

## TC50 Series Digital Room Thermostats with LCD

### Features

- Ultra slim wall-mount unit to match any decor
- Large easy-to-read Liquid Crystal Display (LCD), with LED backlight
- A stylish bi-directional rotating dial and two compact touch keys to provide ease of operation
- Choice of constant display of ambient temperature or temperature set point value
- Output relays employed for direct connection of valve actuators and 3-speed fan
- Configurable operating parameters
- Choice of °C or °F temperature display via parameters setup menu
- 2-wire on-off, 3-wire on-off/floating and 0-10 VDC output models available
- Adjustable proportional band for modulating models
- Adjustable integral time for 3-wire floating output models
- Choice of valve stroke time for 3-wire floating output models
- Field adjustable high and low occupied set point limit settings
- Choice to retain last entered settings on power resumption
- Dual-output on-off and 0-10 VDC models with auto cooling/heating changeover (deadband operation) and manual override
- Adjustable 1 to 5 K deadband for dual-output models
- Choice of operating sequence for dual-output models
- Unoccupied mode capability with field adjustable cooling and heating set points, not available to "1M", "1AM" and "1FM" models.
- Choice of unoccupied mode activation in operating mode only or in both standby and operating modes

- Choice of fan action in unoccupied mode
- Field recalibration capability of measured temperature
- Continuous or auto fan operation
- External and seasonal changeover temperature sensor capability
- Optional infra-red remote control unit
- Optional special faceplate color available on request

### General

The TC50 Series digital room thermostats are available in various models for 2-wire on-off, 3-wire floating and 0-10 VDC control of valves and on-off control of fan motors in fan coil units, heat pumps and packaged air-conditioning units for commercial, industrial and residential installations.

The modulating thermostats adopt true proportional-integral (PI) control algorithm. The microprocessor combines a proportional plus integral (PI) algorithm with advanced adaptive control logic. The proportional component of the algorithm adjusts the control output in response to changes in the measured temperature. The integral component of the algorithm adjusts the control output to eliminate offset (difference between the set point and the actual temperature). This provides precise and stable control under various system capacity and varying load conditions without the need for tuning or calibrating the control algorithm in the field. The digital display of ambient temperature, set



point and operating mode provides the user with an attractive and functional thermostat that is easy to use.

A fan-speed control touch key allows control of a 3-speed fan. The speed control key has 4 positions: "Hi-Med-Low-Auto". In the "Hi", "Med" or "low" position, the fan runs continuously at the selected speed. In the "Auto" mode, the fan speed is temperature dependent and controlled automatically in 2 K differential increments from low to high speed.

A bi-directional rotating dial allows change of settings such as temperature set point values.

### Ordering

To order, specify model numbers. When ordering models TC50-1F or TC50-1FM for on-off control, specify this requirement in the order.

## Specifications

Product model numbers	See Fig.3: TC50 Series Model Number Selection Guide	
Power requirements	110-230 V, +10% and -15%, 50/60 Hz	
Operating temperature differential (for 2-wire on-off models)	Fixed at 1 K for both cooling and heating modes	
Temperature display range	5-35°C in 0.5 K increments: accuracy ±1 K (41-95°F in 0.5 R increments, accuracy ±1 R)	
Temperature set point range	5-35°C in 0.5 K increments, initial factory setting at 22°C (41-95°F in 0.5 R increments)	
Offset adjustment of temperature indication (field recalibration)	+2, +1, 0, -1 and -2 K (+2, +1, 0, -1 and -2 R) throughout the range, factory setting 0	
Deadband of dual-output models	Adjustable 1 to 5 K(2 to 10 R) between cooling Mode and heating Mode, factory set at 3 K(3 R)	
Valve stroke time for 3-wire floating models	Accumulatively 10 to 240 s maximum in one direction, in steps of 10 s; factory setting 120 s	
Proportional band for PI control	Adjustable 1 to 10 K (1-10 R) in 1 K (1 R) increments, factory setting 5 K (5 R)	
Integral time for PI control	Adjustable 0 to 30 minutes in 1 minute increments, factory setting 15 minutes. Setting = 0 means integral time being turned off.	
Auto fan temperature differential	At 2 K (2 R) increments. At ≥0 K, fan is on low speed in cooling mode and fan status in heating mode depends on choice of auto fan action.	
Sensing element	NTC thermistor, 10 kΩ@25°C; accuracy ±0.5 K@25°C	
Unoccupied mode	Input signal from external voltage-free contact Choice of unoccupied mode activation: in operating mode only or in both standby and operating modes. Choice of fan action: always runs at "Low" fan when in operation or runs at "low" fan only when thermostat calls for cooling or heating (not applicable to "1M", 1AM" and "1FM" models).	
Unoccupied temperature set point range (not applicable to "1M" models)	Field adjustable 5-35°C (41-95°F) in 1 K (1 R) increments separately for cooling and heating; Factory settings: 16°C (61°F) for heating and 26°C (79°F) for cooling	
Enclosure	Material: Self-extinguishing, molded ABS Finish: Off white housing and dark grey faceplate	
Electrical ratings	Valve output relays	110-230 V, 3 A resistive, 1 A inductive, 50/60 Hz
	Fan output relays	
	For on-off and floating models	110-230 V, 3 A resistive, 1 A inductive, 50/60 Hz
	For 0-10 VDC models	110-230 V, 5 A resistive, 2 A inductive, 50/60 Hz
	Total rating	110 -230 V, 5 A maximum, 50/60 Hz
Ambient/Storage temperature limits	0 to 50 °C / -30 to 50 °C, 10% to 90% RH non-condensing	
Connectors	Non-removable line-voltage terminal blocks and removable low-voltage wire plugs	
Power wires	Wire size 1 mm <sup>2</sup> or 18 AWG solid copper recommended	
Sensor wires	22 AWG twisted shielded pair double-insulated cable	
Accessories and options	See Figure 8: Optional Accessories	
Agency approval	CE Mark compliant to EMC and Low Voltage Directives	
Shipping weight	0.2 kg (0.44 lb)	
Dimensions	See Figure 6: Dimensions in mm	

*The performance specifications above are nominal and subject to tolerances and application variables of generally acceptable industry standards. The Manufacturer shall not be liable for damages resulting from misapplication or misuse of its products.*

**Figure 2: Display Control Unit and LCD Layout**

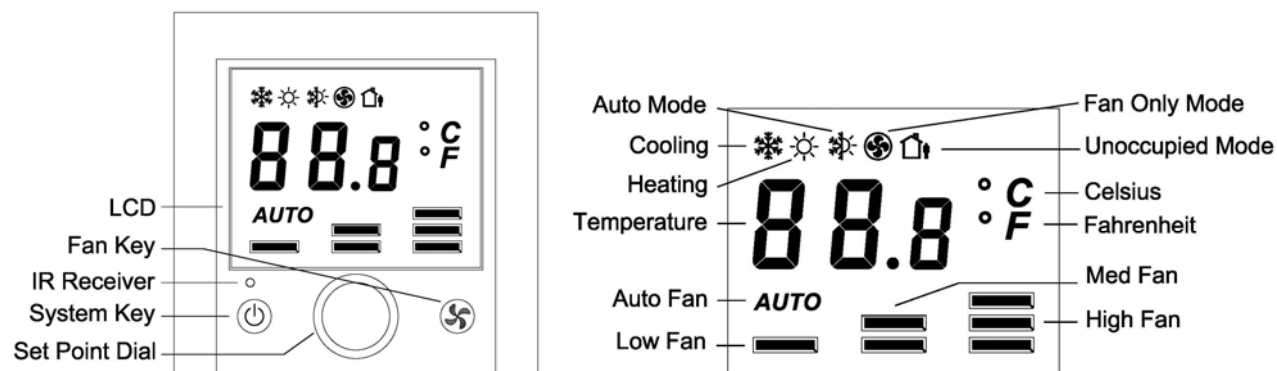


Figure 3: TC50 Series Digital Room Thermostat Model Number Selection Guide

TC50 Series Digital Room Thermostats Model Number Selection Guide (Complete Sets)				
TC5	0	—	1M	R
Product Type	Power Supply	Separator	Control Type	Options
TC5 = TC50 Series Digital Room Thermostats	0 = 110-230 VAC		<p>1 = Single 2-wire on-off output, cool only or heat only</p> <p>1M = Single 2-wire on-off output, manual cool/heat changeover</p> <p>1A = Single 0-10 VDC output, cool only or heat only</p> <p>1AM = Single 0-10 VDC output, manual cool/heat changeover</p> <p>1F = Single 3-wire floating output, cool only or heat only</p> <p>1FM = Single 3-wire floating output, manual cool/heat changeover</p> <p>2 = Dual 2-wire on-off outputs, manual or Auto cool/heat changeover</p> <p>2A = Dual 0-10 VDC outputs, manual or Auto cool/heat changeover</p>	<p>R = with infra-red receiver for RCU-1</p> <p>B = without buzzer for key touch sounding</p> <p>W = with white color faceplate</p>

Figure 4: Jumper Settings

The models TC50-2 and TC50-2A can be re-configured in the field to various model numbers by a qualified servicing agent, if necessary, by changing the jumper positions of JP2 and JP3. The locations of these jumpers can be found after removing the thermostat cover from its baseplate.

Model Number	Jumper Settings of JP2 and JP3		Jumper Settings of JP1 and JP4		
	JP2	JP3	Jumper	Cut	Uncut
TC50-1	Cut	Cut	JP1	With External Sensor	With Built-in Sensor
TC50-1M	Cut	Cut	JP4	For 2-10 VDC Output	For 0-10 VDC Output
TC50-2	Uncut	Uncut	<p><i>Note: JP4 is available in 0-10 VDC/2-10 VDC output models only. Factory setting is 0-10 VDC.</i></p>		
TC50-1F	Cut	Uncut			
TC50-1FM	Cut	Uncut			
TC50-1A	Cut	Cut			
TC50-1AM	Cut	Cut			
TC50-2A	Uncut	Uncut			

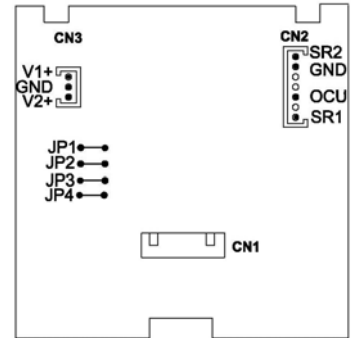


Figure 5: Wiring Diagrams and Application Notes

#### Wiring and Application Notes

- Cut jumper JP1 open if an external sensor is wired to SR1 and GND. Run the wiring away from any electrical motors or power wiring. Failure to do so may result in poor thermostat performance due to electrical noise.
- Cut jumper JP4 open if 2-10 VDC proportional output is required.
- 22 or 24 AWG twisted shielded pair double-insulated cable is recommended as remote sensor wiring and its length must not exceed 25 m.
- Do not bundle and run power wiring and remote sensor wiring in the same conduit.
- The seasonal changeover sensor should be wrapped around the supply water pipe when associated with a water system. When the changeover sensor temperature exceeds 30 °C, the thermostat enters into heating mode.
- External seasonal changeover sensor or switch is applicable to heat only or cool only 2-pipe models only.
- Unoccupied contact closure activates unoccupied mode.
- Hidden-line wiring for Terminal 7 of CN6 and V2+ of CN3 is applicable to dual-output models only.
- The thermostat outputs are designed for controlling zone valves. If used for controlling electric heaters, external contactors must be used.

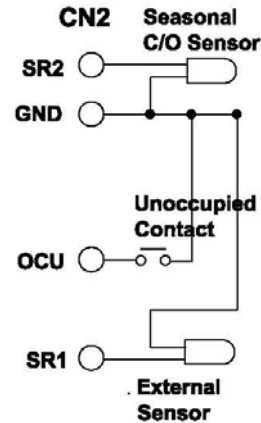
### WARNING

Incorrect wiring connection may cause permanent equipment damages to the thermostat.

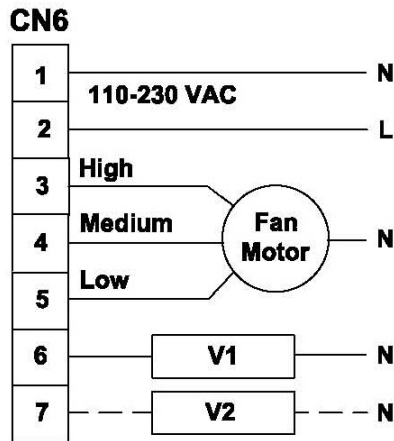
#### Piping Notes:

1. On a single-output unit, V1 can be either a 2-wire spring-return cooling or heating valve.
2. On a dual-output unit, V1 must be a 2-wire spring-return cooling valve and V2 a 2-wire spring-return heating valve.
3. V3 must be a 3-wire floating valve. In cooling mode, Terminal 6 output opens valve on temperature rise and Terminal 7 output closes valve on temperature drop. The action in heating mode is reversed.
4. On a single-output unit, V4 can be either a 0-10 VDC cooling or heating valve.
5. On a dual-output unit, V4 must be a 0-10 VDC cooling valve and V5 a 0-10 VDC heating valve.

### Connections of Sensors and Contacts

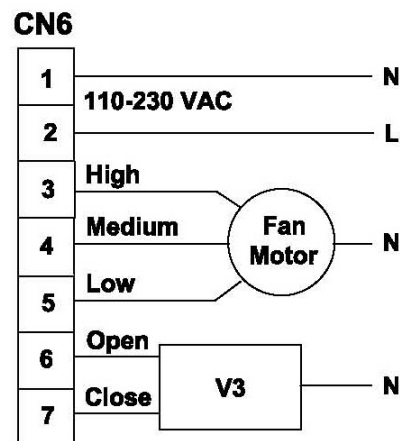


### Wiring Diagram for Single and Dual 2-Wire On-Off Valve Outputs



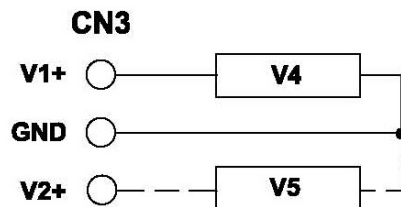
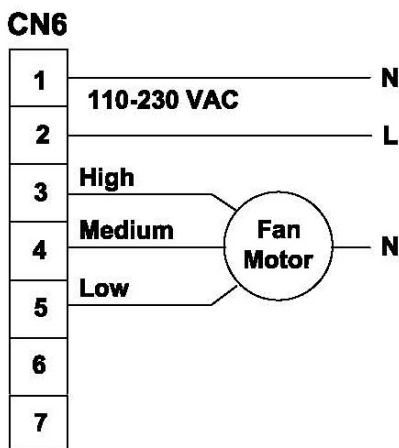
V1 and V2 are 2-wire on-off spring-return valves

### Wiring Diagram for Single 3-Wire Floating Valve Output



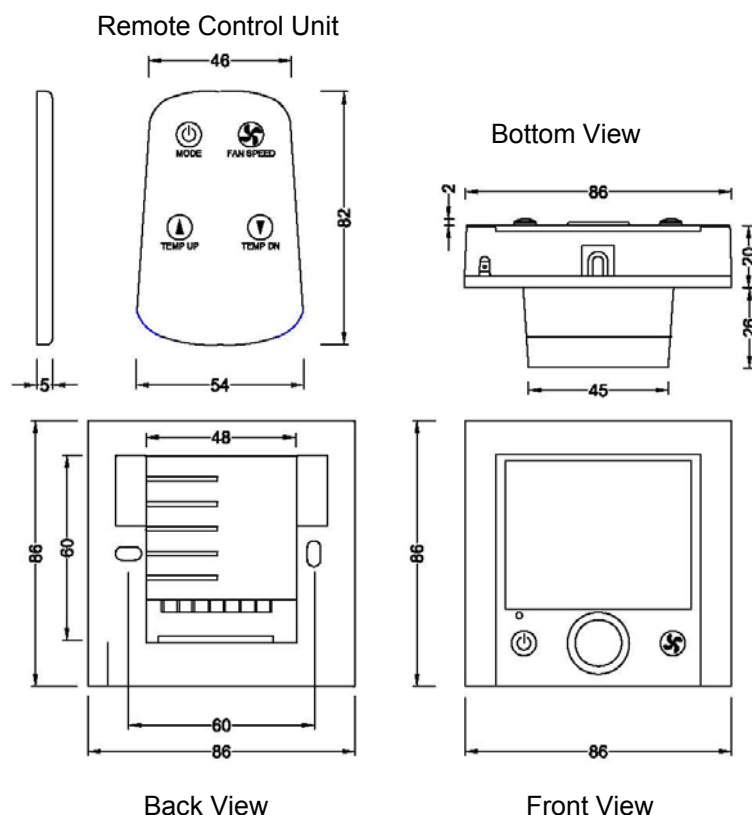
V3 is a 3-wire floating valve

### Wiring Diagram for Single and Dual 0-10 VDC Valve Outputs

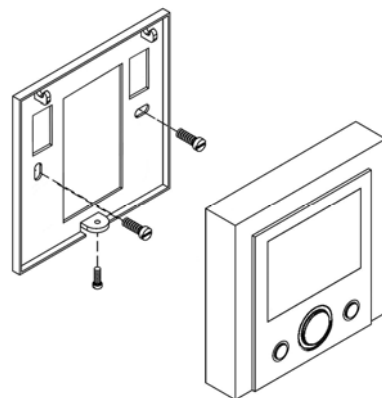


V4 and V5 are 0-10 VDC valves

**Figure 6: Dimensions in mm**



**Figure 7: Mounting Details**



### Mounting

The thermostat can be surface mounted or secured to a standard European 75 x 75 x 47 mm (strongly recommended) electrical box. Two mounting screws are included.

**Figure 8: Optional Accessories**

Description	Part No.
Remote control unit	RCU-1
Probe temperature sensor	TE10-1
Duct temperature sensor	TE10-2
With infra-red receiver capability	TC50-xxxR
Without buzzer capability	TC50-xxxB
With white-color faceplate	TC50-xxxW

## Operation Notes

- LCD shows ambient temperature constantly except when set point adjustment is being made.
- Press the system key  $\Phi$  to enter into the desired operating mode: Cool-Heat-Auto-Fan Only-Off, etc.
- Press the fan key  $\text{P}$  to change the fan speed mode: High-Med-Low-Auto.
- Increase or decrease temperature set point by rotating the adjustment dial clockwise or counter-clockwise. When the dial is rotated, the LCD shows the existing set point setting.
- In unoccupied mode, the factory temperature set points are 26 °C for cooling and 16 °C for heating and the fan speed is always set at "low".
- Unoccupied mode can be activated in the following manner when the unoccupied contact closes:  
For Models "1", "1A" and "1F", the unoccupied cooling or heating mode is determined by the status of the SR2 seasonal changeover sensor and the valve output is activated according to the measured temperature.  
For Models "1M", "1AM" and "1FM", while in unoccupied mode, the valve output is never activated.  
For Model "2" and "2A", the unoccupied cooling or heating mode is always determined by the measured temperature and valve output is also activated according to the measured temperature.  
Unoccupied mode activation in operating mode only or in both standby and operating mode will be determined by activation setting in setup menu. Low fan will run according to fan action setting in setup menu.  
When unoccupied mode is activated, all keys are locked out and no settings can be entered.
- The thermostat allows authorized service agent to change the following operating parameters in the field.
- When "1F" or "1FM" is used for on-off control, its parameter settings must be set as  $\text{R } 1$ ,  $\text{b } 0$  and  $\text{C } 3$  and its effective operating temperature differential will be 1 K.

Function	Symbol	Description
MCU firmware (software) revision level	<b>D</b>	Appears after entering the setup menu
Choice of temperature engineering unit	<b>I</b>	<b>I-C</b> = °C (factory setting) <b>I-F</b> = °F
Choice to retain last entered settings on power resumption	<b>Z</b>	<b>ZOn</b> = program on (factory setting) <b>ZOf</b> = program off
Offset adjustment of temperature indication (field recalibration of measured temperature)	<b>3</b>	<b>3 2</b> = temperature indication plus 2 degrees <b>3 1</b> = temperature indication plus 1 degree <b>3 0</b> = no offset (factory setting) <b>3- 1</b> = temperature indication minus 1 degree <b>3- 2</b> = temperature indication minus 2 degrees
Adjustable proportional band for PI control	<b>A</b>	Selections of 1 to 10 <b>A 1</b> = 1 K (1 R)..... <b>A 5</b> = 5 K (5 R) = factory setting..... <b>A 10</b> = 10 K (10 R)
Choice of integral time for 3-wire floating models	<b>b</b>	To set integral time from 0 (0 min) to 30 (30 min) in numeric 1 (1 min) increment factory setting = 15 minutes. Setting = 0 means integral time being turned off.
Choice of valve stroke time for 3-wire floating models	<b>C</b>	Adjustable 1 to 24: <b>C 1</b> = 10 seconds..... <b>C 12</b> = 120 seconds = factory setting..... <b>C 24</b> = 240 seconds
Deadband value adjustment for dual-output models only	<b>d</b>	To set auto cool/heat changeover deadband value from 1 to 5 K (2 to 10 R)
Upper occupied set point limit setting	<b>E</b>	To set upper occupied set point limit, adjustable between current lower set point limit value and 35°C (factory setting 35°C). The program is set such that there is always a minimum separation of 4 degrees maintained between the upper occupied set point limit value and the lower set point limit value.
Lower occupied set point limit setting	<b>F</b>	To set lower occupied set point limit, adjustable between current upper set point limit value and 5°C (factory setting 5°C). The program is set such that there is always a minimum separation of 4 degrees maintained between the upper occupied set point limit value and the lower set point limit value.
Unoccupied cooling set point setting	<b>g</b>	To set unoccupied cooling set point, adjustable between current unoccupied heating set point value and 35°C (factory setting 26°C). The program is set such that there is always a minimum separation of 4 degrees maintained between the unoccupied cooling set point value and the unoccupied heating set point value. Unoccupied cooling set point setting is not applicable to Models "1M", "1AM" and "1FM".
Unoccupied heating set point setting	<b>h</b>	To set unoccupied heating set point, adjustable between current unoccupied cooling set point value and 5°C (factory setting 16°C). The program is set such that there is always a minimum separation of 4 degrees maintained between the unoccupied cooling set point value and the unoccupied heating set point value. Unoccupied heating set point setting is not applicable to Models "1M", "1AM" and "1FM".
Choice of fan action in unoccupied mode	<b>J</b>	<b>J- 1</b> = Low fan will run only when unoccupied set point calls for cooling or heating in unoccupied mode (factory setting). <b>J- 2</b> = Low fan always runs whenever thermostat is in unoccupied mode. Note: For "1M" models, the fan will always run when unoccupied contact is closed.
Choice of activation for unoccupied mode	<b>L</b>	<b>L- 1</b> = Unoccupied mode can only be activated when thermostat is in operating mode (factory setting). When unoccupied contact closes with this setting, all thermostat functions will be locked out. <b>L- 2</b> = Unoccupied mode can be activated when thermostat is in either standby mode or operating mode
Choice of auto fan action in heating mode (operation of both control valve and fan is temperature-dependent)	<b>P</b>	<b>P- 1</b> = No fan output when room temperature (Tr) => set point value (Ts). Low speed when - 2.0 K <= Tr - Ts <= -0.5 K Med speed when - 4.0 K <= Tr - Ts <= -2.5 K High speed when Tr - Ts <= -4.5 K <b>P- 2</b> = (factory setting) Low fan output when -2.0 K <= Tr - Ts Med speed when - 4.0 K <= Tr - Ts <= -2.5 K High speed when Tr - Ts <= -4.5 K
Choice of operating mode sequence for dual-output models only	<b>r</b>	<b>r- 1</b> = to set operating mode in sequence of Cool-Heat-Auto-Fan Only-Off (factory setting) <b>r- 2</b> = to set operating mode in sequence of Auto-Off
Choice of "1" or "1M" model, "1A" or "1AM" model and "1F" or "1FM" model	<b>t</b>	<b>t- 1</b> = to set operating mode in sequence of Off-Cool or Heat-Fan Only (factory setting for "1", "1A" and "1F" models) <b>t- 2</b> = to set operating mode in sequence of Off-Cool-Heat-Fan Only (factory setting for "1M", "1AM" and "1FM" models)
Choice of constant display of ambient temperature or temperature set point value	<b>U</b>	<b>U- 1</b> = constant display of ambient temperature (factory setting) <b>U- 2</b> = constant display of set point value
Restoration of default factory settings	<b>r5</b>	<b>r5 1</b> = Retain current settings (factory setting) <b>r5 2</b> = Restore default factory settings

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