NT800 Series

BACnet MS/TP Networking Room Thermostats for Fan Coil Units

Features

- Ultra slim wall-mount network control unit to match any décor
- Supports standalone operation on BACnet MS/TP communication failure; relinquishes all network commands by a special key operation at the thermostat
- Field selectable RS-485 communication port baud rate setting: 9,600, 19,200, 38,400 or 76,800 bps
- Fan coil application database pre-loaded
- Extra large easy-to-read liquid crystal dislplay (LCD) with LED backlight (white)
- 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 and to provide high current ratings and performance
- Slim separate power supply unit to fit on all sizes of fan coil units and to provide highly reliable power source
- Configurable operating parameters
- Choice of ºC or ºF temperature display via parameter setup menu
- Adjustable 1-5 K proportional band and integral time for PI control
- Choice of valve stroke time for 3-wire floating output models
- Field adjustable high and low occupied set point limit values
- Field adjustable cooling and heating unoccupied set point values (applicable to some models only)
- Choice to retain last entered settings on power resumption
- 2-wire on-off, 3-wire floating and 0-10 VDC output models available
- Dual-output 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
- Choice of unoccupied mode activation in operating mode only or in both standby and operating modes
- Provides thermostat keys lockout from any workstation in the network
- Window contact closure to lock out all thermostat functions
- Provides two additional digital inputs for function such as remote night setback, service/filter alarm or motion detection
- Provides one digital output for external device interlocking; output is on whenever the fan is running at any speed
- Provides one additional digital output for function such as lighting control
- 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 available
- Optional energy metering capability
- Optional special faceplate color available on request

General

The NT800 Series networking room thermostats are BACnet Master-Slave/Token-Passing (MS/TP) networked devices designed in strict accordance with ASHRAE standard 135-2010 and are native BACnet devices. These thermostats provide line-voltage or 24-VAC 2-wire on-off, 3-wire floating or 0-10 VDC output to water valves in 2-pipe or 4-pipe fan coil units.

The technologically advanced NT800 Series networking thermostats feature a BACnet MS/TP communication capability that enables remote monitoring and programmability for efficient space or return air temperature control.

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 NT800 Series networking thermostats also feature an intuitive user interface that makes setup and operation quick and easy.

A system mode control touch key allows the user to enter into the desired operating mode of cool-heat-auto-fan only-off for single- and dual-output models or auto-off for dual-output models only.

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 0.5~4.5 K differential increments from low to high speed. For actual activating temperature differential values, refer to the parameter setup menu on Page 7.

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

Ordering

To order, specify model numbers of complete set, network control unit or power supply unit.

Figure 1: NT800 Series Model Number Selection Guide

NT800 Series Networking Room Thermostats Model Number Selection Guide (Complete Sets)

NT8	0	1M	-	R
Product Type	Power Supply	Control Type	Separator	Options
NT8 = NT800 Series BACnet MS/TP Networking Thermostats	**0** = 100-230 VAC **2*** = 230 VAC + 24 VAC **3*** = 120 VAC + 24 VAC * Suitable for line-voltage fan control and 24 VAC 2-wire on-off or 3-wire floating valve control	**1** = Single output, line-voltage 2-wire on-off, cool only or heat only **1M** = Single output, line-voltage 2-wire on-off, manual cool/heat changeover **1F** = Single output, line-voltage 3-wire floating, cool only or heat only **1FM** = Single output, line-voltage 3-wire floating, manual cool/heat changeover **2** = Dual outputs, line-voltage 2-wire on-off, Manual or auto cool/heat changeover **1A** = Single output, 0-10 VDC, cool only or heat only **1AM** = Singlle output, 0-10 VDC, manual cool/heat changeover **2A** = Dual outputs, 0-10 VDC, manual or auto cool/heat changeover **2AH** = Dual outputs, 0-10 VDC cooling + line -voltage on-off heating, 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 **E** = with energy metering capability **24** = with 24 VAC 2-wire on-off or 3-wire floating output

Power Supply Unit Model Number Selection Guide

PSU8	0	1	F	M	–24
Product Type	Power Supply	Number of Outputs	Control Type	Seasonal Changeover	Control Output
PSU8 = Power Supply Units for NT800 Series	**0** = 100-230 VAC **2** = 230 VAC + 24 VAC* **3** = 120 VAC + 24 VAC* * Suitable for line-voltage fan control and 24 VAC 2-wire on-off or 3-wire floating valve control	**1** = Single output **2** = Dual outputs	**Nil** = 2-wire on/off **F** = 3-wire floating **A** = 0-10 VDC **AH** = 0-10 VDC + on-off	**Nil** = Auto by external sensor **M** = Manual	**Omitted** = Line-voltage 2-wire on-off or 3-wire floating output **–24** = with 24 VAC 2-wire on-off or 3-wire floating output

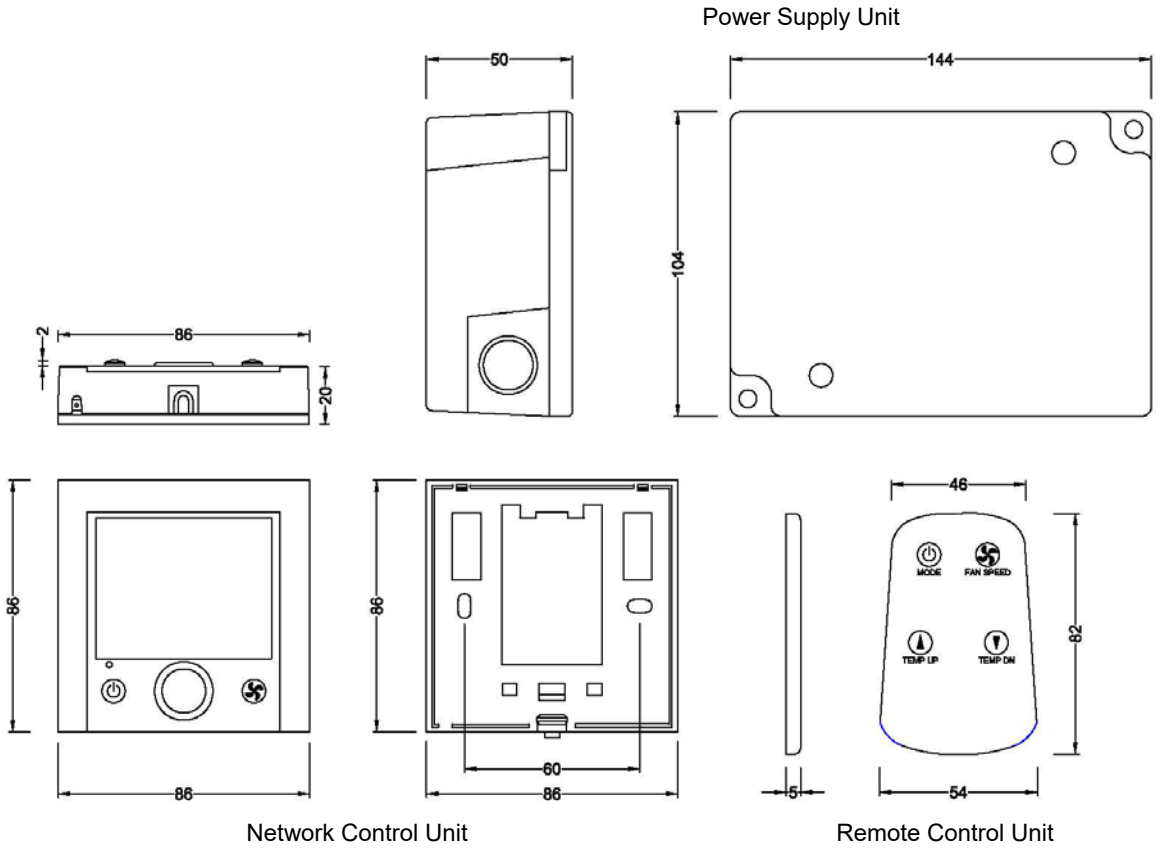
Network Control Unit Model Number Selection Guide

NCU8	1	A	M	-	R
Product Type	Number of Outputs	Control Type	Seasonal Changeover	Separator	Options
NCU8 = Network Control Units For NT800 Series	**1** = Single output **2** = Dual outputs	**Nil** = 2-wire on-off **F** = 3-wire floating **A** = 0-10 VDC **AH** = 0-10 VDC + on-off	**Nil** = Auto by external sensor **M** = Manual		**Nil** = No option **R** = with IR receiver for RCU-1 **B** = without buzzer for key touch sounding **W** = with white color faceplate **E** = with energy metering capability

Figure 2: NT800 Series Application Guide

Model Number	Outputs	Applications	Cooling/Heating Mode	External Seasonal Changeover	System Modes	Fan Control	Unoccupied Mode
NT8x1	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
NT8x1M	Single 2-Wire On-Off	Cooling or Heating (2-Pipe System)	Manual Only	No	Cool or Heat-Fan Only-Off	Hi-Med-Low-Auto	Yes
NT8x1F	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
NT8x1FM	Single 3-Wire Floating	Cooling or Heating (2-Pipe System)	Manual Only	No	Cool or Heat-Fan Only-Off	Hi-Med-Low-Auto	Yes
NT8x2	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
NT8x1A	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
NT8x1AM	Single 0-10 VDC	Cooling or Heating (2-Pipe System)	Manual Only	No	Cool or Heat-Fan Only-Off	Hi-Med-Low-Auto	Yes
NT8x2A	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



Specifications

Product model numbers	See Figure 1: NT800 Series Model Number Selection Guide
Power requirements	100-230 V, ±10%, 50/60 Hz or 230 V, ±10%, 50/60 Hz depending on models
0(2)-10 VDC output impedance	Minimum 10,000 Ω
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 set point range	5-35°C in 0.5 K increments (41-95ºF in 0.5 R increments), initial factory setting at 22°C
Temperature set point limits	Field adjustable 5-35ºC (41-95ºF) in 0.5 K increments
Constant display on LCD	Choice of ambient temperature or temperature set point value
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	Choice of 1, 2 , 3, 4 or 5 K between cooling mode and heating mode, factory setting 3 K
Valve stroke time for 3-Wire floating models	Accumulatively 10 to 240 s maximum in one direction in steps of 10 s Factory setting 180 s
Proportional band for PI control	Adjustable 1 to 10 K (2-10 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 (4 R) increments. In cooling mode, fan stays at low speed when there is no cooling valve output. Fan status in heating mode depends on auto fan action selection setting.
Sensing element	NTC thermistor, 10 kΩ @ 25ºC,accuracy ± 0.5 K @ 25ºC
Unoccupied mode binary Input	From external voltage-free contact. Choice of activation of unoccupied mode: 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
Unoccupied temperature set Point range	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 inputs	3 binary inputs for external voltage-free contacts
Binary outputs	For direct Connection of valve actuators (100-230 VAC) 1 relay output for 2-pipe models 2 relay outputs for 4-pipe models For direct connection to 3-speed fans (100-230 VAC) 3 relay outputs For connection to relay coils 2 photo-coupler outputs for 30 VDC@50mA external power
RS-485 communication speed	Selectable baud rate at 9600, 19200, 38400 or 76,800 bps (factory set at 38,400 bps)
Maximum number of BACnet device instance ID	9999 thermostat addresses: from 0001 to 9999 via parameter setup menu, factory setting “0123”
BACnet MS/TP network guidelines	Maximum 32 devices and maximum 1,000 m cable length per segment; maximum two segments per network trunk with one repeater; maximum 64 devices per network trunk; only one segment allowed at 76,800 bps baud rate
Enclosure	Material: Self-extinguishing, molded ABS Finish: Off white housing and dark grey faceplate
Protective class	IP30
Electrical ratings	Valve output (24 VAC valve output only) 24 V, 0.3 A resistive, 0.3 A inductive, 50/60 Hz Valve output (all other models) 100-230 V, 5 A resistive, 2 A inductive, 50/60 Hz Fan output relays 100-230 V, 5 A resistive, 2 A inductive, 50/60 Hz Total rating 100-230 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 terminal blocks and removable wire plugs
Power wires	Wire size 1 mm^2 or 18 AWG solid copper recommended
PSU/NCU inter-connecting wires	Cat 5e twisted 6-conductor cable (shielded or unshielded)
Sensor wires	22 AWG twisted shielded pair double-insulated cable
RS-485 communication wires	22 AWG twisted shielded pair double-insulated cable
Input/output wires	Cat 5e twisted conductor cable (shielded or unshielded) recommended
Accessories and options	See Figure 6: Optional Accessories
Agency approval	CE Mark compliant to EMC and Low Voltage Directives, BTL Listing pending
Shipping weight	Network control unit & power supply unit together: 0.62 to 0.78 kg (1.4 to 1.7 lb)
Dimensions	See Figure 3: 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.

Thermostat Errors Reporting

When the following errors are reported on the LCD display unit, these errors will prevent the thermostat from normal operation and all thermostat functions will be locked out:

E-1 EEPROM read/write error
E-2* Temperature sensor open-circuited
E-3 Temperature sensor short-circuited
E-4 User configuration checksum error

* If jumper JP1 is cut open and external sensor is used, E-2 means the external sensor may have been disconnected from Terminals SR1 and GND. Check the external sensor's connectivity and resistive value. If E-2 error is still reported, return the thermostat to the manufacturer for repair.

When the error E-1, E-3 or E-4 is reported or when the error E-2 is reported without jumper JP1 being cut and external sensor being installed, return the thermostat to the manufacturer for repair.

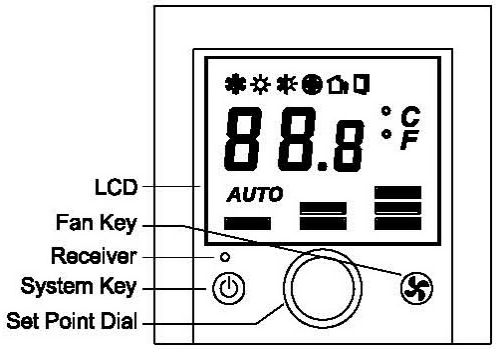
Trouble-Shooting

Before trouble-shooting starts, ensure that the voltage output from Terminals 1 (GND) and 2 (+12 Vdc) on the power supply unit is between 12 Vdc and 15 Vdc and not higher. Higher voltage may damage the internal circuitry and components of the network control unit.

When abnormal power voltages are found, return the thermostat to the manufacturer for repair.

When there is no 12 Vdc power output, check the line voltage power and its 5 A fuse.

Figure 4: Network Control Unit and LCD Layout



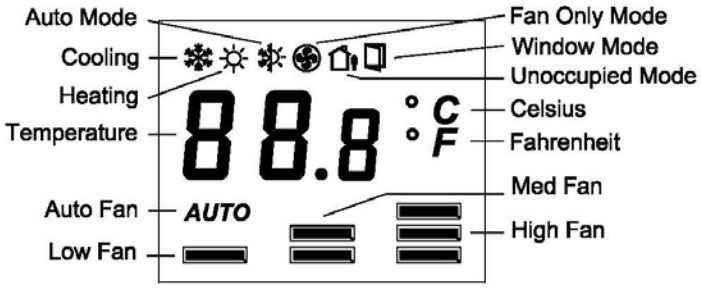


Figure 5: NCU Mounting Details

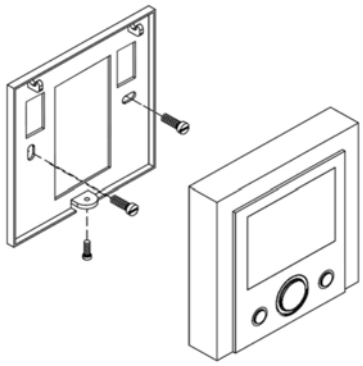


Figure 6: Optional Accessories

Description	Part Number
Remote control unit	RCU-1
Probe temperature sensor	TE10-1
Duct temperature sensor	TE10-2
With infra-red receiver capability	NT8xxx-R
Without buzzer capability	NT8xxx-B
With white color faceplate	NT8xxx-W
With energy metering capability	NT8xxx-E

Mounting of Network Control Unit
The NT800 Series network control unit can be flush mounted or secured to a standard European 75 x 75 x 35 mm electrical box. See Fig. 2: Mounting Details. Two M3.5 mounting screws for Network Control Units only are included.

Figure 7: NT800 Series Networking Room Thermostat Wiring Diagram

The networking thermostats consist of two basic units: the Network Control Unit and the Power Supply Unit. While all line-voltage wiring is terminated at the Power Supply Unit, all connections between Network Control Unit and Power Supply Unit are of low-voltage signaling wires.

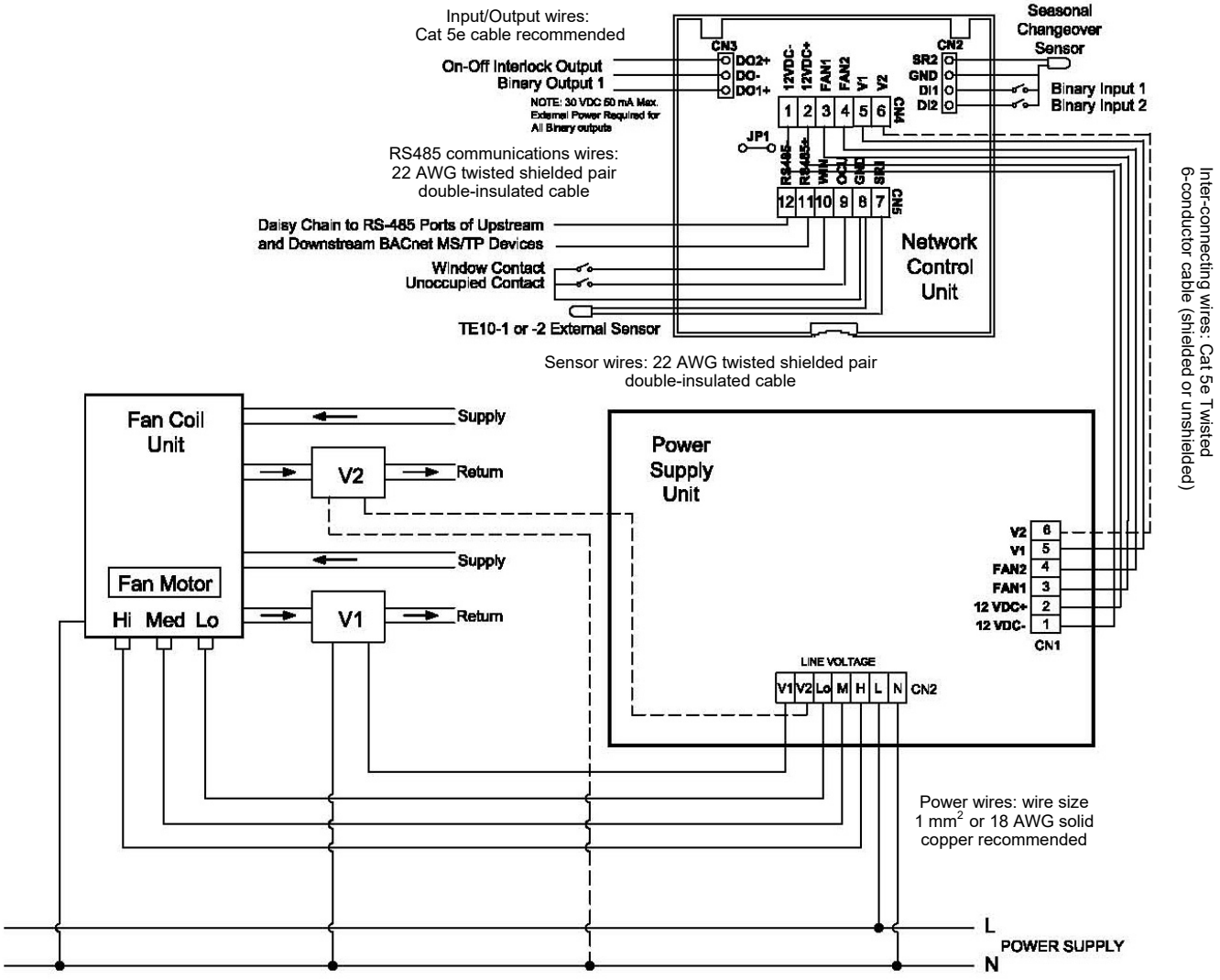
Wiring and Application Notes

- Cut jumper JP1 if 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 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.
- Connecting wires between Network Control Unit and Power Supply Unit must not exceed 15 m.
- Seasonal changeover sensor or switch is only applicable to heat only or cool only 2-pipe model only.
- 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.
- Unoccupied contact closure activates energy saving mode.
- Window contact closure locks out all thermostat functions.
- The thermostat outputs are designed for controlling zone valves. If used for controlling electric heaters, external contactors must be used.

Wiring Diagram for Line-Voltage Fan and Line-Voltage 2-Wire On-Off Valve Outputs

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

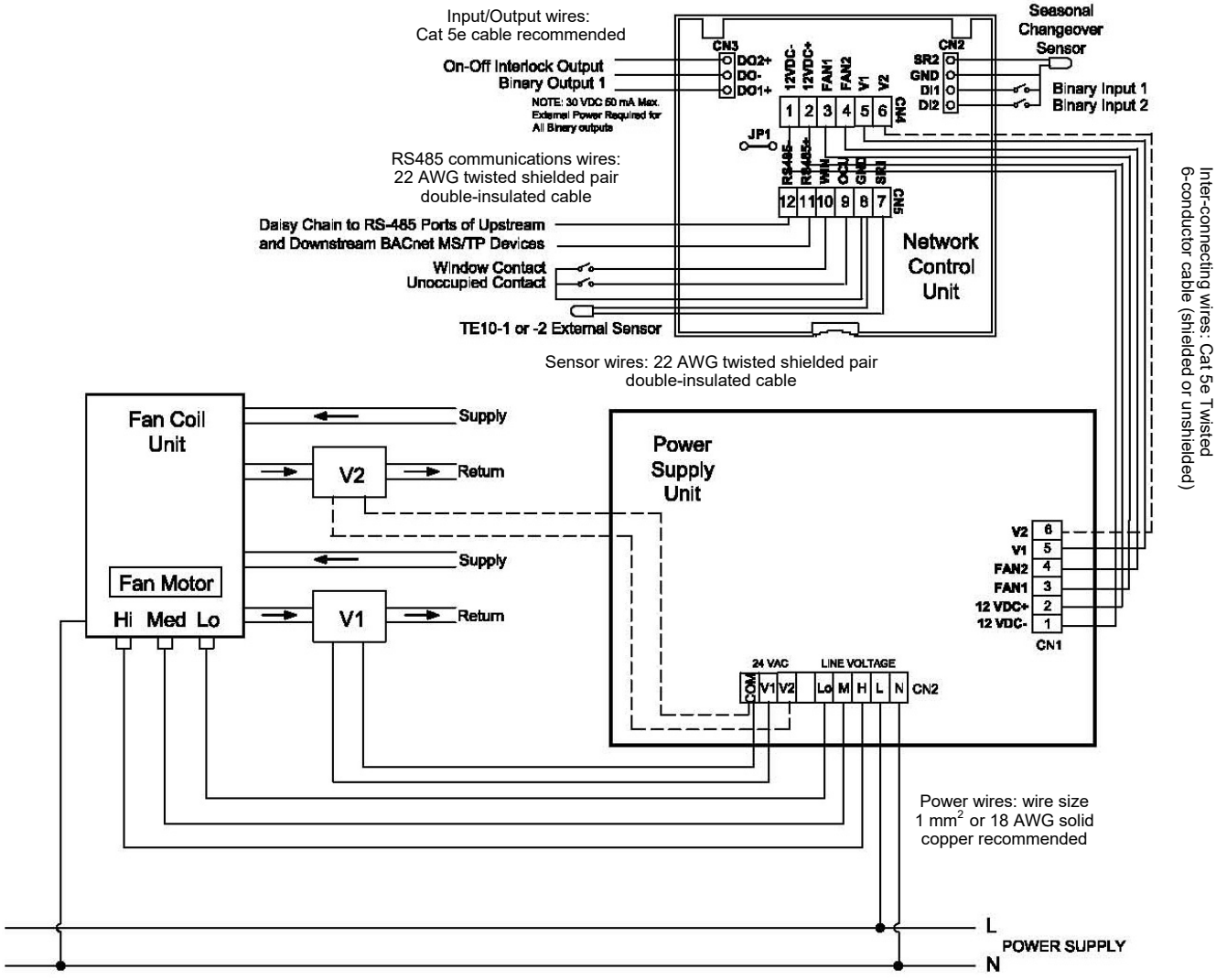
Piping Notes:
1. On a single-output unit, V1 can be a 2-wire cooling or heating valve.
2. On a dual-output unit, V1 must be a 2-wire cooling valve and V2 a 2-wire heating valve.
3. Hidden-line wiring for Terminals V2 and 6 are applicable to dual-output models only.



Wiring Diagram for Line-Voltage Fan and 24 VAC 2-Wire On-Off Valve Outputs

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

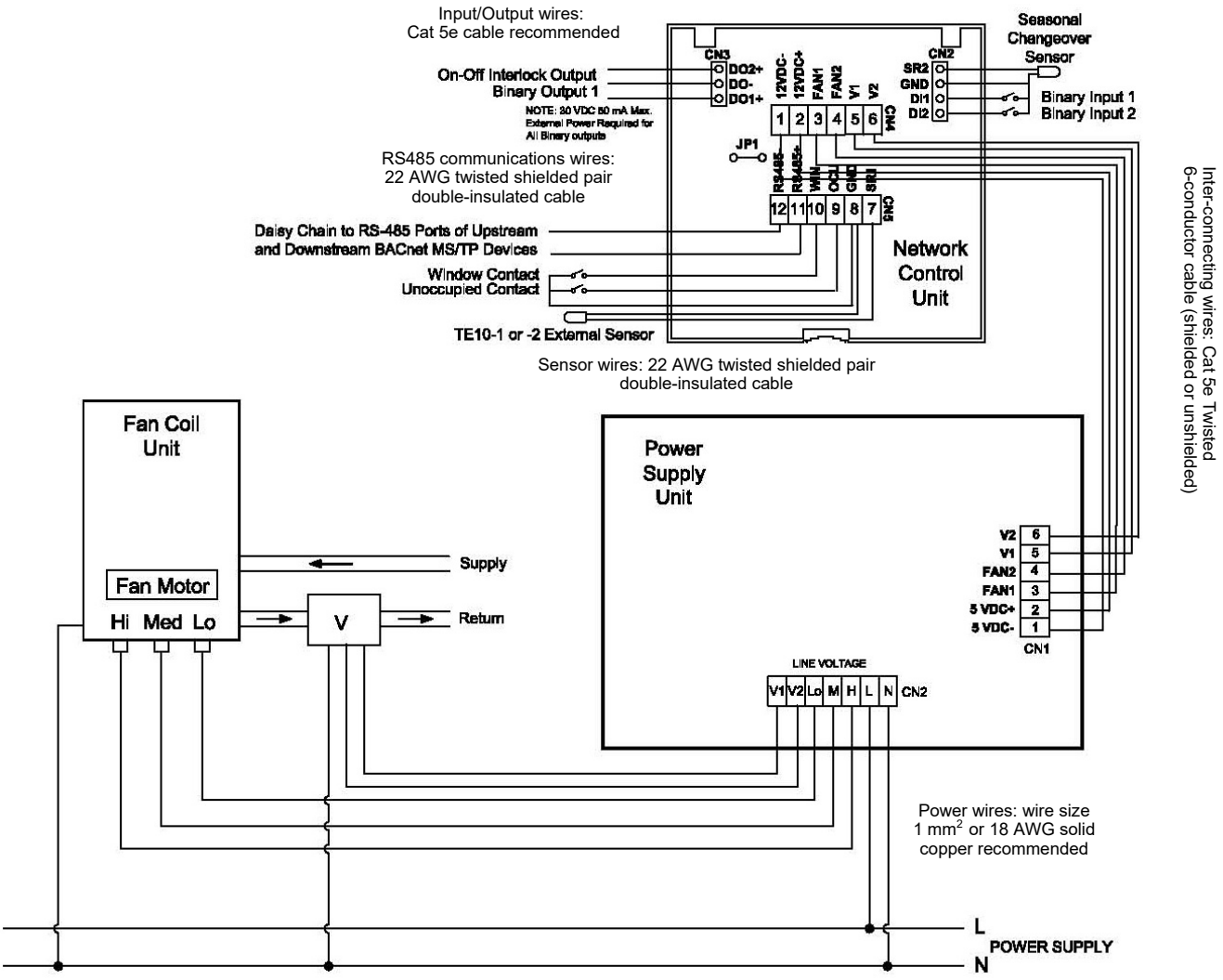
Piping Notes:
1. On a single-output unit, V1 can be a 2-wire cooling or heating valve.
2. On a dual-output unit, V1 must be a 2-wire cooling valve and V2 a 2-wire heating valve.
3. Hidden-line wiring for Terminals V2 and 6 are applicable to dual-output models only.



Wiring Diagram for Line-Voltage Fan and Single Line-Voltage 3-Wire Floating Valve Output

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

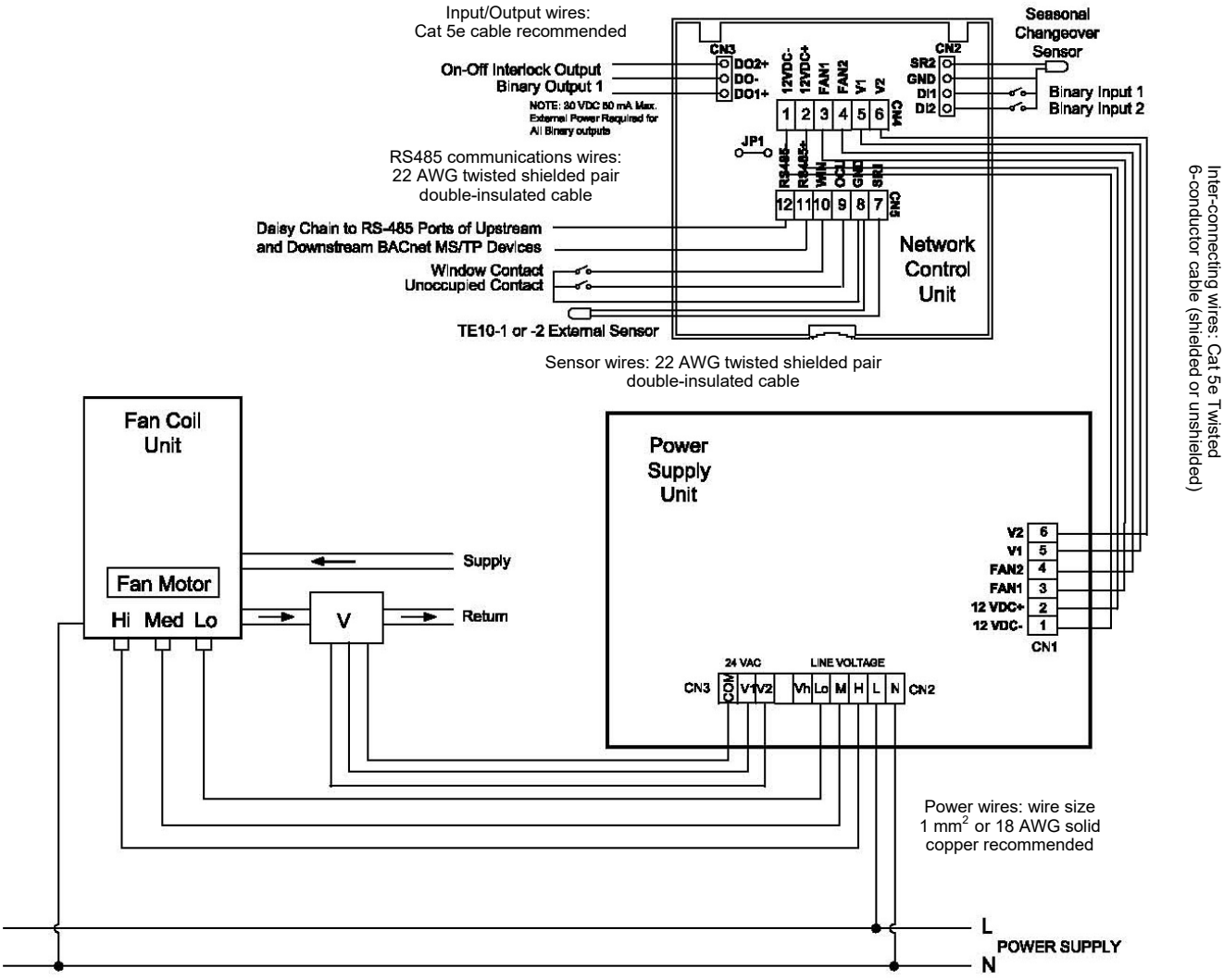
Piping Notes:
1. V must be a line-voltage 3-wire floating valve.
2. In cooling mode, V1 output opens valve on temperature rise and V2 output closes valve on temperature drop. The action in heating mode is reversed.



Wiring Diagram for Line-Voltage Fan and Single 24 VAC 3-Wire Floating Valve Output

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

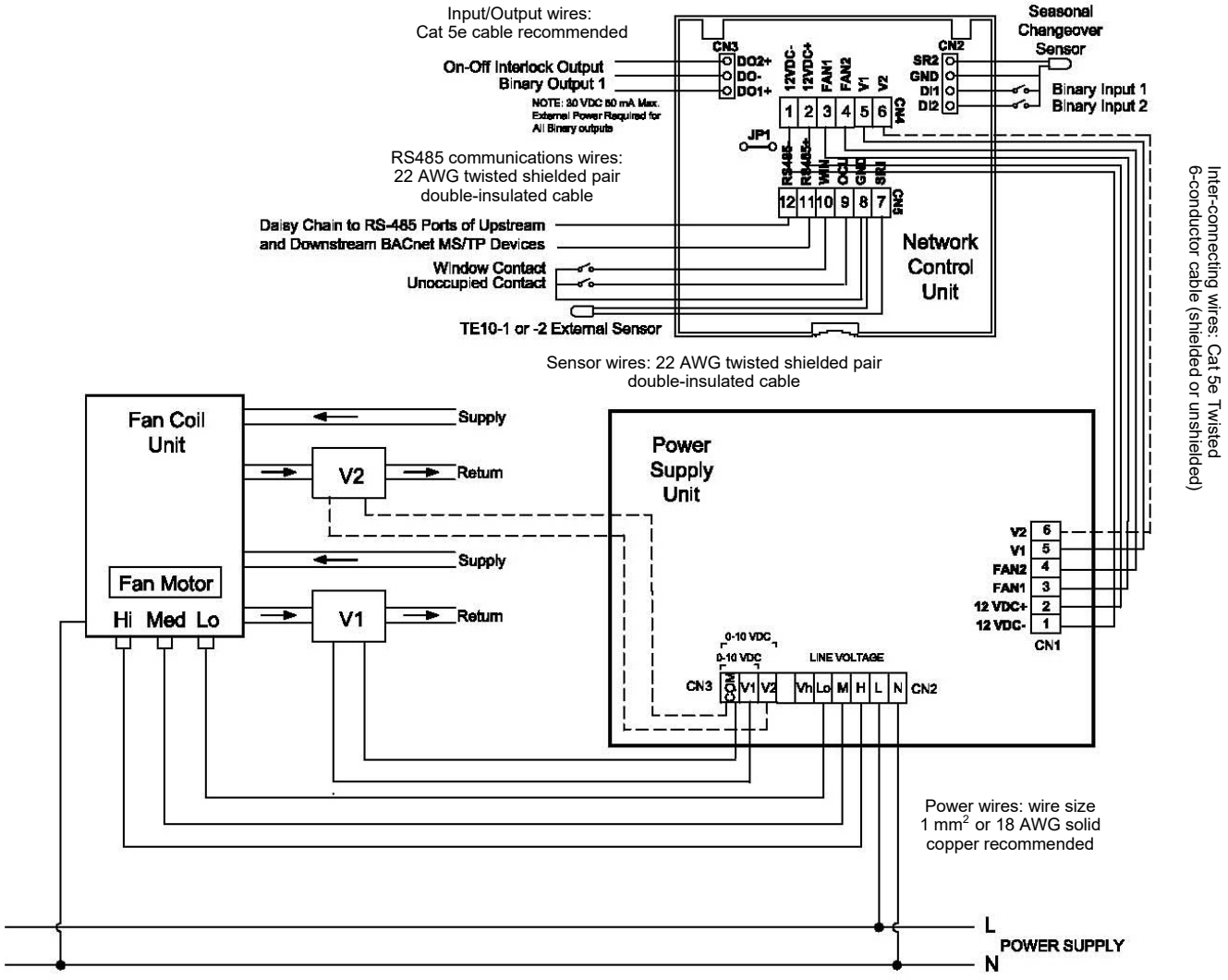
Piping Notes:
1. V must be a 24 VAC 3-wire floating valve.
2. In cooling mode, V1 output opens valve on temperature rise and V2 output closes valve on temperature drop. The action in heating mode is reversed.



Wiring Diagram for Line-Voltage Fan and 0(2)-10 VDC Valve Outputs

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

Piping Notes:
1. On a single-output unit, V1 can be a cooling or heating valve.
2. On a dual-output unit, V1 must be a cooling valve and V2 a heating valve.
3. Hidden-line wiring for Terminals V2 and 6 are applicable to dual-output models only.



Network & Cabling Requirements

To ensure network stability and reliable communications, particularly at high speeds on a BACnet MS/TP network with 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 repeater.
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.

Operation Notes

User Operating Mode

- LCD shows ambient temperature constantly except when set point adjustment is being made.
- Press the switch 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 in 0.5 K increments by rotating the adjustment dial clockwise or counter-clockwise. When the dial is rotated, the LCD shows the existing set point setting.
- 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.
- In unoccupied mode, the factory-set temperature cut-in points are 26°C for cooling and 16°C for heating. Meanwhile, the operation of all operating keys is 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.
  When unoccupied mode is activated, all keys are locked out and no settings can be entered.
- When Window contact closes, it will override the operating mode and operate the thermostat in off mode despite the thermostat being in operating or standby mode. Meanwhile, all operating keys are locked out until the window contact opens.

Parameter Setup Mode

- The thermostat allows authorized service agent to change a number of operating parameters in the field. For details, refer to the parameter setup manual.

Error Reporting

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

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