MegaControls

NT50 Series
RS-485 Modbus RTU Room Thermostats with LCD for Fan Coil Units

Features

- Ultra slim wall-mount unit to match any decor
- Supports standalone operation on RS-485 communication failure
- Fan coil application database pre-loaded
- 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 ºC or ºF temperature display via parameter setup menu
- 2-wire on-off, 3-wire on-off/floating and 0-10 VDC output models available
- Adjustable proportional band and integral time for 3-wire floating and 0-10 VDC output models
- Choice of valve stroke time for 3-wire floating output models
- Field adjustable high and low occupied set point limit settings
- Field adjustable cooling and heating unoccupied set point values (applicable to some models only)
- 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
- Choice of operating sequence for dual-output models
- Adjustable 1 to 5 K deadband 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
- Provides one additional digital input for function such as remote night setback, service/filter alarm or motion detection
- Choice of fan action in unoccupied mode
- Choice of auto fan action in heating 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 NT50 Series RS-485 networking room thermostats use the communication technologies of Modbus RTU protocol to monitor and supervise fan coil units in the heating, ventilating and air-conditioning industry, and employ a simple master/slave protocol. All NT50 Series thermostats are slaves in this protocol, and under the control of a BACnet MS/TP gateway (BMG) called the master. The BMGs are native BACnet MS/TP devices and communicate using the BACnet MS/TP protocol.

Net 2 port of the BMG master and all slaves are daisy-chained through a RS-485 Modbus RTU network. The maximum number of NT50 slaves in a Modbus RTU network is 32.

The BMG has 2 addresses. Net 2 address is always 0 which is the address of the Modbus RTU network. Net 1 address is the MAC address of the BACnet MS/TP network which is also set up for a maximum of 32 devices in a trunk cable length not exceeding 1,000 m.

If more than 32 BMGs are needed in the system, an additional BACnet MS/TP network supervising device is required for the second BACnet MS/TP network.

The NT50 Series thermostats cover a wide range of fan coil applications, including 2 and 4-pipe fan coils and direct connection to 3-speed fans. Temperature sensing can be from a built-in room sensor or a remote sensor.

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 at 2 K differential increments from low to high speed.

Mounting

The thermostats can be surface mounted or secured to a standard European 75 x 75 x 47 mm (strongly recommended) electrical box. See Fig. 2: Mounting Details. Two mounting screws are included.

Ordering

To order, specify complete model numbers. When ordering models NT50-1F-xx or NT50-1FM-xx for on-off control, specify this requirement in the order.

Mega Controls Limited
Room 1521A, Star House
3 Salisbury Road, Tsimshatsui, Kowloon, Hong Kong
Phone: +852 6281 1320   Fax: +852 3741 7084   E-mail: sales@megacontrols.com   Website: www.megacontrols.com

Specifications

Product model numbers	See Fig.1: NT50 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 (41-95ºF in 0.5 R increments, accuracy ±1 R)
Temperature setpoint range	5-35°C in 0.5 K increments, initial factory setting at 22°C (41-95ºF 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(6 R)
Valve stroke time for 3-wire floating models	Accumulatively 10 to 240 s maximum in one direction in steps of 10 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@25ºC; accuracy ±0.5 K@25ºC
Unoccupied mode	Input signal from external voltage-free contact
	Always runs at "Low" fan when in operation
Unoccupied temperature set point range (not applicable to "1M" models)	Field adjustable 5-35ºC (41-95ºF) in 1 K (1 R) increments separately for cooling and heating; Factory settings: 16ºC (61ºF) for heating and 26ºC (79ºF) for cooling
Binary input	1 binary input for external voltage-free contacts
Digital outputs	For direct connection of valve actuators (110-230 VAC)
	1 relay output for 2-pipe models
	2 relay outputs for 4-pipe models
	For direct connection to 3-speed fans (110-230 VAC)
	3 relay outputs
RS-485 communication speed	Baud rate fixed at 19,200 bps
Device MAC addressing	01-32 via parameter setup menu, factory default setting 255 (displays as FF on thermostat screen)
Proprietary FClink network and Modbus RTU network guideline	Maximum 32 devices and maximum 1,000 m cable length
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 55ºC/-30 to 50ºC , 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^2 or 18 AWG solid copper recommended
RS-485 Communication Wires	22 or 24 AWG Twisted Shielded Pair Double-insulated Cable
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 4: 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 1: NT50 Series Model Number Selection Guide

NT50 Series RS-485 Networking Room Thermostats Model Number Selection Guide (Complete Sets)				
NT5	**0**	**–**	**1M**	**R**
Product Type	Power Supply	Separator	Control Type	Options
NT5 = NT50 Series RS-485 Networking Room Thermostats	**0** = 110-230 VAC		**1** = Single 2-wire on-off output, cool only or heat only **1M** = Single 2-wire on-off output, manual cool/heat changeover **1A** = Single 0-10 VDC output, cool only or heat only **1AM** = Single 0-10 VDC output, manual cool/heat changeover **1F** = Single 3-wire floating output, cool only or heat only **1FM** = Single 3-wire floating output, manual cool/heat changeover **2** = Dual 2-wire on-off outputs, manual or Auto cool/heat changeover **2A** = Dual 0-10 VDC outputs, manual or Auto cool/heat changeover	**R** = with infra-red receiver for RCU-1 **B** = without buzzer for key touch sounding **W** = with white color faceplate

Figure 2: NT50 Series Application Guide

Model Numbers	Outputs	Applications	Cooling/Heating Mode	External Seasonal Changeover	System Modes	Fan Control	Unoccupied Mode
NT50-1	Single 2-Wire On-Off	Cooling Only or Heating Only (2-Pipe System)	Auto Only	Yes	Cool or Heat-Fan Only-Off	Hi-Med-Low-Auto	Yes
NT50-1M	Single 2-Wire On-Off	Cooling/Heating (2-Pipe System)	Manual Only	No	Cool or Heat-Fan Only-Off	Hi-Med-Low-Auto	Yes
NT50-1F	Single 3-Wire Floating	Cooling Only or Heating Only (2-Pipe System)	Auto Only	Yes	Cool or Heat-Fan Only-Off	Hi-Med-Low-Auto	Yes
NT50-1FM	Single Line-Voltage 3-Wire Floating	Cooling/Heating (2-Pipe System)	Manual Only	No	Cool or Heat-Fan Only-Off	Hi-Med-Low-Auto	Yes
NT50-1A	Single 0-10 VDC	Cooling Only or Heating Only (2-Pipe System)	Auto Only	Yes	Cool or Heat-Fan Only-Off	Hi-Med-Low-Auto	Yes
NT50-1AM	Single 0-10 VDC	Cooling/Heating (2-Pipe System)	Manual Only	No	Cool or Heat-Fan Only-Off	Hi-Med-Low-Auto	Yes
NT50-2	Dual 2-Wire On-Off	Cooling and Heating (4-Pipe System)	Manual or Auto	No	Cool-Heat-Auto-Fan Only-Off Or Auto-Off	Hi-Med-Low-Auto	Yes
NT50-2A	Dual 0-10 VDC	Cooling and Heating (4-Pipe System)	Manual or Auto	No	Cool-Heat-Auto-Fan Only-Off Or Auto-Off	Hi-Med-Low-Auto	Yes

Figure 3: Dimensions in mm

Remote Control Unit

Bottom View

Back View

Front View
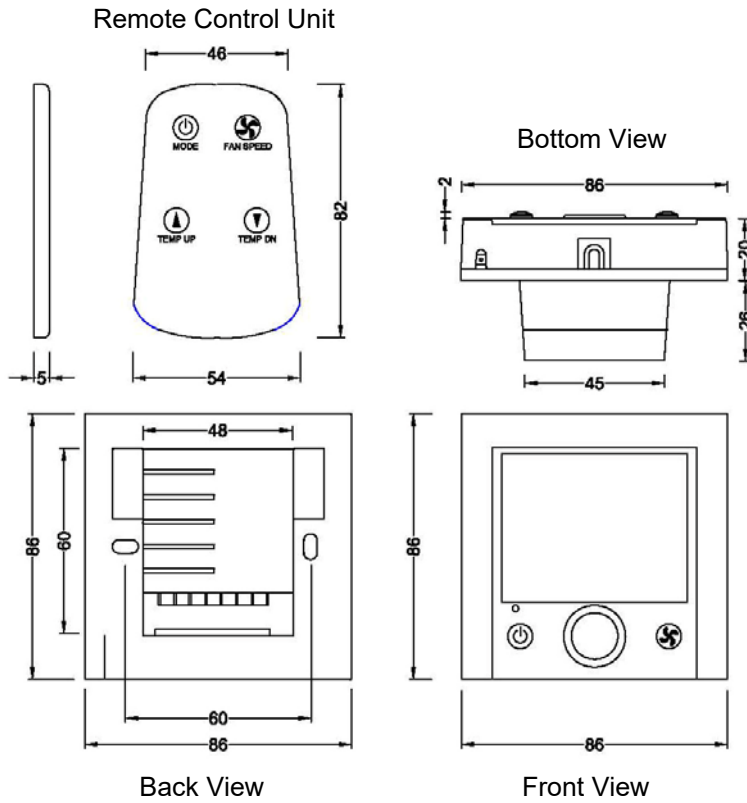
Figure 4: Mounting Details
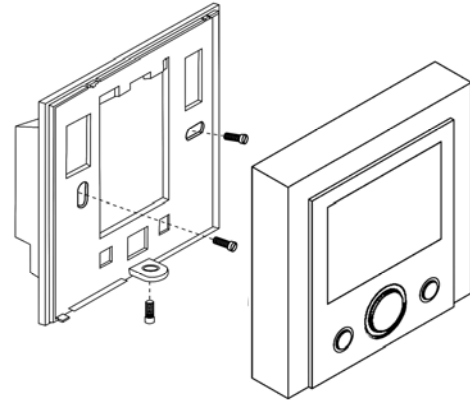
Figure 5: Optional Accessories

Description	Part No.
Remote control unit	RCU-1
Probe temperature sensor	TE10-1
Duct temperature sensor	TE10-2
With infra-red receiver capability	NT50-xxxR-xx
Without buzzer capability	NT50-xxxB-xx
With white-color faceplate	NT50-xxxW-xx

Network & Cabling Requirements

To ensure network stability and reliable communications, particularly at high speeds on a BACnet MS/TP network for a number of devices, it is imperative that the following network and cabling requirements are adhered to:

Item	Description
Cabling	It is recommended to use networking cabling that matches the following specifications: • Balanced 100 to 120 ohms nominal impedance, 22 or 24 AWG Twisted Shielded Pair (TSP) Cable • Nominal capacitance of 52 pF/m or lower • Nominal velocity of propagation of 66% or higher • Terminating the shield to ground at one end only for each isolated segment will prevent ground loops in the shield and drain RF energy to ground. Grounding at the BACnet router or controller is preferred.
Topology	Ensure the MS/TP network cable is installed as a daisy chain from one device to the next.
Maximum Nodes	The maximum number of devices is 32 per MS/TP network segment and 64 per network trunk with one re-peater.
Terminator	A terminator of 120-ohm impedance must be installed at each end of each MS/TP network segment, or two per MS/TP network. Ensure that this requirement is not overlooked in laying out the network architecture and ordering product.
Cable Shielding	Use a shielded, twisted pair cable for communications. Never directly ground wire in more than one point on the shield. Doing so can induce large currents and result in communication problem.
Repeater	A repeater is not necessary unless more than 32 nodes will be installed on a network or the MS/TP network is extended beyond 1,000 m.
Step-down Trans-former	A separate isolated double-wound transformer is recommended for supplying 24 VAC power to each BMG. If and when the same transformer is shared with other devices, observe the polarities of the power supply of all devices including the BMG.

Figure 6: Jumper Settings

The models NT50-2 and NT50-2A can be re-configured in the field to other 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	
	JP2	JP3
NT50-1	Cut	Cut
NT50-1M	Cut	Cut
NT50-2	Uncut	Uncut
NT50-1F	Cut	Uncut
NT50-1FM	Cut	Uncut
NT50-1A	Cut	Cut
NT50-1AM	Cut	Cut
NT50-2A	Uncut	Uncut

Jumper Settings of JP1 and JP4		
Jumper	Cut	Uncut
JP1	With External Sensor	With Built-in Sensor
JP4	For 2-10 VDC Output	For 0-10 VDC Output

Note: JP4 is available in 0-10 VDC/2-10 VDC output models only. Factory setting is 0-10 VDC.

Note: Terminals V1+, GND and V2+ are only available in 0-10 VDC output models.
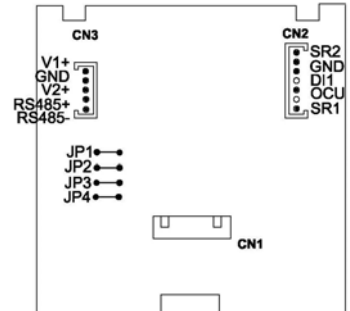
Operation Notes

Operation
- LCD shows ambient temperature constantly except when set point adjustment is being made.
- Press the system key Φ to enter into the desired operating mode: Cool-Heat-Auto-Fan Only-Off, etc.
- Press the fan key ✳ 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 setpoint setting.

Unoccupied Mode
- When the unoccupied contact closes, it will override the operating mode and operate the thermostat in energy saving mode despite the thermostat being in operating or standby mode, depending on activation setting of unoccupied mode in setup menu.
- In unoccupied mode, the factory-set temperature cut-in points are 26°C for cooling and 16°C for heating. Meanwhile, all operating keys are locked out until the unoccupied contact opens.
- During unoccupied mode, the default fan speed is set at "low" when pre-set cut-in temperature is reached, or otherwise the fan output is always "off".
- Unoccupied mode can be activated in the following manner when the unoccupied contact closes:
  For 2-pipe models with auto seasonal changeover, 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 2-pipe models with manual seasonal changeover, the unoccupied cooling or heating status is determined by the last status of the occupied mode and the valve output is controlled according to the measured temperature.
  For 4-pipe models, 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.

Parameter Setup Mode
- The thermostat allows authorized service agent to change a number of operating parameters in the field. Refer to the parameter setup manual for details.
- When "1F" or "1FM" is used for on-off control, its parameter settings must be set as $A1$, $b0$ and $C3$. and its effective operating temperature differential will be 1 K.

Error reporting
- All valve and fan outputs will be shut down when error is reported.

MCU firmware revision level	0	Appears after entering the setup mode
Choice of temperature engineering unit	1	1-C= ºC (factory setting) 1-F = ºF
Choice to retain last entered settings on power resumption	2	2On = program on (factory setting) 2OF = program off
Offset adjustment of temperature indication (field recalibration of measured temperature)	3	3 2 = temperature indication plus 2 degrees 3 1 = temperature indication plus 1 degree 3 0 = no offset (factory setting) 3-1 = temperature indication minus 1 degree 3-2 = temperature indication minus 2 degrees
Device MAC address setting	5	To set the slave device address from 1 to 32, factory default setting 255 (displays as FF on thermostat screen)
Adjustable proportional band for PI control	A	Selections of 1 to 10 A 1 = 1 K…….A 3 = 3 K (factory setting)……...A 5 = 5 K
Adjustable integral time for PI control	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	C	Adjustable1 to 24: C 1 = 10 seconds……..C 18 = 180 seconds = factory setting……..C24 = 240 seconds
Deadband adjustment for dual-output models	d	To set deadband value from 1 to 5 K, factory setting 3 K
Upper occupied set point limit setting	E	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	F	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	G	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 heating set point setting	h	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.
Choice of fan action in unoccupied mode (always in auto fan mode)	J	J-1 = Low fan will run only when unoccupied set point calls for cooling or heating in unoccupied mode (factory setting) J-2 = Low fan always runs whenever unoccupied contact is closed while opening and closing of control valve are temperature-dependent.
Choice of activation of unoccupied mode	L	L-1 = Unoccupied mode can only be activated when thermostat is in operating mode (factory setting) L-2 = 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)	P	P-1 = 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 P-2 = (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 sequence for dual-output models only	r	r-1 = to set operating mode in sequence of Cool-Heat-Auto-Fan Only-Off (factory setting) r-2 = to set operating mode in sequence of Auto-Off
Choice of "1" or "1M" model	t	t-1 = to set operating mode in sequence of Off-Cool or Heat-Fan Only (factory setting for "1" model) t-2 = to set operating mode in sequence of Off-Cool-Heat-Fan Only (factory setting for "1M" model)
Choice of constant display of ambient temperature or temperature set point value	u	u-1 = constant display of ambient temperature (factory setting) u-2 = constant display of set point value
Restoration of default factory settings	rS	rS1 = Retain current settings (factory setting) rS2 = Restore default factory settings

LCD
Fan Key
IR Receiver
System Key
Set Point Dial

Auto Mode — Fan Only Mode
Cooling — Unoccupied Mode
Heating — Celsius
Temperature — Fahrenheit
Auto Fan — Med Fan
Low Fan — High Fan
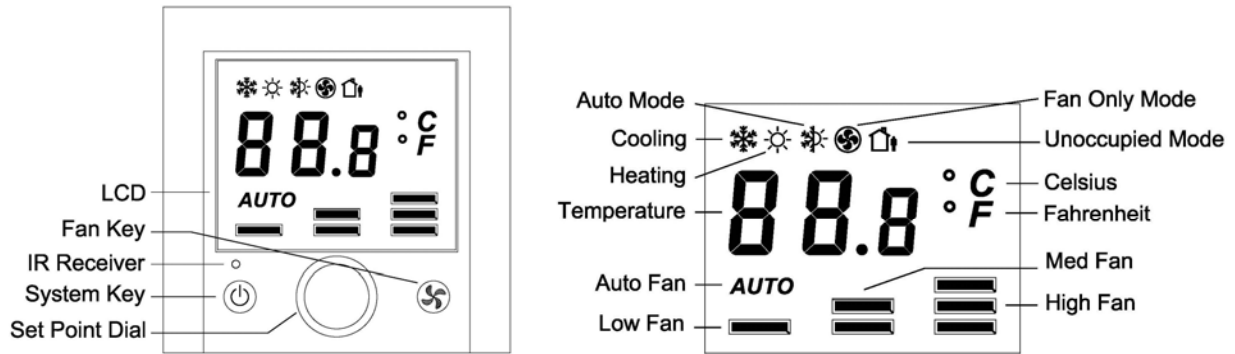
Figure 8: Network Configuration

To a BACnet MS/TP
Network Supervisor

BACnet MS/TP Network

TERMINATOR

TERMINATOR

NET1 NET2

NET1 NET2

BMG
(Master)

BMG
(Master)

RS-485 FClink or Modbus RTU Network

TERMINATOR

Slaves

NT50   NT50   NT50   NT50
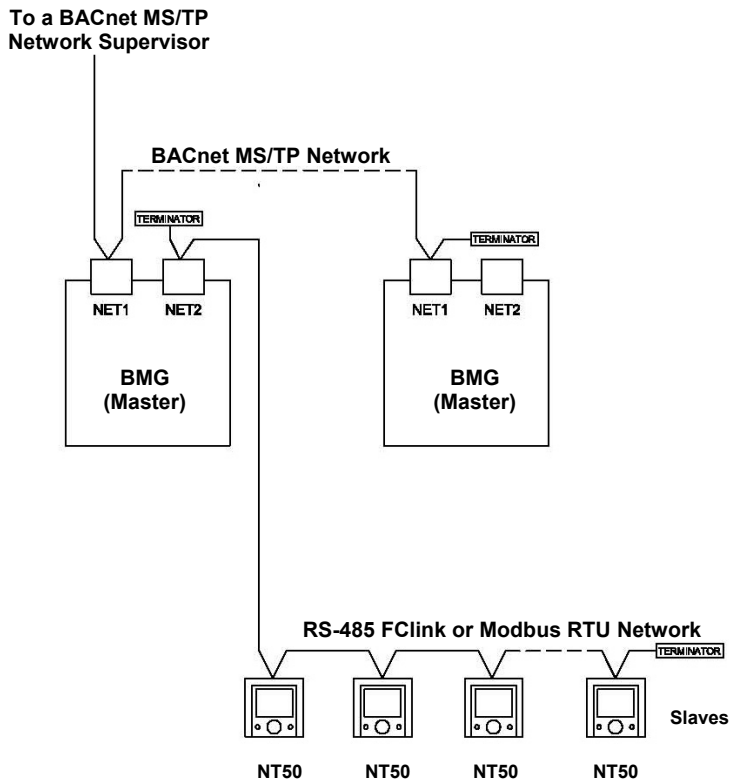
BACnet MS/TP Network Notes:
1. Ensure the recommended balanced cable is used.
2. Ensure the cable is installed as a daisy chain from one device to the next (1,000 m maximum) and the shield is grounded at one single point of the network only.
3. Ensure a MS/TP terminator is installed on each end of each MS/TP network.
4. The maximum nodes per MS/TP network is 32 without a repeater.

RTU Network Notes:
1. Ensure the recommended balanced cable is used.
2. Ensure the cable is installed as a daisy chain from one device to the next (1,000 m maximum) and the shield is grounded at one single point of the network only.
3. Ensure a terminator is installed on each end of each Modbus RTU network.
4. The maximum nodes per Modbus RTU network is 32

Figure 9: 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.
- 22 or 24 AWG twisted shielded pair double-insulated cable must be used as RS-485 communication wiring and its length must not exceed 1,000 m without a repeater
- 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 ºC, 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 is applicable to dual-output models only.
- The thermostat outputs of on-off models are designed for controlling zone valves. If used for controlling electric heaters, external contactors must be used.

## Figure 9: NT50 Series RS-485 Networking Room Thermostat Wiring Diagrams

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.

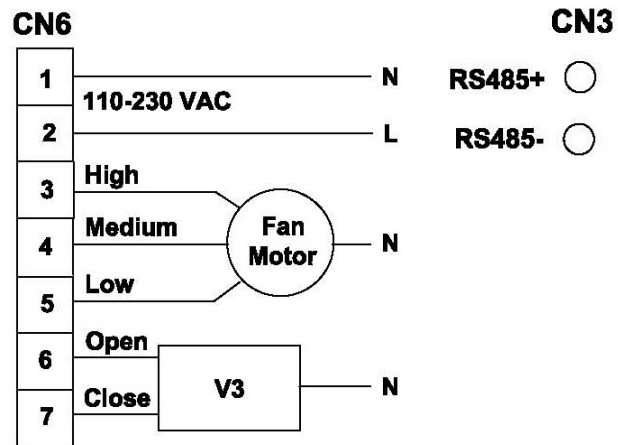### Connections of Sensors and Contacts
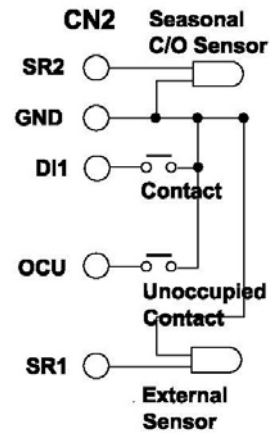
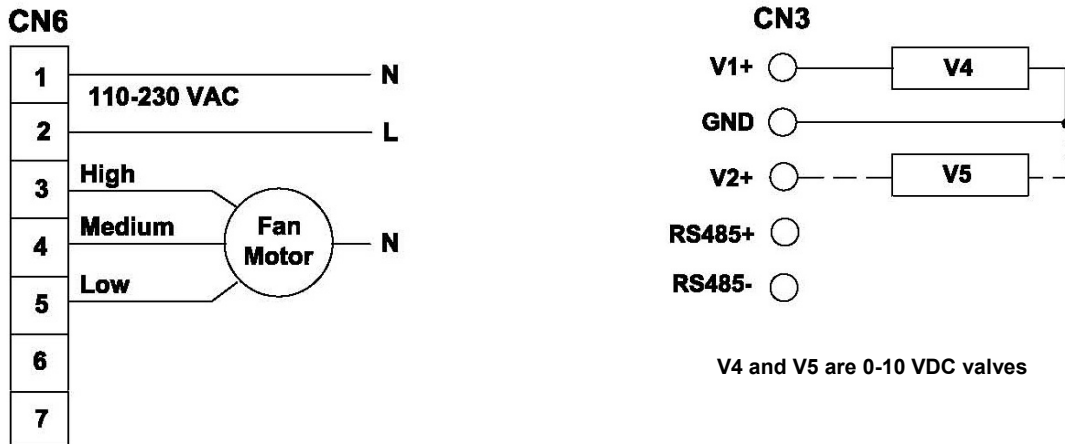### Wiring Diagram for Single and Dual 2-Wire On-Off Valve Outputs
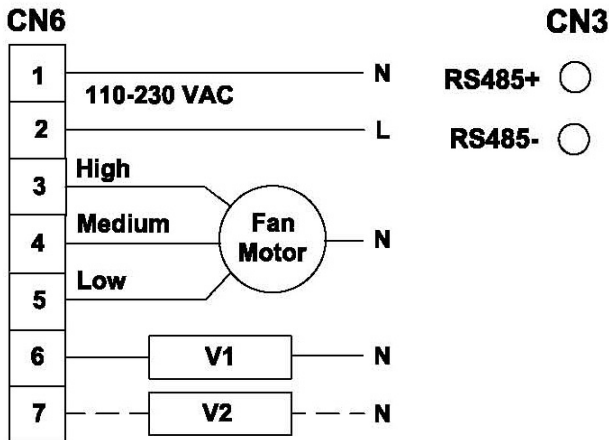
V1 and V2 are 2-wire on-off spring-return valves

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