95 % r.H. non-condensing
Standards	Mechanical Conditions	class 2MT2
	 conform according to EMC Standard 89/336/EEC EMEI Standard 73/23/EEC	EN 61 000-6-1/ EN 61 000-6-3
	Product standards	
	Automatic electrical controls for household and similar use	EN 60 730 -1
	Special requirement on temperature dependent controls	EN 60 730 - 2 - 9
	Degree of Protection	IP30 to EN 60529
	Safety Class	III (IEC 60536)
	Cover, back part	Fire proof ABS plastic (UL94 class V-0)
	Mounting Plate	Galvanized Steel
General	Dimensions (H x W x D)	Front part: 112 x 73 x 15 mm (4.4" x 2.9" x 0.6") Power case: $\varnothing$ 58 x 32 mm ($\varnothing$ 2.3" x 1.3")
	Weight (including package)	270 g (9.5 oz)

Dimensions [mm] (inch)



Connection diagram



Description:

G0	Power supply:	0V, -24VDC, internally connected to signal common
G	Power supply:	24VAC, +24VDC
M	Signal common:	Common 0 potential for analog inputs and analog outputs.
X1	External temperature input:	NTC 10kΩ @ 25°C (77°F)

TCY-MT2-U:

X2	Changeover input:	NTC 10kΩ @ 25°C (77°F)
U1	Analog output:	0...10 V DC

TCY-MT4-U:

U1	Analog heating output:	0...10 V DC
U2	Analog cooling output:	0...10 V DC

Mechanical Design and installation

The unit consists of two parts: (a) The power case with attached mounting plate and (b) the front part.

Mounting location

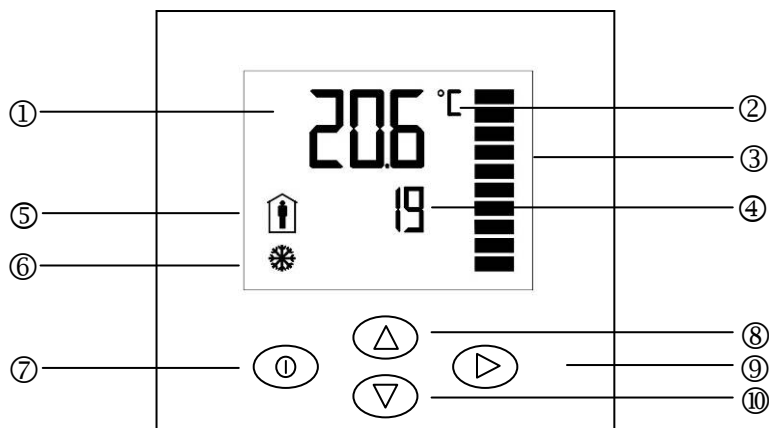
- On an easy accessible interior wall, approx. 1.5 m (4.5') above the floor in an area of average temperature.
- Avoid exposure to direct sunlight or other heat sources, e.g. the area above radiators and heat emitting electrical equipment.
- Avoid locations behind doors, outside walls and below or above air discharge grills and diffusers.
- Location of mounting is less critical if external temperature sensors are used

Installation

1. Connect the wires to be connected to the terminals of the power case according to wiring diagram
2. Install the mounting plate to the flush mounting box. Make sure that the nipple with the front holding screw is facing to the ground. Make sure the mounting screw heads do not stand out more than 5 mm (0.2") off the surface of the mounting plate.
3. Ensure that the jumpers are set correctly.
4. Slide the two latches located on the top of the front part into the hooks at the upper side of the mounting plate.
5. Carefully lower the front part until the interconnector reaches the mounting-plate. Continue pressing in a gentle way until the front part is fully connected. While inserting the connectors, a slight resistance can be felt. This is normal. Do not use excessive force!
6. With a Philips-type screw driver of size #2, carefully tighten the front holding screw to secure the front part to the mounting plate. This screw is located on the front lower side of the unit. There is no need to tighten the screw too much.

Display and Operation

The operation terminal uses an LCD display and four operation buttons.



Legend:

1. 4-digit display of current value, time, control parameter or set point
2. Unit of displayed value, °C, °F, % or none
3. Graphical display of output or input value with a resolution of 10%
4. 4-digit display of current value, time, control parameter or set point
5. Operation modes: Comfort mode, Standby mode, Energy Hold Off
6. Symbols: Heating active: , Cooling Active: external temperature sensor connected:
7. **POWER button**: Standard function: Pressing the button less than 2 sec toggles standby and comfort mode. Pressing the button for more than 2 seconds switches the unit off.
Programming function: ESC function, to return to previous level or ignore changed value
8. **UP buttons**: increment set points and parameters, select menu options
9. **OPTION button**: Standard function: If pressed less than 2 sec access for different control modes
If pressed for more than 2 sec starts operation level for advanced users. Change of time schedules, offsets and heat – cool settings.
Programming function: Acts as Enter to select menu option or accept changed parameter value.
10. **DOWN buttons**: decrement set points and parameters, select menu options

Operation Modes

- **Comfort**: The unit is in full operation mode. All the control functions are operating according to their setpoints. The unit displays occupied mode.
- **Standby**: The set points are shifted according to parameters **CP04**. The heating parameter is shifted down and cooling parameter up. The unit displays unoccupied mode. Outputs are limited to **CP17** standby maximum. For two stages heating or cooling the second stage will not operate while in standby mode. Standby operation may be disabled with **UP06**.
- **Energy Hold-Off (EHO)**: The unit is switched off. All outputs are off. The temperature will still be monitored in order to activate the unit in case of frost. (If frost protection is enabled). Off is displayed.

Activation of operation modes

- Via operation terminal
- Via external input

Operation of the Terminal Unit

Switching ON

The unit is switched on by pressing the POWER button. It will start up in comfort mode.

Changing between COMFORT and STANDBY

Pressing the POWER button for less than 2 seconds toggles between STANDBY and COMFORT modes. Standby mode may be disabled with **UP06**.

Switching OFF

Pressing the POWER button for more than 2 seconds, will switch the unit off. OFF and current time will be displayed in the LCD for the deluxe unit. Current temperature and OFF is displayed for the basic unit.

Changing of set points

Change the set point with the UP/DOWN buttons. Changing of set points may be disabled with **UP01**.

Manually activating heating or cooling mode

Pressing the option button for more than three seconds will toggle Heating – Cooling mode.
Manual Heat/Cool change may be disabled with **UP03**

Power Failure

All the parameters and set points are memorized and do not need to be reentered. Depending on **UP05** the unit will remain switched off, switch on automatically or return to the operation mode it was in before the power failure.
Deluxe version only: Timer operation and daytime setting will be retained for 24h. The controller has to be connected to a power supply for at least 10 hours for the backup function to operate accordingly.

Error messages

The TCY-MT-U may display the following error condition:

Err1: The connection to the temperature sensor may be interrupted or the temperature sensor is damaged.
The output is switched off. Verify parameter settings and wiring.

Setting of parameters

The TCY-MT-U is an *intelligent* controller and can be adapted to fit perfectly into your application. The control operation is defined by parameters. The parameters are set during operation by using the standard operation terminal.

The parameters are password protected. There are two levels of parameters: User operation parameters for access control settings and Expert parameters for control functions and unit setup. The passwords for user levels and expert levels are different. Only control experts should be given the control parameter password.

The parameters can be changed as follows:

1. Press UP and DOWN button simultaneously for three seconds. The display will indicate the firmware version in the upper large digits and the revision in the lower small digits. Pressing any key will show: CODE.
2. Select a password using UP or DOWN buttons. Dial 009 in order to get access to the user parameters. Press OPTION after selecting the correct password.
3. Once logged in, the parameter is displayed immediately
4. Select the parameters with the UP/DOWN keys. Change a parameter by pressing the OPTION key. The MIN and MAX symbols show up and indicate that the parameter may be modified now. Use UP and DOWN key to adjust the value.
5. After you are done, press OPTION or POWER in order to return to the parameter selection level.
6. Press the POWER key again so as to leave the menu. The unit will return to normal operation if no key is pressed for more than 5 minutes.

User Parameters (Password 009)

Parameter	Description	Range	Default
UP 00	Enable access to operation modes	ON, OFF	ON
UP 01	Enable access to set points	ON, OFF	ON
UP 02	Not used	ON, OFF	OFF
UP 03	Enable manual change of heating / cooling mode Has no influence for TCY-MT2-U-W1 and TCY-MT2-U-W2	ON, OFF	ON
UP 04	Not used	ON, OFF	OFF
UP 05	State after power failure: 0 = off, 1 = on, 2 = state before power failure	0, 1, 2	2
UP 06	Enable standby functionality	ON, OFF	ON
UP 07	Celsius or Fahrenheit, ON for Fahrenheit, OFF for Celsius	ON, OFF	OFF (Celsius)
UP 08	Calibration value of temperature sensor. This value is calibrated at manufacturing of the thermostat. If required it is possible to shift the temperature -10° to $+10^{\circ}$ in 0.1° steps.	$-10...10$	0
UP 09	Enable Frost Protection	ON, OFF	TCY-MT2-U-W1: OFF TCY-MT2-U-W2: ON TCY-MT2-U: ON TCY-MT4-U: ON

Control Functions

Temperature control loop: Signal input: either internal or external passive temperature probe

Manipulation of the set point

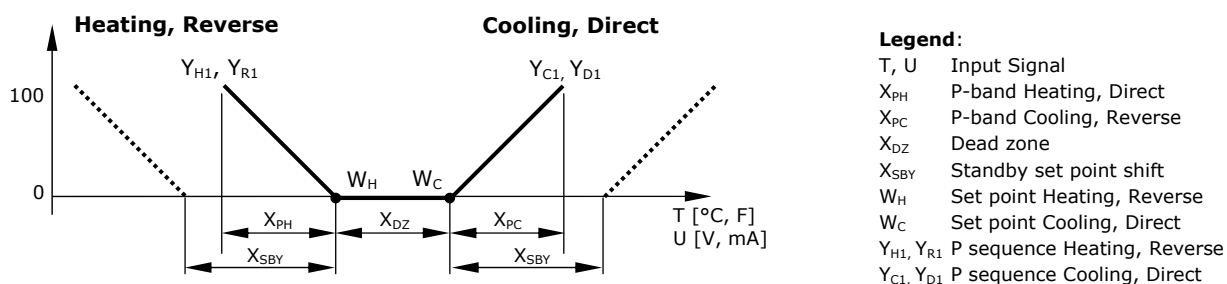
Standby set point shift X_{SBY} : This function shifts the set point while the operation mode is standby. The heating set point W_H is reduced and the cooling set point W_C increased by the value of the standby set point shift X_{SBY} .

Dead Zone Span X_{DZ} : For TCY-MT4-U only. The dead zone span lies between the heating and the cooling set point.

Minimum and Maximum Set Point Limits: Limits the adjustable range of the loop set point. The limits for heating and cooling sequence may be chosen individually.

PID-Control

Each loop has one reverse (heating) and one direct (cooling) acting PID sequence.



Proportional Control:

Proportional-band X_P : The proportional part is defined through the p-band. A narrow P-band increases the sensitivity of the controller. Typical values used are 1 – 1.5K for heating, 2 – 3K for cooling sequences.

The P-band should be extended in case the ID-Part is active, to prevent instability.

Integral & Differential Control:

The algorithm used reduces the swinging tendency of the control loop and improves a direct approach of the current value to the setpoint. The ID part is defined by two parameters:

The time interval TI specifies how fast the control sequence reacts. A low value (short interval) increases the swinging tendency and with it the risk of an instable loop. A high value (long interval) slows than reaction time.

The integral gain factor KI specifies how strong the control sequence reacts. Opposite to TI a high gain factor increases instability and a low factor delays the response of the controller.

The setting of these two parameters depend on the type and size of heating or cooling equipment used, the size of the room and the usage of the room. Here are some values that may be considered. These must be verified upon commissioning.

We recommend the following values:

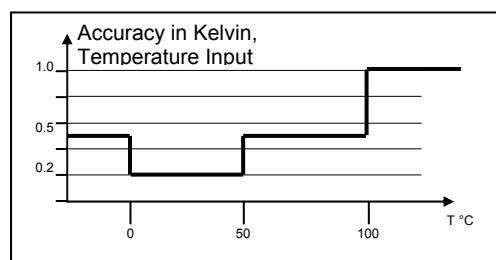
For air based heating systems: $KI = 0.5$

For floor heating systems: $KI = 0.3$

For air cooling systems: $KI = 1.0$

Temperature Input

The TCY-MT-U includes an NTC-based passive temperature sensor. A sensor of the same type can be connected as alternative control input or remote control input. The TCY-MT2-U may use an additional input as changeover input. The accuracy of the temperature input is shown in the table to the right. Specified accuracy can only be guaranteed by using an approved temperature sensor. For best results use Sxx-Tn10 sensors.



Options for input X1

These functions are activated by parameters

External controls input

The control input is provided by the external input. The internal input will not be used.

Remote Enable

Opening the external temperature input will force the unit into the OFF operation mode. The operation mode cannot be overridden by using the terminal. Connecting the binary input to GND returns control of the operation mode to the terminal. This function may be used as window contact to prevent loss of energy.

Toggle of Standby and Comfort operation modes

Standby and Comfort modes are controlled through an external contact by connecting the external temperature input to ground

Activation Delay: Defines the delay the binary contact has to be open before standby mode is activated.

This function may be used together with key card switches for hotels or motion detectors for offices.

Auto change over instructions for input X2 (TCY-MT2 only):

There are several ways to switch a 2-pipe system from heating to cooling. The temperature of the supply media or the outside temperature may be measured. The controller detects the mode automatically. If heating limit is above cooling limit, supply media mode is selected. If heating limit is below cooling limit, outdoor mode applies. Heating and cooling may be as well changed by an open contact switched to GND. Note: all ground levels of involved controllers must be the same in case more than one controller is switched.

Supply media

Set auto change over limit heating above the change over limit cooling but below the temperature of the heating media. For example 25°C (77°F).
Set auto change over limit cooling above the temperature of the cooling media. For example 18°C (64°F).

Outside temperature

Set auto change over limit heating at the temperature where heating should start. For example if outside temperature is below 15°C (59°F).
Set auto change over limit cooling at the temperature where cooling should start. For example at 25°C (77°F).

Open Contact: heating active while contact is closed
Open Contact: cooling active while contact is closed

Auto change over limit heating = 25°C (77°F)
Auto change over limit cooling = 15°C (59°F)
Auto change over limit heating = 15°C (59°F)
Auto change over limit cooling = 25°C (77°F)

Output Configuration

Analog Output

The analog output is fixed to 0-10VDC. The signal range may be configured with parameters. It is thus possible to directly set min and maximum flow levels for VAV systems for example.

To adjust the output for a 2-10VDC signal set the minimum to 20% and keep the maximum at 100%

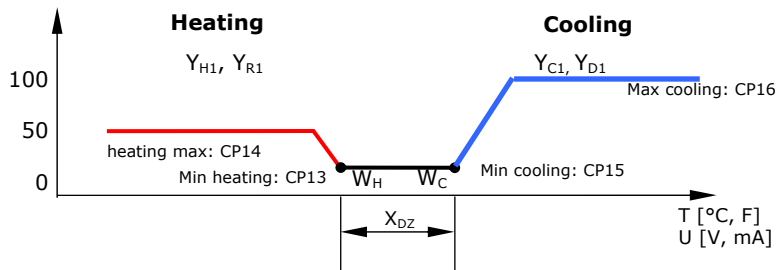
Output in standby mode

The analog output in standby mode may be reduced in order to save energy. The default value is set to 50%.

VAV applications

The following description is for 4-pipe systems. The settings apply to TCY-MT4-U.

In the VAV control sequence, at peak cooling the airflow setpoint is the maximum amount of air the VAV box is set to deliver. It may be adjusted through the maximum limit on the analog output in cooling mode (**CP16**). As cooling requirements decrease, airflow dwindles until it reaches its minimum setpoint. This setpoint will be based on the airflow needed at design cooling and is typically 10% to 15% of maximum cooling airflow. Minimum airflow can be adjusted by the minimum limit on the analog output in cooling mode (**CP15**) and in heating mode (**CP13**). When it reaches this minimum, the system is in its dead band and is neither heating nor cooling. As the system moves into heating mode, the airflow rate increases until it reaches the maximum airflow required for heating mode. This is typically 30 to 50% of maximum airflow of cooling mode. The parameter for this is the maximum limitation in heating mode (**CP14**).



Configuration parameters for firmware version 1.1

The TCY-MT-U is preset to work for most applications. For special requirements it can be fine tuned to work ideal with a simple parameter setup routine. The parameters can be changed on the unit without the need of additional equipment.

Identifying the firmware version

The parameters and functionality of controller depend on its firmware version and revision. It is therefore important to use a matching product version and parameter set. The Firmware version and revision version can be found when pressing simultaneously the ▲ and ▼ keys during several seconds. On the upper 7 segment display, the firmware version can be found, on the lower 7 segment display the current revision index (or "sub-version").

Control Parameters (Access Code: 241)

Warning! Only experts should change these settings! See user parameters for login procedure.

Parameter	Description	Range	Default
CP 00	Minimum setpoint limit in Heating mode	0...60°C (32...160°F)	16°C (61°F)
CP 01	Maximum setpoint limit in Heating mode	0...60°C (32...160°F)	30°C (86°F)
CP 02	Minimum setpoint limit in Cooling mode	0...60°C (32...160°F)	18°C (65°F)
CP 03	Maximum setpoint limit in Cooling mode	0...60°C (32...160°F)	30°C (86°F)

Controls configuration

Parameter	Description	Range	Default
CP 04	Economy temperature shift	0...100°C (200°F)	5.0°C (10°F)
CP 05	TCY-MT4 only: Dead zone between heating & cooling set point X_{DZ}	0...100°C (200°F)	1.0°C (2°F)
CP 06	TCY-MT4 only: Delay on Heat/Cool change over	0...255 min	5 min
CP 07	P – band heating X_{PH}	0...100°C (200°F)	2.0°C (4.0°F)
CP 08	P – band cooling X_{PC}	0...100°C (200°F)	2.0°C (4.0°F)
CP 09	K_{IH} , Integral gain heating, in 0.1 steps, (TI is fixed to 4s) 0 disables ID part low value = slow reaction high value = fast reaction	0...25.5	0.0
CP 10	K_{IC} , Integral gain cooling, in 0.1 steps, 0 disables I part	0...25.5	0.0
CP 11	Configuration of operation mode 0 = TCY-MT2-W1 = Cooling mode Y_{C1} 1 = TCY-MT2-W2 = Heating mode: Y_{H1} 2 = TCY-MT2 = Heating and Cooling (2 pipe system), $Y_{H1} + Y_{C1}$ 3 = TCY-MT4 = Heating and Cooling (4 pipe system), $Y_{H1} + Y_{C1}$	TCY-MT2: 0 - 2 TCY-MT4: 0 - 3	TCY-MT2-W1: 0 TCY-MT2-W2: 1 TCY-MT2: 2 TCY-MT4: 3

Analog Output

Parameter	Description	Range	Default
CP 12	Manual override of analog outputs OFF = Control mode ON = Manual mode (0 – 100%)	ON, OFF	OFF
CP 13	Min output for AO1 (For TCY-MT4-U = Heating output)	0 – 100 %	0%
CP 14	Max output for AO1 (For TCY-MT4-U = Heating output)	0 – 100 %	100%
CP 15	Min output for AO2 (For TCY-MT4-U = Cooling output)	0 – 100 %	0%
CP 16	Max output for AO2 (For TCY-MT4-U = Cooling output)	0 – 100 %	100%
CP 17	Maximum limitation in standby mode	0 – 100 %	50%

Input configuration

Parameter	Description	Range	Default
CP 18	Configuration of remote control input (X1) 0 = Control input if temperature sensor connected 1 = Occupation sensor – Comfort / Standby 2 = Remote enable – Comfort / OFF 3 = Keycard function: fixed setpoint	0...3	0
CP 19	Activation delay (Minutes) = the time the binary input needs to be open before standby/off mode is activated.	0...255 min	5
CP 20	Fixed setpoint for key card function in heating mode	0...60°C (32...160°F)	17°C (63°F)
CP 21	Fixed setpoint for key card function in cooling mode	0...60°C (32...160°F)	27°C (81°F)
CP 22	For TCY-MT2-U only: Enable Auto changeover	ON, OFF	OFF
CP 23	For TCY-MT2-U only: Auto-changeover limit heating	0...60°C (32...160°F)	30°C (86°F)
CP 24	For TCY-MT2-U only: Auto changeover limit cooling	0...60°C (32...160°F)	15°C (59°F)