## TC10 Series

# Digital Room Thermostats with LCD

### Features

- Ultra slim wall-mount display control unit to match any decor
- Large easy-to-read liquid crystal display (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
- 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 proportional band and integral time for PI control
- Choice of valve stroke time for 3-wire on-off/floating 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 on-off/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
- Choice of fan action in unoccupied mode
- Window contact closure to lock out all thermostat functions
- Provides one on-off output for external device interlocking; output is on whenever fan at any speed is running.
- Field recalibration capability of measured temperature
- Continuous or auto fan operation
- External and seasonal changeover temperature sensor capability
- Output relays to provide high current ratings and performance
- Optional infer-red remote control unit


### General

The TC10 Series digital room thermostats are available in various models for 2-wire on-off, 3-wire on-off/ floating or 0-10 VDC proportional control of valves and High-Medium-Low-Auto speed control of fan motors in fan coil units and heat pumps for commercial, industrial and residential installations.

All 3-wire floating and 0-10 VDC proportional 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 touch key allows control of a 3-speed fan. The speed control touch 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 medium and from medium to high speed. For actual activating temperature differential values, refer to the parameter setup menu in 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, display control unit or power supply unit.

## Figure 1: TC10 Series Digital Room Thermostat Model Number Selection Guide

### TC10 Touch Series Digital Room Thermostats Model Number Selection Guide (Complete Sets)

| TC1 | 0 | – | 1AM | R |
|---|---|---|---|---|
| Product Type | Power Supply | Separator | Control Type | Options |
| **TC1** = TC10 Series digital room thermostats | **0** = 100-230 VAC<br>**2** = 230 VAC + 24 VAC*<br>**3** = 120 VAC + 24 VAC*<br>* Suitable for line-voltage fan control and 24 VAC valve control | | **1** = Single 2-wire on-off output, cool only or heat only<br>**1M*** = Single 2-wire on-off output, manual cool/heat changeover<br>**1F** = Single 3-wire floating output, cool only or heat only<br>**1FM*** = Single 3-wire floating output, manual cool/heat changeover<br>**1A** = Single 0-10 VDC output, cool only or heat only<br>**1AM*** = Single 0-10 VDC output, manual cool/heat changeover<br>**2** = Dual 2-wire on-off outputs, manual or auto cool/heat changeover<br>**2F** = Dual 3-wire floating outputs, manual or auto cool/heat changeover<br>**2A** = Dual 0-10 VDC outputs, manual or auto cool/heat changeover<br>**2AH** = 0-10 VDC cooling output, 2-wire on-off heating output, manual or auto cool/heat changeover<br>*These models do not provide unoccupied mode capability | **R** = with infra-red Ireceiver for RCU-1<br>**B** = with buzzer for key touch sounding<br>**W** = with white color **faceplate** |

### Power Supply Unit Model Number Selection Guide

| PSU1 | 0 | – | 1 | A | M |
|---|---|---|---|---|---|
| Product Type | Power Supply | Separator | Number of Outputs | Control Type | Seasonal Changeover |
| **PSU1** = Power Supply Units for TC10 Series | **0** = 100-230 VAC<br>**2** = 230 VAC + 24 VAC*<br>**3** = 120 VAC + 24 VAC*<br>* Suitable for line-voltage fan control and 24 VAC valve control | | **1** = Single output<br>**2** = Dual outputs | **Nil** = 2-wire on/off<br>**F** = 3-wire floating<br>**A** = 0-10 VDC | **Nil** = Auto by external sensor<br>**M** = Manual |

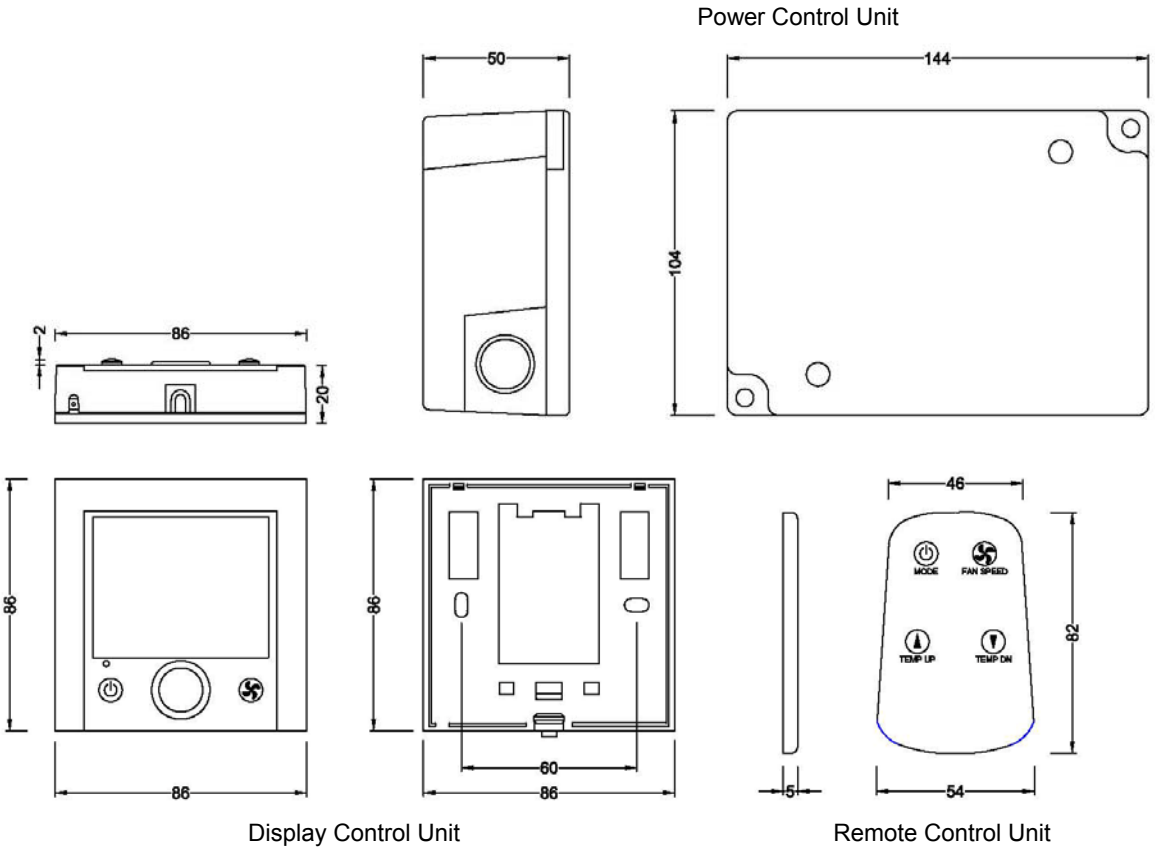
### Display Control Unit Model Number Selection Guide

| DCU1 | 1 | A | M | R |
|---|---|---|---|---|
| Product Type | Number of Outputs | Control Type | Seasonal Changeover | Options |
| **DCU1** = TC10 Series Display Control Units | **1** = Single output<br>**2** = Dual outputs | **Nil** = 2-wire on/off<br>**F** = 3-wire floating<br>**A** = 0-10 VDC output<br>**AH** = 0-10 VDC cooling output + line-voltage 2-wire on-off heating output | **Nil** = Auto<br>**M** = Manual | **R** = with infra-red Receiver for RCU-1<br>**B** = with buzzer for key touch sounding<br>W = with white color faceplate |

## Figure 2: TC10 Series Application Guide

| Model Number | Outputs | Applications | Cooling/Heating Mode | External Seasonal Changeover | System Modes | Fan Control | Unoccupied Mode |
|---|---|---|---|---|---|---|---|
| TC1x-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 |
| TC1x-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 |
| TC1x-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 |
| TC1x-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 |
| TC1x-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 |
| TC1x-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 |
| TC1x-1AM | Single 0-10 VDC | Cooling/Heating (2-Pipe System) | Manual Only | No | Cool or Heat-Fan Only-Off | Hi-Med-Low-Auto | Yes |
| TC1x-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 6: Dimensions in mm

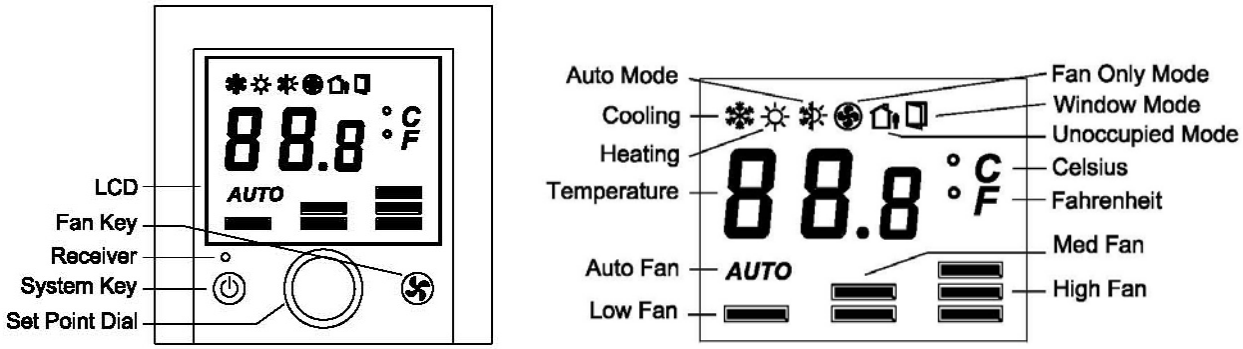


## Specifications

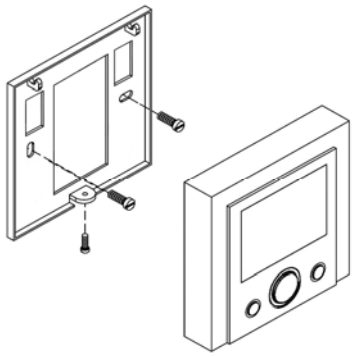
| | |
|---|---|
| Product model numbers | See Figure 1: TC10 Series Model Number Selection Guide |
| Power requirements | 100-230 V, ±10%, 50/60 Hz or 120 V or 230 V, +10% and -15%, 50/60 Hz depending on models |
| 0-10 VDC output impedance | Minimum 10,000 Ω |
| Operating temperature differential for 2-wire on-off models | Fixed at 1 K (1 R) 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 | Adjustable 1 to 5 K(1 to 5 R) between cooling mode and heating mode, factory set at 3 K(3 R) |
| Valve stroke time for 3-Wire floating models | Accumulatively 10, 60, 90,120, 150,180, 210 or 240 s maximum in one direction, depending on setting. Setting = 0 means the output being activated as on-off mode. |
| 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 | Input signal from external voltage-free contact<br>Choice of activation of unoccupied mode: in operating mode only or in both standby and operating modes.<br>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" models). |
| Unoccupied temperature set Point range (not applicable to "1M" models) | 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 |
| Enclosure | Material: Self-extinguishing, molded ABS<br>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<br>Valve output (all other models) 100-230 V, 5 A resistive, 2 A inductive, 50/60 Hz<br>Fan output relays 100-230 V, 5 A resistive, 2 A inductive, 50/60 Hz<br>Total rating 100-230 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 screw-type terminal blocks and removable wire plugs |
| Power wires | Wire size 1 $mm^2$ or 18 AWG solid copper recommended |
| Sensor wires | 22 AWG twisted shielded pair double-insulated cable |
| PSU/DCU inter-connecting wires | Cat 5e twisted 6-conductor cable (shielded or unshielded) |
| Accessories and options | See Figure 5: Optional Accessories |
| Agency approval | CE Mark compliant to EMC and Low Voltage Directives pending |
| Dimensions | See Figure 6: Dimensions in mm and Mounting Details |
| Shipping weight | 0.6 kg (1.3 lb) |

*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 3: Display Control Unit and LCD Layout



## Figure 4: DCU Mounting Details



## Figure 5: 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 | TC1x-xxR |
| With buzzer capability | TC1x-xxB |
| With white color faceplate | TC1x-xxW |

**Mounting of Display Control Unit**

The TC10 Series display control unit can be surface 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.

## Thermostat Errors Reporting

When the following errors are reported on the LED display unit, these errors will prevent the thermostat from normal operation:

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

* 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.

## Trouble-Shooting

Before trouble-shooting starts, ensure that the voltage output from Terminals 1 (GND) and 2 (+5 Vdc) on the power supply unit is between 5 Vdc and 5.25 Vdc and not higher. Higher voltage may damage the internal circuitry and components of the display control unit.

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

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

## Operation Notes

- LCD shows ambient temperature constantly except when set point adjustment is being made.
- Press the system key 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. During the dial rotation, the LCD shows the existing set point value.
- 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 $^{o}$C for cooling and 16 $^{o}$C for heating. Meanwhile, the operation of all operation 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, while in unoccupied mode, the valve output is never activated.
  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.
- The thermostat allows authorized service agent to change the following operating parameters in the field:

| | | |
|---|---|---|
| MCU firmware revision level | 0 | Appears after entering the setup mode |
| Choice of temperature engineering unit | 1 | 1-C = ºC (factory setting)<br>1-F = ºF |
| Choice to retain last entered settings on power resumption | 2 | 2On = program on (factory setting)<br>2OF = program off |
| Offset adjustment of temperature indication (field recalibration of measured temperature) | 3 | 3 2 = temperature indication plus 2 degrees<br>3 1 = temperature indication plus 1 degree<br>3 0 = no offset (factory setting)<br>3- 1 = temperature indication minus 1 degree<br>3-2 = temperature indication minus 2 degrees |
| Adjustable proportional band for PI control | A | 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<br>factory setting = 15 minutes. Setting = 0 means integral time being turned off. |
| Choice of valve stroke time for 3-wire floating models | C | Selections of 1, 6, 9, 12, 15, 18, 21 and 24<br>C 1 = 10 seconds……..C 18 = 180 seconds = factory setting……..C24 = 240 seconds<br>When the stroke time is set to 10 seconds, the output is activated as on-off mode. |
| Deadband value 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)<br>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)<br>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).<br>Low speed when - 2.0 K <= Tr - Ts <= -0.5 K<br>Med speed when - 4.0 K <= Tr - Ts <= -2.5 K<br>High speed when Tr - Ts <= -4.5 K<br>P-2 = (factory setting)<br>Low fan output when -2.0 K <=Tr - Ts<br>Med speed when - 4.0 K <= Tr - Ts <= -2.5 K<br>High speed when Tr - Ts <= -4.5 K |
| Choice of operating sequence for dual-output models only | r | r- 1 = to set operating sequence of Cool-Heat-Auto-Fan Only-Off (factory setting)<br>r-2 = to set operating sequence of Auto-Off |
| Choice of “1” or “1M” model | t | t- 1 = to set operating sequence of Off-Cool or Heat-Fan Only (factory setting for “1” models)<br>t-2 = to set operating sequence of Off-Cool-Heat-Fan Only (factory setting for “1M” models) |
| Choice of constant display of ambient temperature or temperature set point value | u | u- 1 = constant display of ambient temperature (factory setting)<br>u-2 = constant display of set point value |
| Restoration of default factory settings | rS | rS 1 = Retain current settings (factory setting)<br>rS2 = Restore default factory settings |

## Figure 7: Wiring Diagrams

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

Wiring and Application Notes

- Cut jumper JP1 open 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 or 24 AWG twisted shielded pair double-insulated cable is recommended as remote sensor wiring and its length must not exceed 25 m.
- Connecting wires between Display Control Unit and Power Supply Unit must not exceed 15 m.
- Do not bundle and run power wiring and remote sensor wiring in the same conduit.
- When an individual TE10-1 sensor is employed in each thermostat, the seasonal changeover sensor should be wrapped around the supply water pipe when associated with a water system. When the changeover sensor temperature exceeds 30ºC, the thermostat enters into heating mode.
- Seasonal changeover sensor or switch is applicable to cool only or heat only 2-pipe models only.
- Unoccupied contact closure activates unoccupied mode.
- Window contact closure activates thermostat lockout mode.
- Hidden-line wiring for Terminals V2 and 6 are 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.

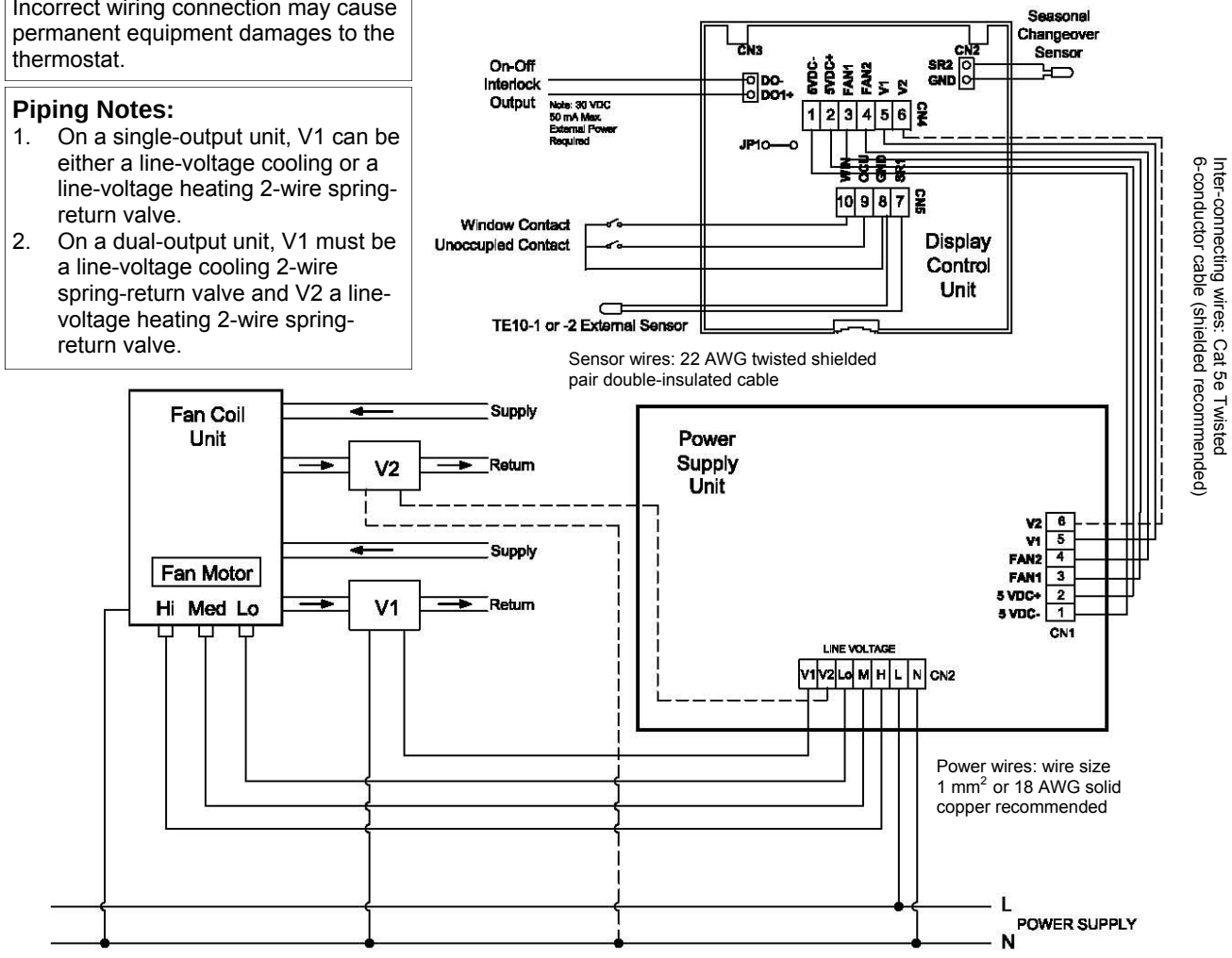
## Wiring Diagram for Line-Voltage Fan and Line-Voltage On-Off Valve outputs

***WARNING***

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

**Piping Notes:**

1. On a single-output unit, V1 can be either a line-voltage cooling or a line-voltage heating 2-wire spring-return valve.
2. On a dual-output unit, V1 must be a line-voltage cooling 2-wire spring-return valve and V2 a line-voltage heating 2-wire spring-return valve.



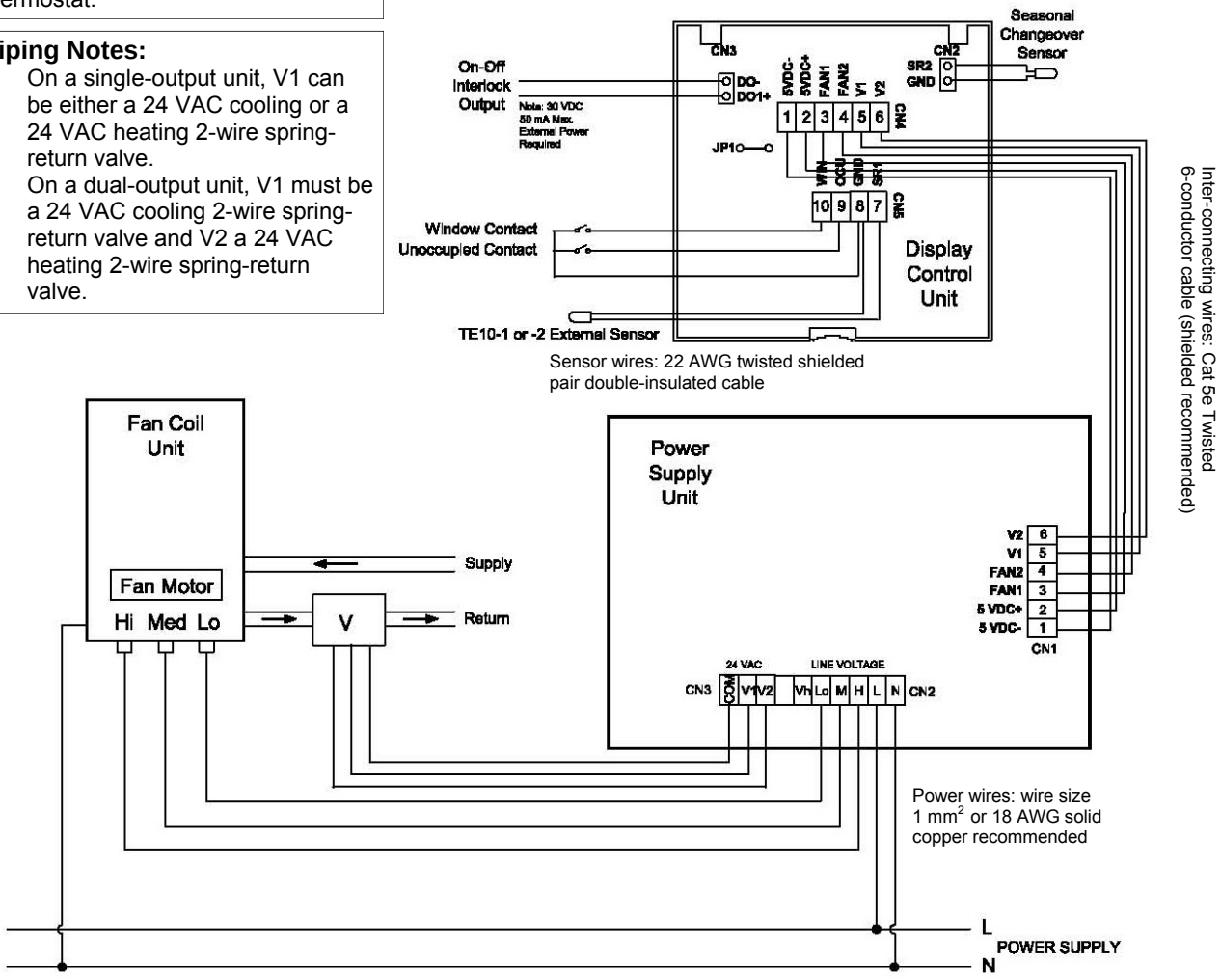
## Wiring Diagram for Line-Voltage Fan and 24 VAC 2-Wire On-Off Valve Outputs

***WARNING***

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

**Piping Notes:**

1. On a single-output unit, V1 can be either a 24 VAC cooling or a 24 VAC heating 2-wire spring-return valve.
2. On a dual-output unit, V1 must be a 24 VAC cooling 2-wire spring-return valve and V2 a 24 VAC heating 2-wire spring-return valve.



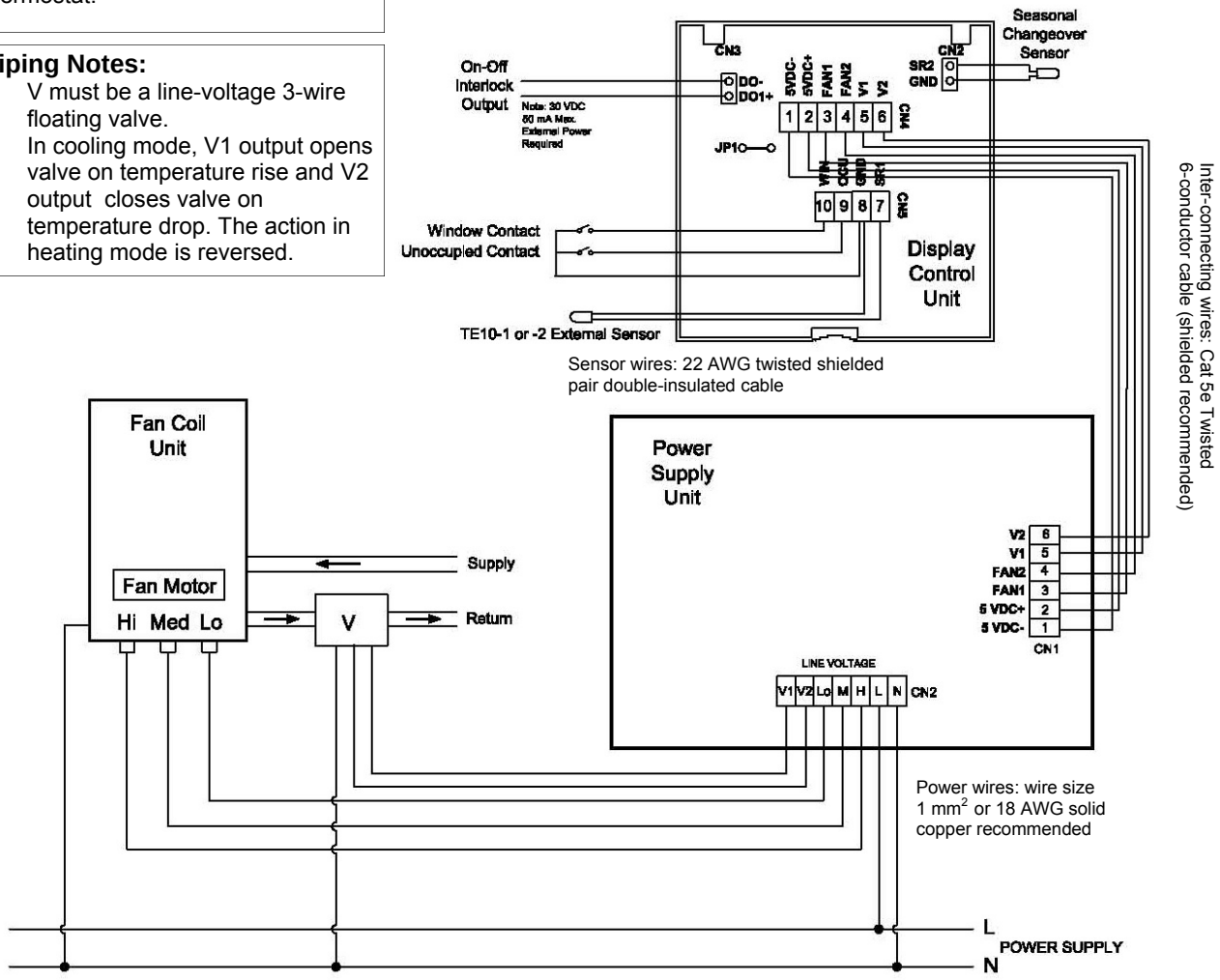
## Wiring Diagram for Line-Voltage Fan and Single Line-Voltage 3-Wire Floating Valve Output

***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.



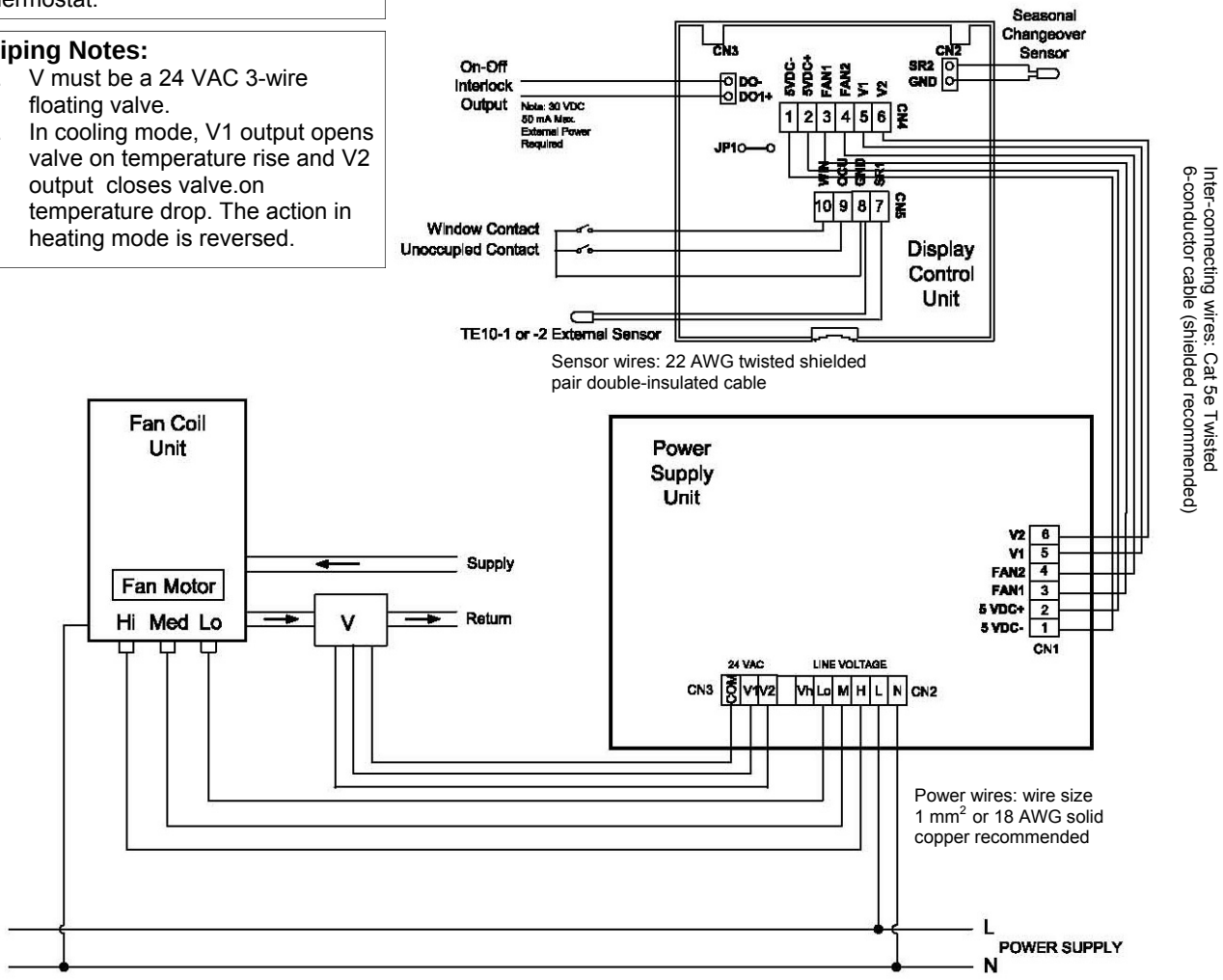
## Wiring Diagram for Line-Voltage Fan and Single 24 VAC 3-Wire Floating Valve Output

***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.



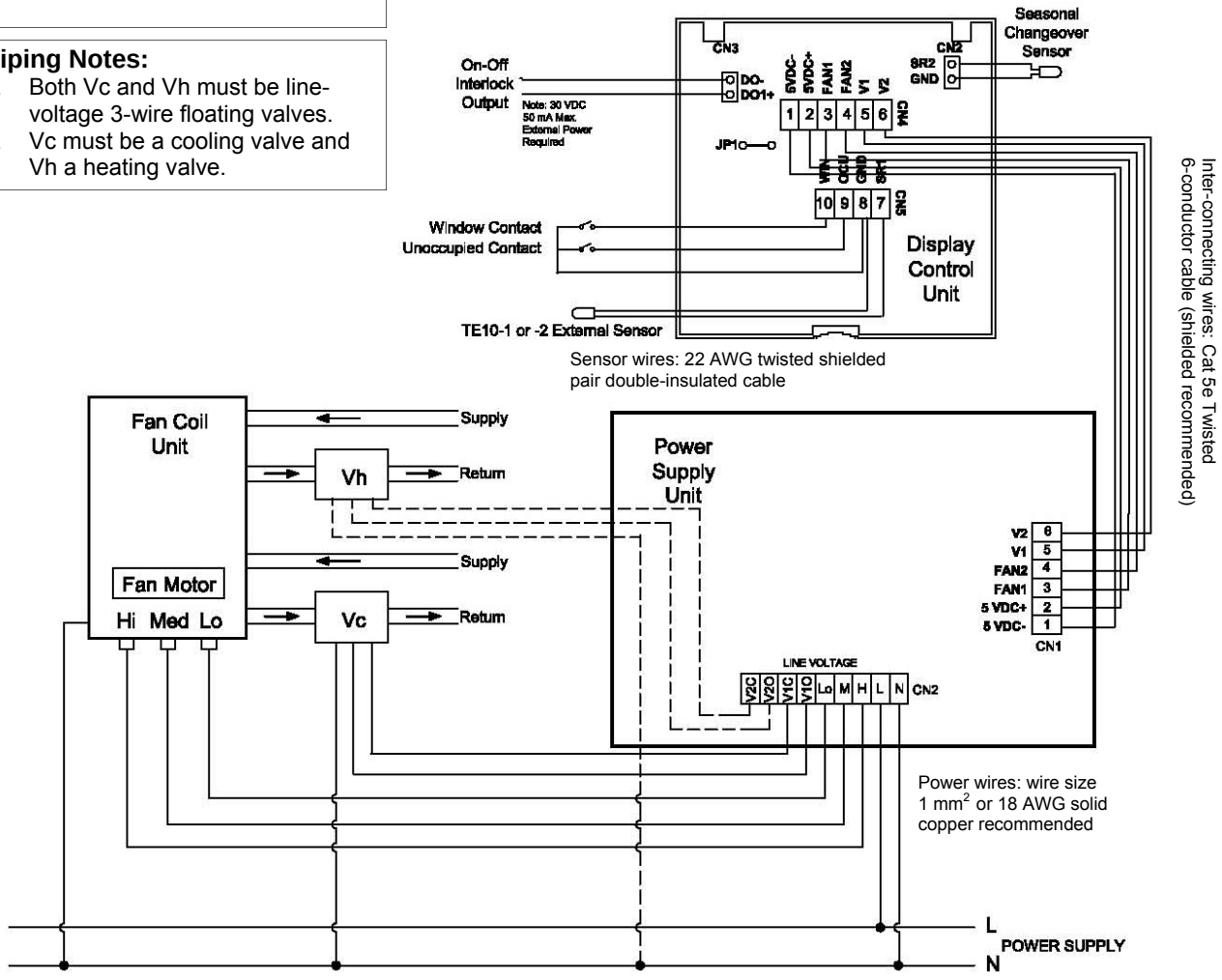
## Wiring Diagram for Line-Voltage Fan and Dual Line-Voltage 3-Wire Floating Valve Outputs

***WARNING***

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

**Piping Notes:**

1. Both Vc and Vh must be line-voltage 3-wire floating valves.
2. Vc must be a cooling valve and Vh a heating valve.



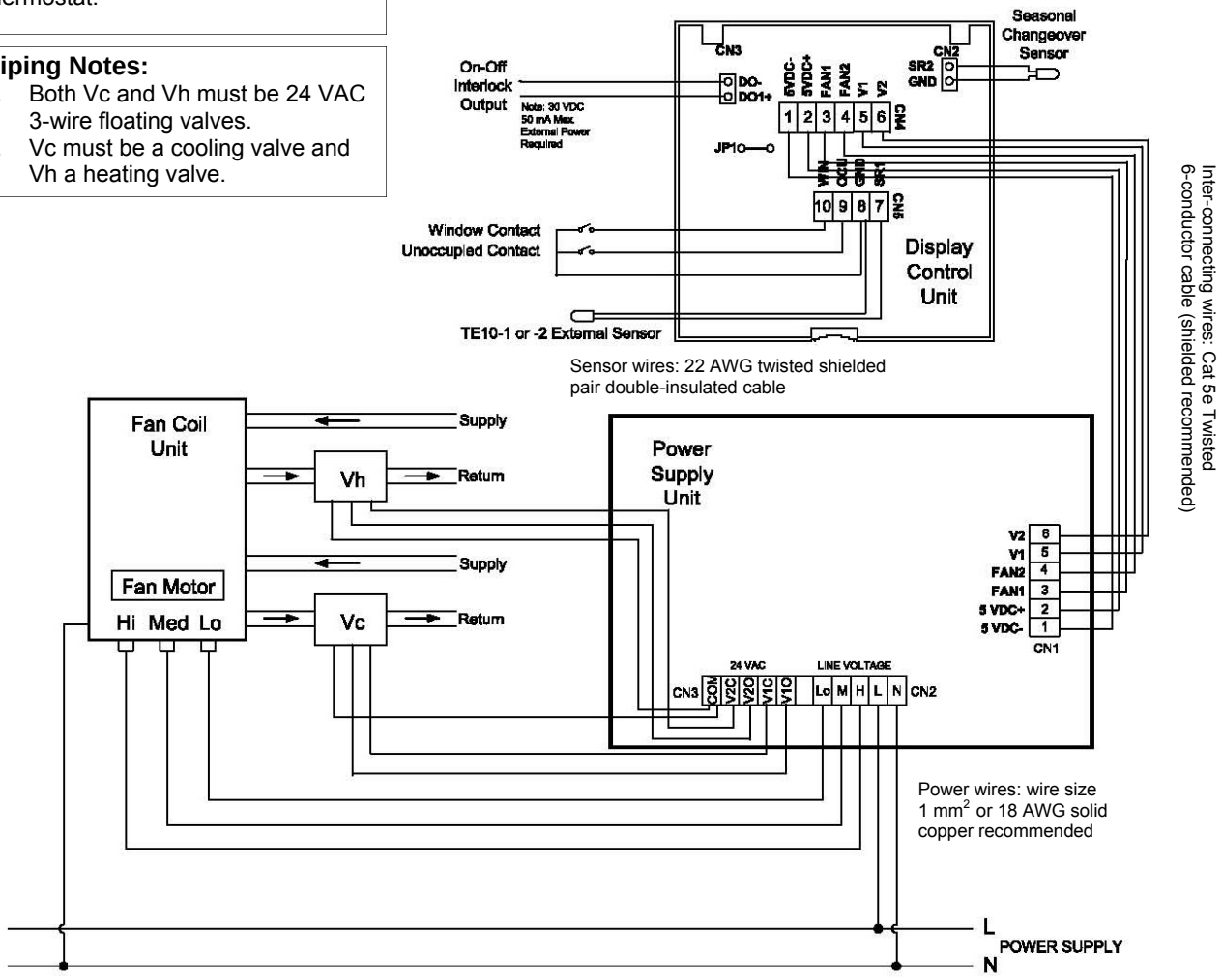
## Wiring Diagram for Line-Voltage Fan and Dual 24 VAC 3-Wire Floating Valve Outputs

***WARNING***

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

**Piping Notes:**

1. Both Vc and Vh must be 24 VAC 3-wire floating valves.
2. Vc must be a cooling valve and Vh a heating valve.



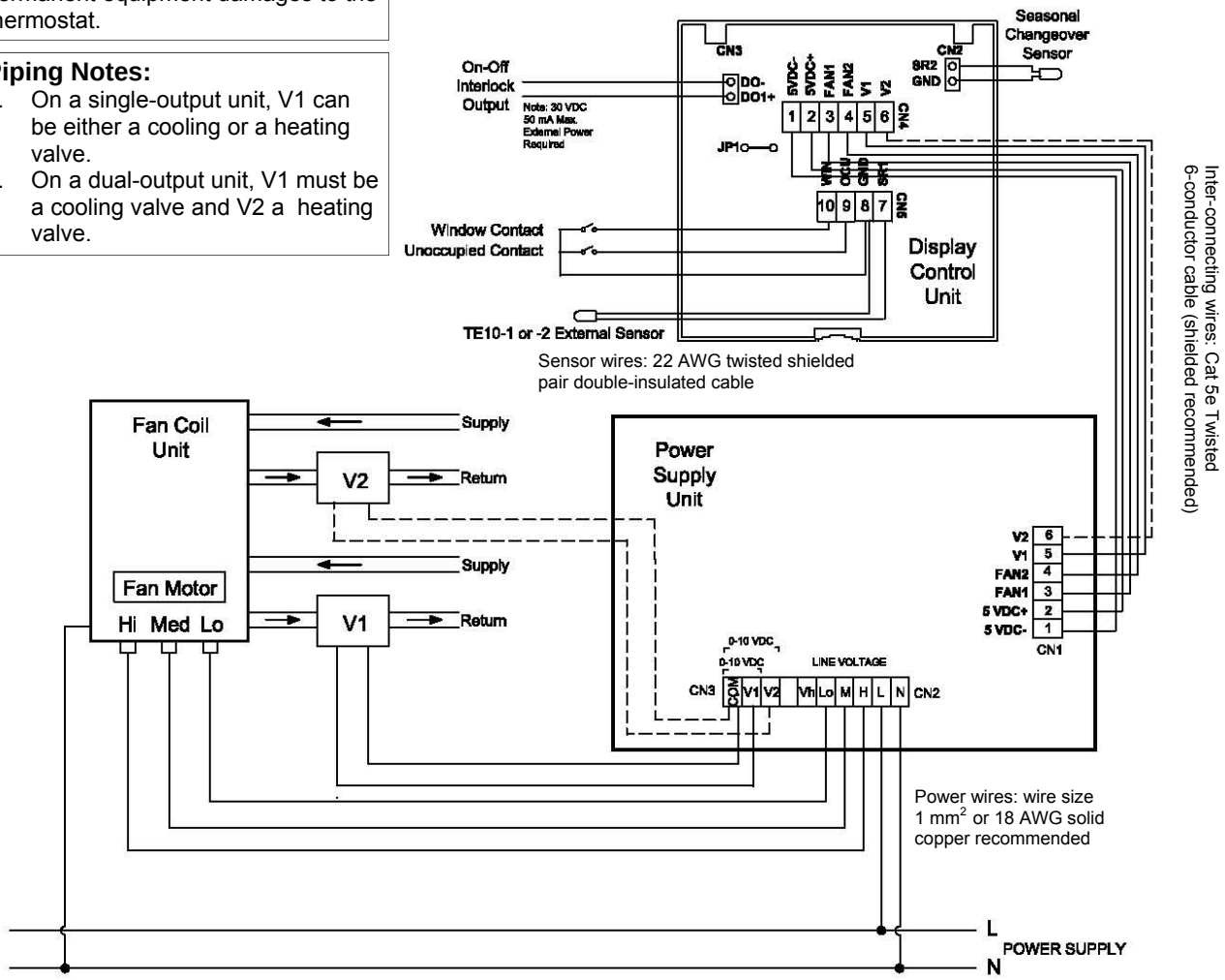
## Wiring Diagram for Line-Voltage Fan and 0-10 VDC Valve Outputs

***WARNING***

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

**Piping Notes:**

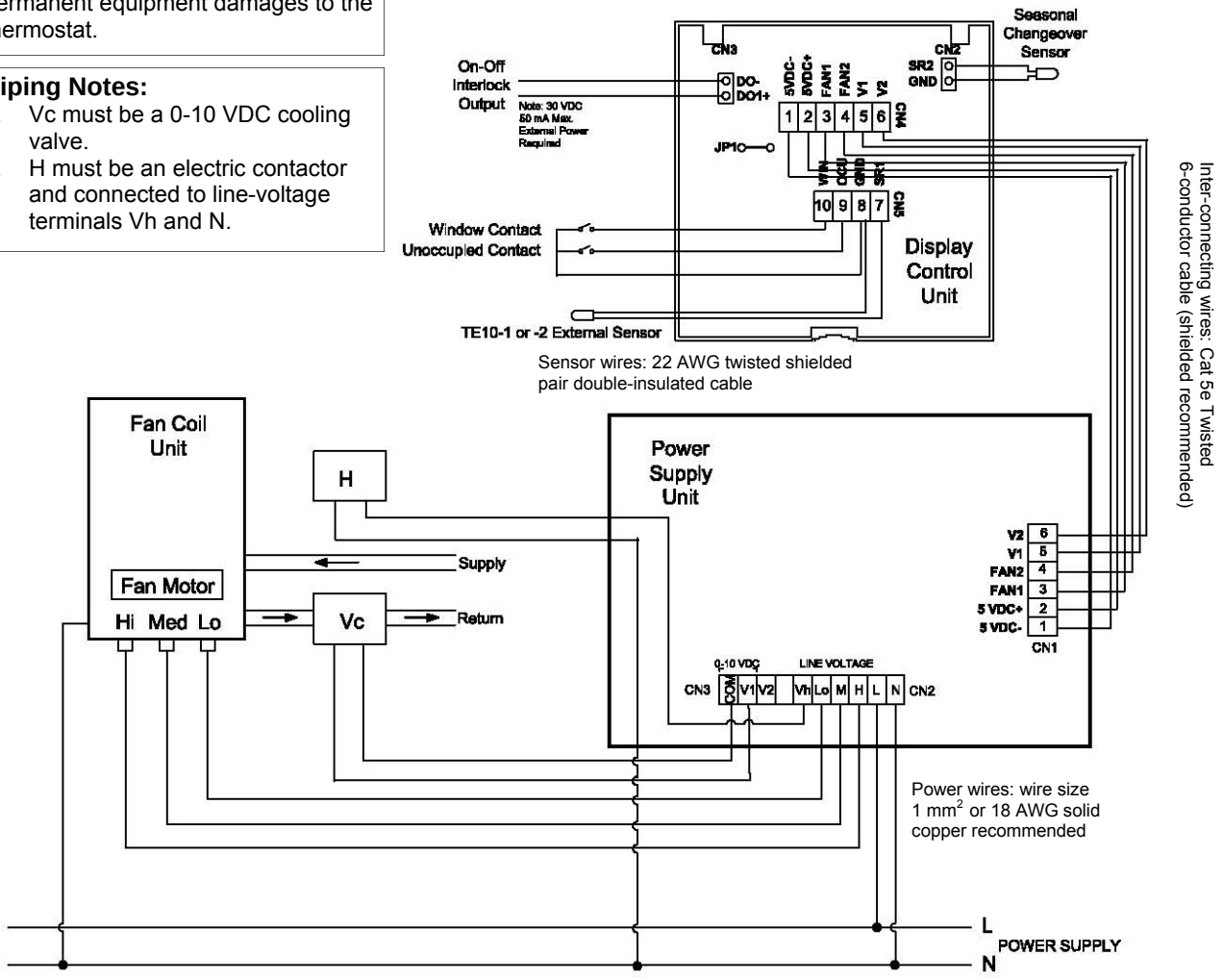
1. On a single-output unit, V1 can be either a cooling or a heating valve.
2. On a dual-output unit, V1 must be a cooling valve and V2 a heating valve.



## Wiring Diagram for Line-Voltage Fan, 0-10 VDC Cooling Valve Output and Line-Voltage On-Off Heating Output

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

**Piping Notes:**
1. Vc must be a 0-10 VDC cooling valve.
2. H must be an electric contactor and connected to line-voltage terminals Vh and N.

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