USER GUIDE

MAN0130 rev 15

CBT-3T6-5R with Rooftop Unit strategy

Style conventions used in this document:

UI Text: Text that represents elements of the UI such as button names, menu options etc. is presented with a grey background and border, in Tahoma font which is traditionally used in Windows UIs. For example:

Ok

Standard Terms (Jargon): Text that is not English Language but instead refers to industry standard concepts such as Strategy, BACnet, or Analog Input is represents in slightly condensed font. For example:

BACnet

Code: Text that represents File paths, Code snippets or text file configuration settings is presented in fixed-width font, with a grey background and border. For example:

```
$config_file = c:\CYLON\settings\config.txt
```

Parameter values: Text that represents values to be entered into UI fields or displayed in dialogs is represented in fixed-width font with a shaded background. For example

`10°C`

Product Names: Text that represents a product name is represented in bold colored text. For example

INTEGRA™

Company Brand names: Brands that are not product names are represented by bold slightly compressed text:

ABB Active Energy

PC Keyboard keys: Text representing an instruction to press a particular key on the keyboard is enclosed in square brackets and in bold font. For example:

[Ctrl]+[1]

1 Getting Started

HOW TO USE THIS MANUAL

The CBT-3T6-5R manual provides users with the information needed to install and configure the controller for the various application specific requirements.

CBT-3T6-5R

The CBT-3T6-5R is a configurable BACnet MS/TP device designed to be used within a BACnet system including existing eBuilding systems. The CBT-3T6-5R is available with a preloaded Rooftop Unit strategy designed to control a wide variety of constant volume common Rooftop Units (RTU) used in commercial HVAC installations. It is also possible to load a custom strategy or to modify the preloaded strategy to meet any application specific needs.

CBT-3T6-5R STRATEGY VERSION INFORMATION

This document (MAN0130 rev 15) applies to CBT-3T6-5R Rooftop Unit Strategy version 1.0. The strategy version will be printed on the factory box label.

PHYSICAL SPECIFICATIONS

Size	5.12 x 5.17 x 1.78” (130 x 131.2 x 45 mm)
Enclosure	Injection molded ABS
Mounting	DIN rail • The housing base is designed for snap-mounting on DIN rails • The controller should not be freely accessible after mounting • Unit must be oriented such that powered relay terminals are at the bottom of unit

ENVIRONMENTAL SPECIFICATIONS

Ambient Temperature	32°-122°F (0° - 50°C) ambient.
Ambient Humidity	0% - 90% RH non-condensing
EMC Immunity	EN 61326-1
EMC Emission	EN 61326-1
Approvals	UL Listed (CDN & US) UL916 Energy Management Equipment - File No. E176435
Safety	EN 60730-1:2011 Automatic Action type i.e. Type 1.B.Y
Pollution Degree	Class 2 (EN 60730-1)

Note: This equipment is intended for field installation within an enclosure.

SUPPORTING SOFTWARE

The following software is required to configure the CBT-3T6-5R.

Engineering Center 7.0 or later versions

The Engineering Center is used to configure the controller for installation. Users will be able to set MS/TP addresses, baud rate, and configuration values using this software. Users will also be able to change the strategy and download their changes to the controller.

For commissioning the controller, it is recommended to use NetLink software or CBT-STAT devices.

NetLink version 1.8 or later

NetLink is commissioning software for hand-held computers, available from the American Auto-Matrix Toolbox. NetLink software can be used to configure the controller for installation. Like the Engineering Center, users can set the MS/TP address, baud rate and configuration values with this software. Users will need the predefined NetLink screens that were developed for use with the preloaded strategy that comes shipped for the CBT-3T6-5R.

SUPPORTING FILES

The following files are needed for configuring the CBT-3T6-5R with Heat Pump Strategy. These are available from the American Auto-Matrix Toolbox (http://www.aamatrix.com/toolbox)

Decoder Spreadsheet (CBT-3T6-5RHPDecoder.xlsx)

This spreadsheet is used to determine what configuration codes are needed to configure the CBT-3T6-5R. See *Configuring the CBT-3T6-5R Rooftop Unit Strategy* on page 20 for instructions.

Netlink screens (IO_ConfigHP.nls)

These NetLink screens are used for configuration of the CBT-3T6-5R. See *Configuring the CBT-3T6-5R Rooftop Unit Strategy* on page 20 for instructions.

2 Installation Overview

PREPARING TO INSTALL THE CBT-3T6-5R

This section describes how to unpack the unit and how to prepare the site for installation of the CBT-3T6-5R. In order to ensure reliable operation of the controller, the installation site should meet the requirements listed in this section.

ENVIRONMENTAL AND ELECTRICAL REQUIREMENTS

The controller's immediate environment must meet the following specifications and comply with all local, state and Federal rules and regulations.

Supply Voltage: 24 V AC, 50/60Hz

Note: One side of the 24 V AC transformer must be grounded; refer to *Connecting Power to the CBT-3T6-5R* on page 8 for more information.

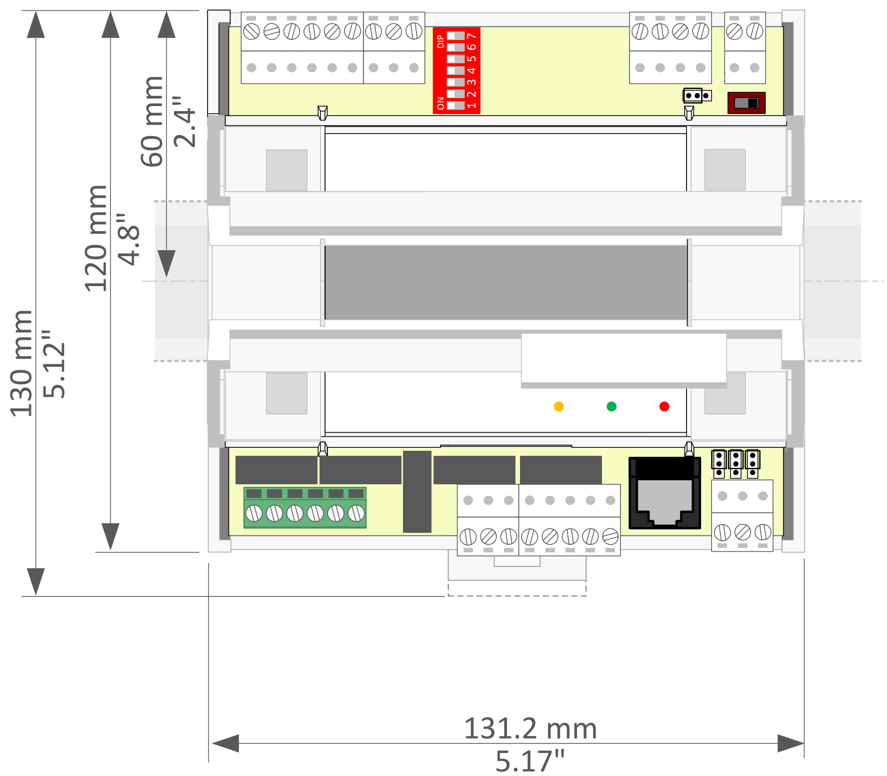
Temperature: Operating temperature is 32°··· 122°F (0°··· 50°C) ambient

UNPACKING THE CBT-3T6-5R

The CBT-3T6-5R is shipped from the factory in its own box. Multiple CBT-3T6-5R boxes may be packaged together in a larger box. Upon receiving the CBT-3T6-5R controller shipment, immediately open and inspect the contents. Check outside of the box for any physical damage. Contact the shipper immediately to report any shipping-related damage to the product. American Auto-Matrix is not responsible for damage to the product caused by shipping, either by an American Auto-Matrix selected shipper or by a customer-specified shipping company.

PHYSICAL INSTALLATION OF THE CONTROLLER

The illustration below shows the mounting dimensions of the controller. Be sure to choose a location for the controller that allows the sufficient clearance for installation and servicing.

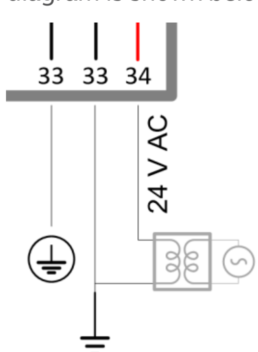


1. Wiring the CBT-3T6-5R

Once the location has been determined, the CBT-3T6-5R can be wired for the network, the room sensors, and the elements of the Roof Top Unit. This section will address the various wiring considerations for the CBT-3T6-5R.

CONNECTING POWER TO THE CBT-3T6-5R

The CBT-3T6-5R requires 24 V AC +15% / -20% 50/60 Hz (SELV Power Source) at 55 VA maximum (up to 12 VA internal power plus up to 43 VA supplied to Triac loads) supplied from an externally mounted power transformer. One conductor of the 24 volt side of the transformer must be grounded to an earth ground to avoid damage to the controller. This conductor will be wired to the CMN (common) of the controller. The wiring diagram is shown below:

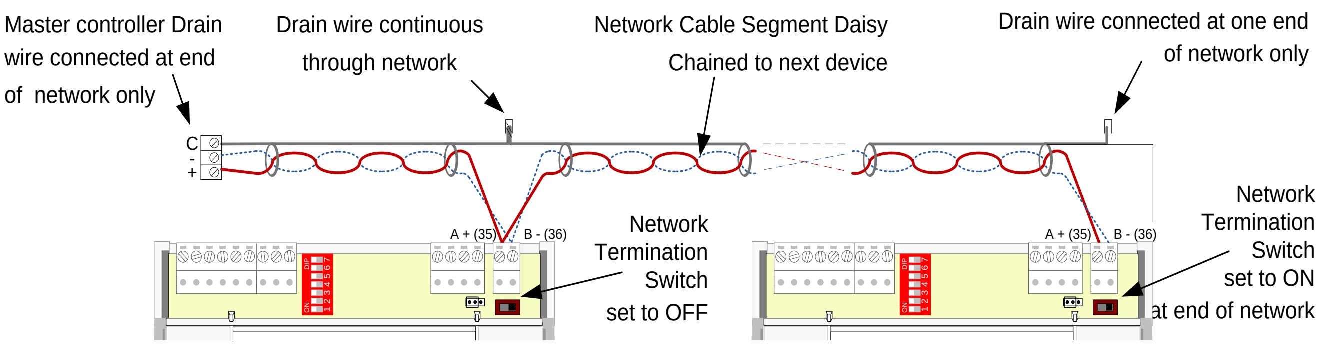


WIRING THE RS-485 COMMUNICATIONS NETWORK

Wiring the RS-485 network involves connecting the `NET+` (35) and `NET-` (36) terminals in a daisy-chained configuration. One end of the network will be connected to the fieldbus of the Network level controller or BACnet router. At the other end of the network, the last device must be "terminated" by either installing a 100 ohm to 120 ohm resistor or, if the last device is a **CBT-3T6-5R**, users can switch the "Network Termination Switch" (BACnet MS/TP Terminator) to `on`. This will effectively terminate the network. The shield, or drain wire, must be carried through the entire network.

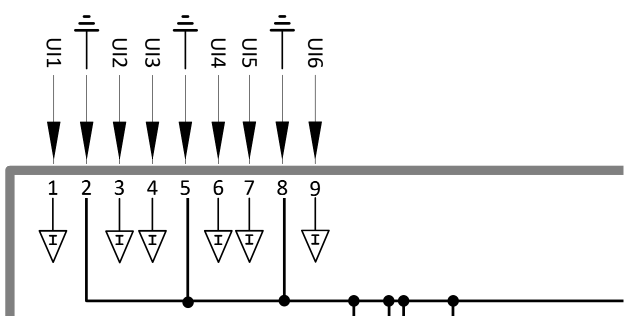
If the RS-485 network is wired to an **eSC**, then the shield will be grounded at the **eSC**.

If the RS-485 network is wired to a **CBR**, the shield must be grounded at one point on the network as shown below:



WIRING THE UNIVERSAL INPUTS

The **CBT-3T6-5R** comes with 6 universal inputs. `UI1`, `UI2`, `UI3` and `UI4` are used for wiring in-room sensors, setpoint adjust, discharge air sensors, CO_2 sensors, relative humidity sensors and motion sensors, depending on the application (see *Wiring the Room Sensor* on page 11 for an example).



The sequences for this wide range of applications are available within the preloaded strategy. See *CBT-3T6-5R Rooftop Unit* Control Sequences on page 26 of this manual for selecting the sequence for specific applications.

- `UI1` will typically be where the room temperature sensor or return air temperature sensor is wired. If you are controlling to Return Air Temperature, this is where the return air temperature sensor is to be wired. This input is pre-configured to support a 10K Type III thermistor. All room sensors purchased from American Auto-Matrix are 10K Type III.

Note: Room sensors that short the thermistor for push button occupancy are supported with this controller.

- `UI2` will typically be where the room setpoint adjust is wired. This input is pre-configured to support a 5K potentiomenter. All room sensors purchased from American Auto-Matrix are of this sensor type.
- `UI3` is a dedicated input that has been configured to support a 10K Type III thermistor. In the pre-loaded strategy this input is used for a discharge air temperature sensor for control using discharge air temperature reset.

- UI4 is a dedicated input that has been configured to support a 10K Type III thermistor. In the pre-loaded strategy this input is used for a mixed air temperature sensor.
- UI5 is a dedicated input that has been configured to support a 10K Type III thermistor. In the pre-loaded strategy this input is used for an outside air temperature sensor.
- UI6 is configured as a voltage input and have a range of 0 ··· 10 V dc. This input can be used for wiring in a CO_2 sensor, relative humidity sensor, or a motion sensor (must be a dry contact closure).

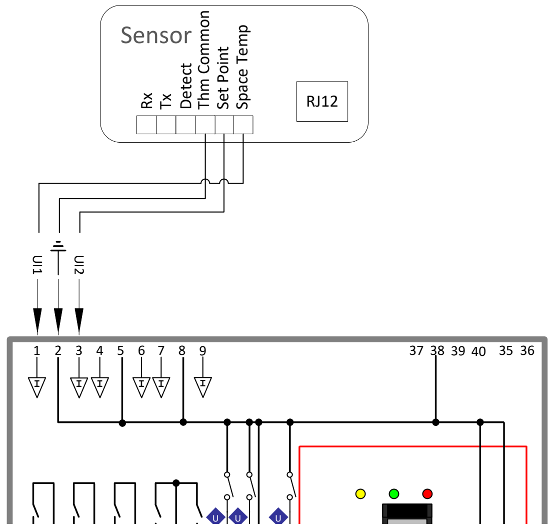
Note: To adjust the span for the CO_2 sensor
CO2SensorBase (A253) Low range of sensor, default is 0.
CO2SensorSpan (A254)Total range of senor, default is 2000.

Note: To adjust the span for the relative humidity sensor
CO2SensorBase (A253) Low range of sensor, default is 0.
CO2SensorSpan (A254) Total range of senor, default is 100.

IO POINTS	DESCRIPTION
UI1	Zone Temperature (with optional override button)
UI2	Setpoint Adjustment (optional 5K slider)
UI3	Discharge Temperature (optional)
UI3	Discharge Temperature (optional)
UI4	Mixed Air Temperature (optional)
UI5	Outdoor Air Temperature Sensor
UI6	CO_2, Humidity or occupancy signal (all optional)

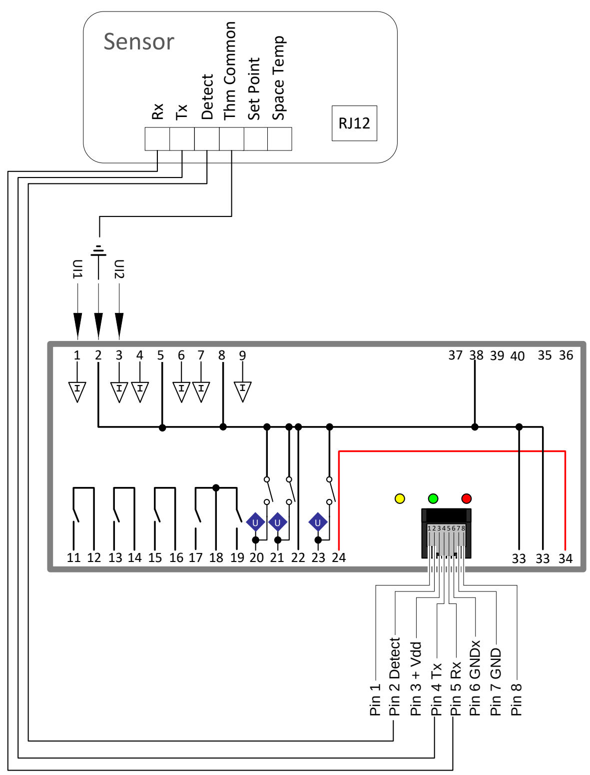
WIRING THE ROOM SENSOR

The diagram below illustrates the typical room sensor that can be ordered from American Auto-Matrix. This is a standard room sensor with a space temperature type III thermistor, including a 5K setpoint slide adjust.



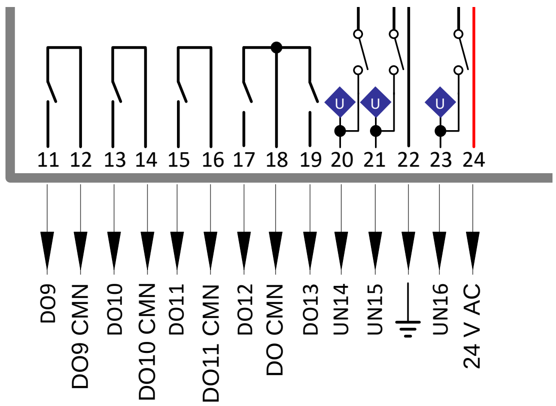
WIRING FOR SERIAL COMMUNICATIONS THROUGH ROOM SENSOR

In addition to the sensor connection illustrated above, the sensor can pass through serial communications connected to its RJ-45 serial port. To pass these comms to the CBT-3T6-5R, the `Rx`, `Tx` and `Detect` terminals must be connected to the RJ-45 port in addition to the sensor connections, as illustrated below:



WIRING THE DIGITAL AND ANALOG OUTPUTS

The CBT-3T6-5R comes with 5 digital outputs and 2 analog outputs for controlling a wide variety of possible elements. It is possible to control intermittent and continuous fans, staged heat, and tri-state heating valves depending on the application.



For the supplied strategy, the following are the output allocations:

- `DO9` is always used to control the fan.
- `DO10` can be used for stage 1 of heat when there are fewer than 4 stages of cooling. It is used for stage 1 of cooling when there are 4 stages of cooling. Can be used as heating tristate valve open when there are fewer than 3 stages of cooling configured.
- `DO11` can be used for stage 2 of heat when there are fewer than 3 stages of cooling. It is used for stage 1 of cooling when there are 3 stages of cooling and stage 2 of cooling when there are 4 stages of cooling. Can be used as heating tristate valve close when there are fewer than 3 stages of cooling configured.
- `DO12` can be used for stage 3 of heat when there are fewer than 2 stages of cooling. It is used for stage 1 of cooling when there are 2 stages of cooling and stage 2 of cooling when there are 3 stages of cooling and stage 3 of cooling when there are 4 stages of cooling. Can be used as cooling tristate valve open when there are fewer than 3 stages of heat configured.
- `DO13` can be used for stage 4 of heat when there are no stages of cooling configured. It is used for stage 1 of cooling when there is 1 stage of cooling and stage 2 of cooling when there are 2 stages of cooling and stage 3 of cooling when there are 3 stages of cooling and stage 4 of cooling when there are 4 stages of cooling. Can be used as cooling tristate valve close when there are fewer than 3 stages of heat configured.

Note: The number of stages (heat and cool) cannot exceed 4. Configuring the CBT-3T6-5R for more than 4 stages total will lead to unpredictable results. If tristate heat is configured stages of cooling cannot exceed 2. If tristate cooling is configured, stages of heat cannot exceed 2 as such a configuration will lead to unpredictable results.

- `UN14` is configured for controlling a modulating heating valve.
- `UN15` is configured for controlling a modulating cooling valve.
- `UN16` is configured for controlling a modulating economizer damper.

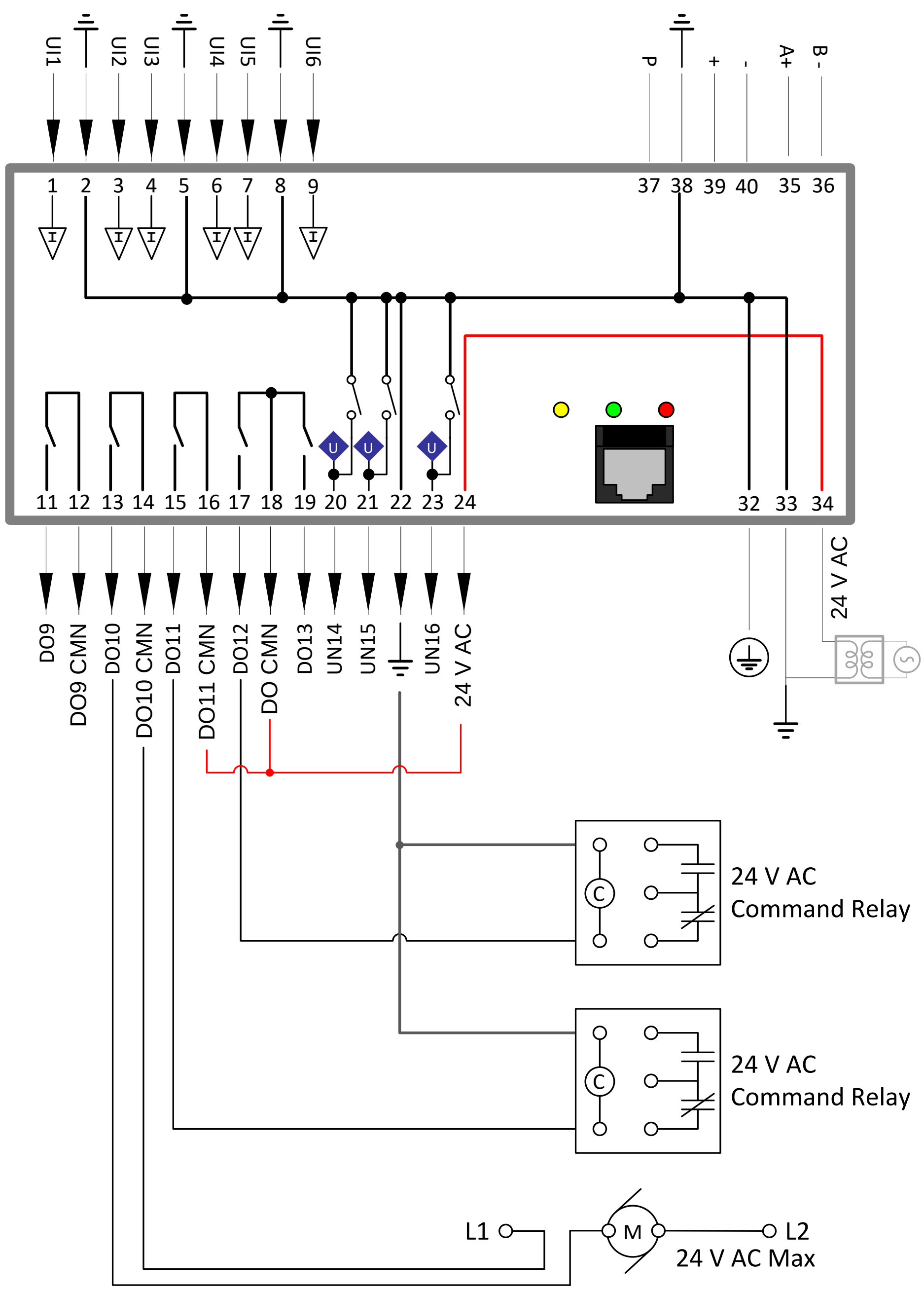
Note: By default, `UN14`, `UN15` and `UN16` (in Analog Output mode) are configured as direct acting 0 ⋯ 10 V dc. However, it is possible to define any Analog Outputs as being reverse acting 10 ⋯ 0 V dc. Depending on the actuator being controlled it is also possible to change the voltage range for 2 ⋯ 10 V dc or 10 ⋯ 2 V dc for any Analog Output.

IO POINTS	DESCRIPTION
`DO9`	Supply Fan Start/Stop
`DO10`	Stage Electric Heat / Cool {See Above} (optional PWM) or Tri-State Heat Valve Open
`DO11`	Stage Electric Heat / Cool {See Above} (optional PWM) or Tri-State Heat Valve Close
`DO12`	Stage Electric Heat / Cool {See Above}
`DO13`	Stage Electric Heat / Cool {See Above}
`UN14`	Modulating Heat Control
`UN15`	Modulating Cool Control
`UN16`	Modulating Economizer Dampers

Digital Output Terminals

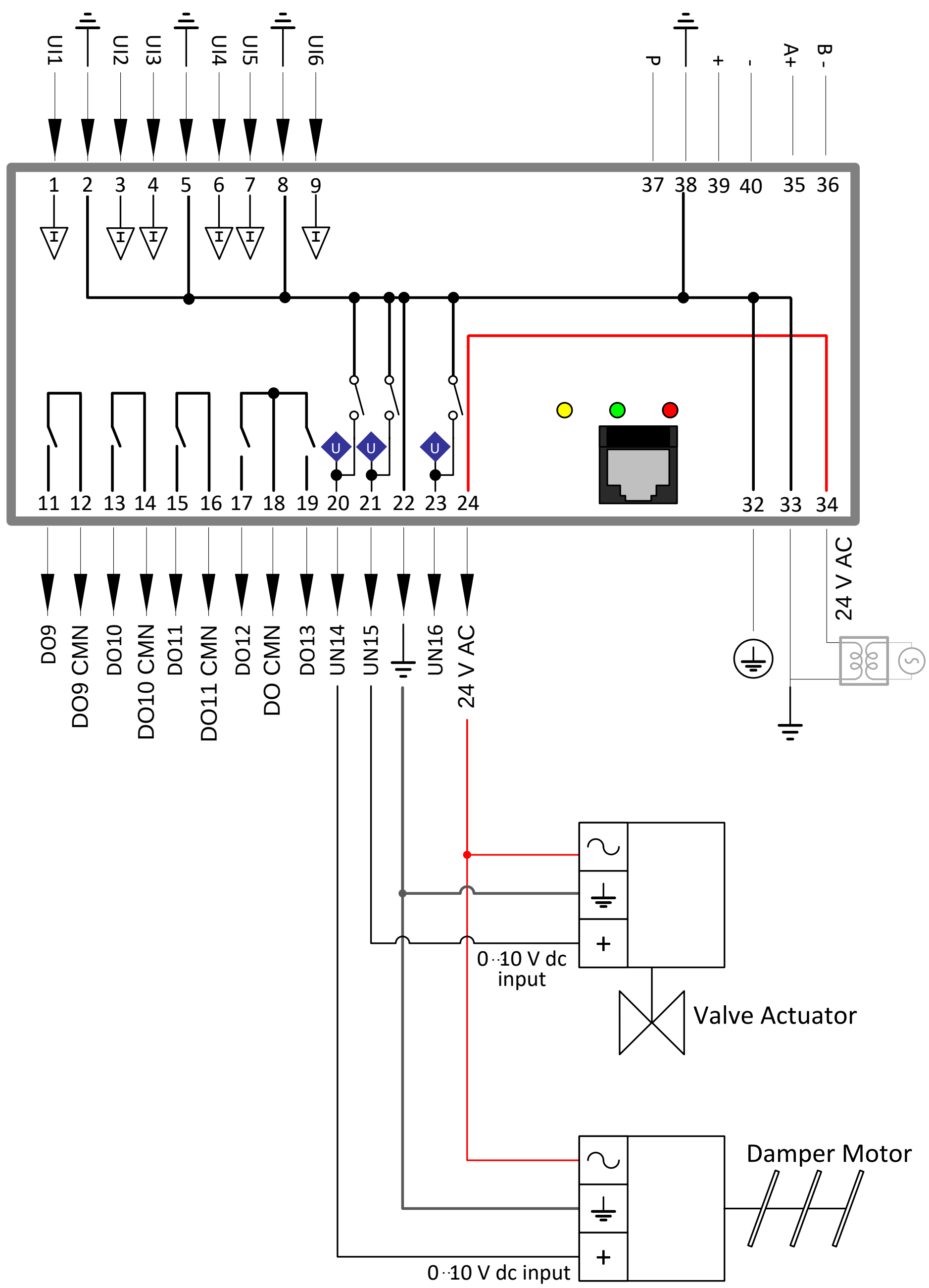
The **CBT-3T6-5R** can be wired to switch up to 240 V AC on Digital Outputs `DO9`, `DO10` and `DO11`, and up to 24 V AC on `DO12` and `DO13`. The relay outputs are Normally-Open dry-contact only and can be wired to switch hot or common.

To switch 24 V AC, users must wire an externally-sourced 24 V AC hot to terminal 18 `DO CMN` (triac common) on the **CBT-3T6-5R**. The 24 V AC can be sourced from the same power supply as the controller, or an external 24 V AC source. A typical wiring diagram for controlling a relay by switching 24 V AC is shown below:



Analog Output Terminals

The **CBT-3T6-5R** can be wired to control 0 ··· 10 V dc devices with a current draw of less than 10 mA on `UN14`, `UN15` and `UN16`. A typical wiring diagram for controlling valves and dampers is shown below:



CONFIGURING THE CBT-3T6-5R FOR BACNET COMMUNICATIONS

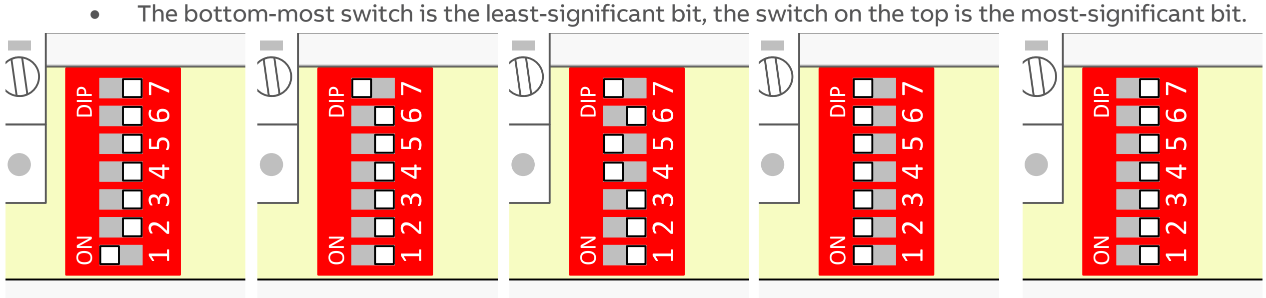
The **CBT-3T6-5R** is shipped with the following default settings:

MS/TP Address:	**(last 2 digits of the serial number)**
BACnet Instance Number	(Instance Number Addressing is based on serial number from the factory)
MS/TP Baud Rate	38,400 bps
Serial to PC Baud Rate	9,600 bps

To communicate to other MS/TP devices on a BACnet MS/TP network, the MS/TP address must be set to a unique address within the MS/TP subnet. Where possible, there should be no gaps between addresses. The BACnet Instance Number must also be unique for the BACnet site.

The DIP switch can be used to set the MS/TP address when the device is first powered on.

- The address is set in binary, from 1 (0000001) to 127 (1111111).
- A switch moved to the left (towards the 'ON' mark) represents 1, moved to the right represents 0.
- The bottom-most switch is the least-significant bit, the switch on the top is the most-significant bit.



0000001	1000000	1011000	1111111	0000000
Address 1	Address 64	Address 88	Address127	Software Selectable*

For convenience, *Appendix: List of DIP switch settings* on page *39* shows a diagram for every address.

***Note**: If the DIP switch is set to all zeros, the device will retain the address to which it was last set, but that address can be subsequently overridden by software.
If no address had previously been set (e.g. when the device is received from the factory), then a device that is powered-on with the DIP switch set to all zeros will use the last 2 digits of its serial number as its initial address.

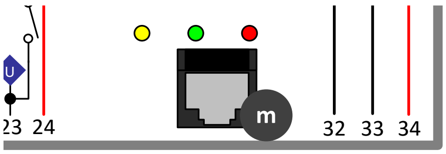
The MS/TP baud rate must match on all devices on the MS/TP subnet. The PC Baud Rate should be left at the default value of 9600 bps.

For the initial configuration of the device, the controller must first be powered on.

Note: Service Port (serial connection) must not be connected until after the device is powered on.

Note: Ensure the 24 V AC and Common wires are correctly connected to the controller. If the wires are swapped, it may cause wdamage to anything connected to the controller.

If connecting directly to the **CBT-3T6-5R**, use a **UC32-PC commissioning cable** by inserting the 9-pin D-Type serial cable into a serial port of the PC on which **NetLink** is installed. Next, insert the RJ-45 connector into the RJ-45 socket **m** on the front of the **CBT-3T6-5R** controller.



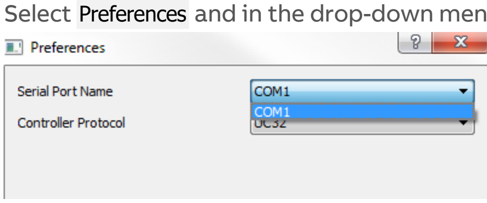
If connecting to the **CBT-3T6-5R** through a room sensor that has been wired for serial communications, insert the 9 pin D-Type serial cable into a serial port on the PC on which **NetLink** is installed, then insert the RJ-12 connector into the RJ-12 socket on the room sensor.

See *Wiring for Serial Communications through Room Sensor* on page 11 for more detail.

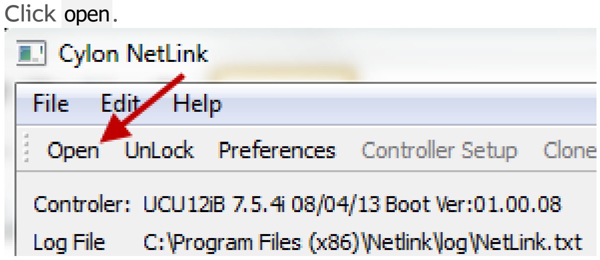
Once connected to the controller, it is possible to change the settings on the controller using the **Engineering Center** or, preferably, **NetLink**. For details on how to use the **Engineering Center**, please refer to the *Cylon BACnet Manual (MAN0106)* available from the American Auto-Matrix Toolbox (http://www.aamatrix.com/toolbox). For details on how to use **NetLink**, continue to the section below.

NetLink is available from the American Auto-Matrix Toolbox (http://www.aamatrix.com/toolbox). Once downloaded, **NetLink** must be installed. Follow the step by step installer and use the default settings where possible.

1. Start **NetLink** from the Start menu or shortcut on your desktop that was created during install.
2. Select Preferences and in the drop-down menu select the COM port that is assigned to the serial cable.

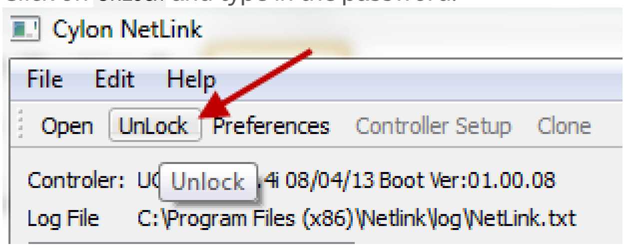
   

   Controller Protocol must be set to “UC32”.
3. Click open.

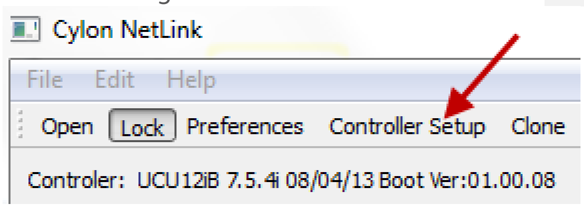
4. Navigate to where the **NetLink** screens are saved and select the “`IO_configHP.nls`” screen.

5. Click on UnLock and type in the password.

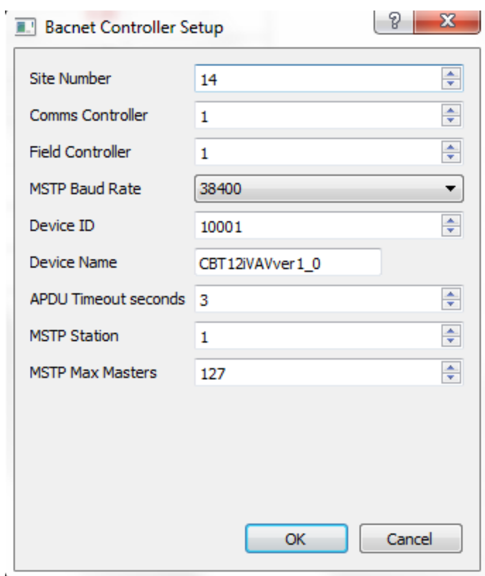


Note: The **NetLink** screens have been configured with a password of "***password***".

6. After unlocking the screens users can now select Controller Setup.



7. After selecting Controller Setup the following BACnet Controller Setup dialog will open:



8. From this window the BACnet MS/TP configuration settings can now be configured.

Note: It is not required to change the Site Number or Comms Controller preset values. It is however recommended to match the Field Controller address with the MSTP Station address (see below).

MSTP Baud Rate is the Baud rate at which all the other devices on the subnet (fieldbus) are communicating. All devices **must** be configured for the same baud rate for communications on the subnet.

Device ID is the BACnet device instance number. Every BACnet controller within the site must receive a unique BACnet instance number to ensure proper communications. This BACnet instance number should be unique even across subnets. See the *Cylon BACnet Manual (MAN0106US)* for further information.

Device Name is the user-assigned name for the controller. This is not necessary for BACnet communications, however, it is useful to name each controller for organizational purposes.

APDU Timeout Seconds : leave this at the default setting of 3 seconds.

MSTP Station is the device MS/TP address. This is the unique address users must give each controller on the subnet (fieldbus).

MSTP Max Masters is the maximum address that this controller will poll when in the “poll for masters” state. Because this is a BACnet master device, it will go into this state to search for the next BACnet master device to pass the token to. To optimize the speed of the network, it is recommended that the last master device on the subnet be set at the maximum MS/TP address on the network. For example, if the last device on the subnet (fieldbus) is the CBT-3T6-5R at address 63, then users would set the **MSTP Max Masters** to 63. This will speed up communications as it will not go into the “poll for masters” state and immediately pass the token back to the eSC or CBM at MS/TP address 0.

See the *Cylon BACnet Manual (MAN0106US)* for more details regarding this functionality and for other tips on optimizing the BACnet network.

3 Configuring the CBT-3T6-5R Rooftop Unit Strategy

The CBT-3T6-5R with Rooftop Unit Strategy (1M810112) has a pre-loaded strategy that is designed to be highly configurable for a wide variety of Rooftop Unit (RTU) sequences.

The sequences can be selected by writing a value to the various input and output codes that are within the strategy. There are multiple ways to configure the CBT-3T6-5R for a specific sequence. Users are able to set these configuration values through a serial connection using NetLink or the Engineering Center.

If the BACnet configuration settings have been configured, users can also set these configuration variables using NetLink for setting these configuration variables.

The preset configuration variables from the factory are:

- InputConfigA (A242) = 16
- HeatConfigA (A243) = 34
- HeatConfigBStages (A261) = 1
- CoolConfigC (A84) = 2
- CoolConfigDStages (A286) = 1

SETTING CBT-3T6-5R ROOFTOP UNIT CONFIGURATION CODES USING NETLINK

To start, the `CBT-3T6-5RRTUDecoder.xlsx` spreadsheet must be downloaded from the American Auto-Matrix Toolbox (http://www.aamatrix.com/toolbox). This spreadsheet will be used to determine the sequence for the CBT-3T6-5R controller with Rooftop Unit strategy. This spreadsheet contains all the configuration options for the CBT-3T6-5R rooftop unit strategy inputs and outputs, along with further configuration options.

INPUT CONFIGURATION CODES

The inputs for the Rooftop Unit strategy are selected using InputConfigA (A242).

There are multiple options which can be selected for each input.

- `Control Temp` - Selections include
  - CBT-STAT Zone Temperature – If a CBT-STAT is connected (CBT-STAT strategy only)
  - FusionAir Zone Temperature – If a FusionAir Smart Sensor is connected (FusionAir Strategy only)
  - Sensor On `UI1` – either a Space Temperature or Return Air Temperature Sensor using a 10K Type III thermistor. All room sensors purchased from American Auto-Matrix are a 10K Type III.
  - Discharge Air Reset – A discharge air Sensor is installed on `UI3` and control is from Supply air temperature.
- `Enable OAT` – Is Outside Air sensor connected to `UI5` and is this to be used in Economizer Lockout? Answer `Yes` or `No`.
- `Enable Temp Occupancy` – Is the System to use the Temporary Override features on either the CBT-STAT / FusionAir Sensor or the Stat connected to `UI1`? Answer `Yes` or `No`.
- `Enable Setpoint Adjust` – Is the System to use the Set point value from either the CBT-STAT / FusionAir Sensor or the Stat connected to `UI1`? Answer `Yes` or `No`.
- `Internal Schedule` – Is the system to use the schedule that is programmed as part of this strategy? A no answer will allow OccupancyCommand (D1) and AspectScheduleOccupancyCmd (A40) to control Occupancy. Answer `Yes` or `No`.
- `CO2 on UI6` – Is the system to use the CO_2 control portion that is programmed as part of this strategy? Answer `Yes` or `No`.

The user can generate an Input code without the use of the `CBT-3T6-5RRTUDecoder.xlsx` spreadsheet using the following formula:

Use as a base number:

- `0` for control with the Discharge Air reset
- `8` for control with zone temperature from CBT-STAT or FusionAir Smart Sensor
- `16` for control with sensor connected to `UI1`. (Space or Return)

Adding a `1` to the base number will allow you to use a remote outside air temperature.

Adding a `2` to the base number will allow for temporary occupancy from the stat.

Adding a `4` to the base number will allow for setpoint adjustment from the stat

Adding a `32` to the base number will allow for the use of an internal BACnet schedule.

Adding a `64` to the base number will enable CO_2 sequence.

- If the CBT-3T6-5R recognizes a CBT-STAT, it will use the stat for space temp, humidity if available, setpoint adjust and temporary occupancy. Setpoint adjustments are made by pressing the up and down arrows on the CBT-STAT. Temporary occupancy is achieved by pressing the forward arrow on the CBT-STAT.

- If there is no CBT-STAT, the CBT-3T6-5R can use an analog stat with a 10k type III sensor for space temperature with an option for a temporary occupancy override that shorts the temperature sensor and a 5k setpoint adjust slider.
- If the CBT-3T6-5R recognizes a FusionAir Smart Sensor, it will use that device for space temp, humidity (if available), setpoint adjust and temporary occupancy. Setpoint adjustments are made by pressing the up and down arrows on the FusionAir touchscreen. Temporary occupancy is triggered by touching the screen.
-

HEATING CONFIGURATION CODES

By clicking into the field associated with each function, users will notice that there are multiple options which can be selected for each input.

The inputs for the RTU strategy are selected using HeatConfigA (A243).

- **Heating Type** - Selections include
  - `None` – Cooling Only Unit
  - `Staged` – Heating accomplished by enabling Stages
  - `Analog` – Heating accomplished by modulating heating valve.
  - `Tristate` – Heating accomplished by modulating Tristate device.
- **Fan Type** – Selections Include
  - `Intermittent` – Fan energizes with need for heating or cooling
  - `Continuous` – Fan On in Occupied Mode (Intermittent in Unoccupied Mode)

The user can generate an Input code without the use of the `CBT-3T6-5RRTUDecoder.xlsx` spreadsheet of the using the following formula:

Use as a base number:

- `0` for No Heat in Unit
- `2` for Staged Mechanical Heat
- `3` for modulating Analog values
- `4` for modulating via Tristate

Adding `32` to the base number will allow the Supply Fan to run intermittently.

Adding `64` to the base number will allow the Supply Fan to run continually in the Occupied Mode.

Note: If neither Supply Fan number is added to the base calculation, the fan output will be disabled.

HeatConfigBStages (A261) indicates the number of stages of heat required if staged mechanical heat is selected.

Note: There are a total of 4 digital outputs that heating and cooling share. For instance, if you have two stages of cooling or have selected tristate cooling you are allowed a maximum of two stages of heat. If three stages of cool are called for you are allowed max 1 stage of heat. If 1 stage of cool is called for you are allowed 3 stages of heat. You are allowed 4 stages of heat only if configured for no cool or modulating analog cooling.

COOLING CONFIGURATION CODES

By clicking into the field associated with each function, users will notice that there are multiple options which can be selected for each input.

The inputs for the RTU strategy are selected using CoolConfigC (A84).

- **Cooling Type** - Selections include
    - `None` – Heating Only Unit
    - `Staged` – Cooling accomplished by enabling Stages
    - `Analog` – Cooling accomplished by modulating heating valve.
    - `Tristate` – Cooling accomplished by modulating Tristate device.
- **Economizer** – Is the System to use the Economizer dampers as a stage of cooling? Answer Yes or No.
- **CO2 on UI6** – Is the system to use the CO_2 control portion that is programmed as part of this strategy? Answer `Yes` or `No`.

The user can generate an Input code without the use of the `CBT-3T6-5RRTUDecoder.xlsx` spreadsheet of the using the following formula:

Use as a base number:

- `0` for No Cool in Unit
- `2` for Staged Mechanical Cooling
- `3` for modulating Analog values
- `4` for modulating via Tristate devices

Adding `32` to the base number will enable CO2 sequence.

Adding `64` to the base number will allow the Economizer Dampers to act as the 1st stage of cooling.

CoolConfigC (A84) indicates the number of stages of heat required if staged mechanical cool is selected.

Note: There are a total of 4 digital outputs that heating and cooling share. For instance, if you have two stages of heat or have selected tristate heat you are allowed a maximum of two stages of cool. If three stages of heat are called for you are allowed max 1 stage of cool. If 1 stage of heat is called for you are allowed 3 stages of cool. You are allowed 4 stages of cool only if configured for no heat or modulating analog heat.

DEFINING AOS

By default, the `AO`s are configured as direct acting 0 ⋯ 10 V dc. However, it is possible to define any `AO`s as being reverse acting 10 ⋯ 0 V dc. Depending on the actuator being controlled it is also possible to change the voltage range for 2 ⋯ 10 V dc or 10 ⋯ 2 V dc for any `AO` output.

WRITING THE CONFIGURATION CODES TO THE CBT-3T6-5R

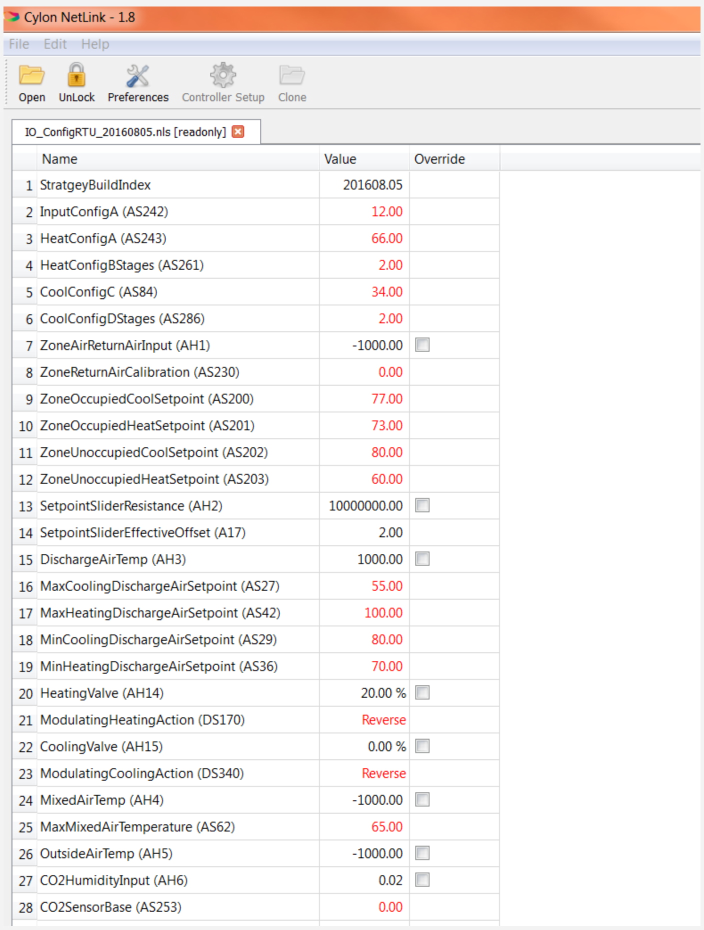
Now that the input and output codes have been determined, it is possible to use NetLink to change the configuration within the CBT-3T6-5R controller.

Connect to the controller using NetLink (if not already connected to controller refer to *Configuring the CBT-3T6-5R for BACnet communications* on page 16). Open the `IO_configRTU.nls` screen to be able to write to the various input/output codes.

Note: By default, the controller is configured as Continuous Fan, 2 Stage Mechanical Heat, 2 Stage Mechanical Cool, No Economizer.

By default, `UI1` is configured with a room sensor with push button override and remote setpoint.

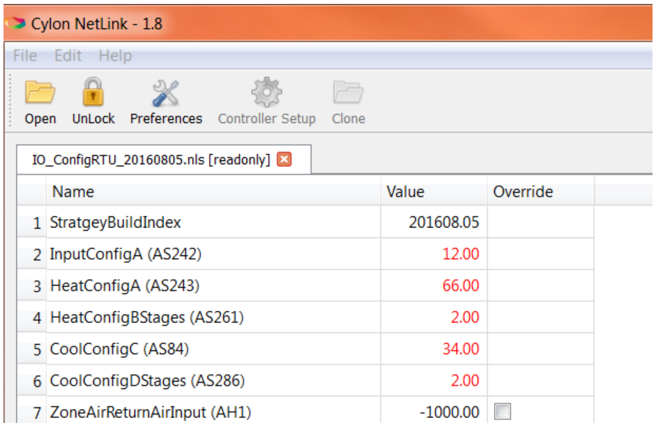
When first connecting to the controller using NetLink, the following are the configuration values that have been preconfigured at the factory:



	Name	Value	Override
1	StratgeyBuildIndex	201608.05	
2	InputConfigA (AS242)	12.00	
3	HeatConfigA (AS243)	66.00	
4	HeatConfigBStages (AS261)	2.00	
5	CoolConfigC (AS84)	34.00	
6	CoolConfigDStages (AS286)	2.00	
7	ZoneAirReturnAirInput (AH1)	-1000.00	☐
8	ZoneReturnAirCalibration (AS230)	0.00	
9	ZoneOccupiedCoolSetpoint (AS200)	77.00	
10	ZoneOccupiedHeatSetpoint (AS201)	73.00	
11	ZoneUnoccupiedCoolSetpoint (AS202)	80.00	
12	ZoneUnoccupiedHeatSetpoint (AS203)	60.00	
13	SetpointSliderResistance (AH2)	10000000.00	☐
14	SetpointSliderEffectiveOffset (A17)	2.00	
15	DischargeAirTemp (AH3)	1000.00	☐
16	MaxCoolingDischargeAirSetpoint (AS27)	55.00	
17	MaxHeatingDischargeAirSetpoint (AS42)	100.00	
18	MinCoolingDischargeAirSetpoint (AS29)	80.00	
19	MinHeatingDischargeAirSetpoint (AS36)	70.00	
20	HeatingValve (AH14)	20.00 %	☐
21	ModulatingHeatingAction (DS170)	Reverse	
22	CoolingValve (AH15)	0.00 %	☐
23	ModulatingCoolingAction (DS340)	Reverse	
24	MixedAirTemp (AH4)	-1000.00	☐
25	MaxMixedAirTemperature (AS62)	65.00	
26	OutsideAirTemp (AH5)	-1000.00	☐
27	CO2HumidityInput (AH6)	0.02	☐
28	CO2SensorBase (AS253)	0.00	

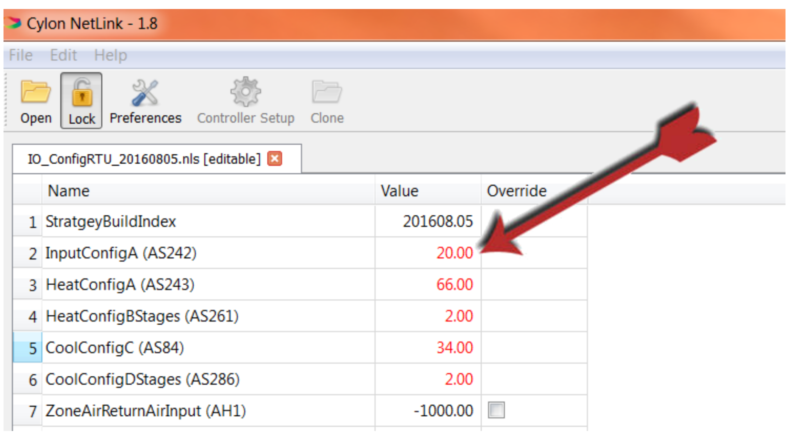
The values that are shown in red are values that can be changed and written to. All values that are shown in black are read only.

Having determined what the input and control configuration codes are for the desired specific application (using **the** `CBT-3T6-5RRTUDecoder.xlsx` **spreadsheet)**, those configuration codes will need to be written to the controller. To change the input and control configuration codes, simply double-click in the appropriate value box and type in the correct code as shown below.



Press [Enter] on the keyboard for the changes to take effect.

When the value is changed, it should now be displayed in red.



Change the rest of the input and output configuration codes.

Note: The **CBT-3T6-5R** must be powered on for these values to be written to flash. If changing these values through a serial connection using **NetLink** or **Engineering Center**, it may take up to 5 minutes before the new values are written to flash.

If the device is power cycled before this time, it could potentially revert back to the default input and output configuration values.

If these values are changed using **Edifice**, **Envoy**, or another master controller via BACnet MS/TP, the controller must be powered for 24 hours before the change in value is written to flash.

These conditions apply to any writable analog or binary values within this controller.

4 CBT-3T6-5R Rooftop Unit Control Sequences

This section provides details of the typical control sequences used for most Rooftop Unit (RTU) applications. The sequences covered in this manual include the following:

OCCUPANCY SEQUENCE

Occupancy can be achieved in 4 different ways:

1. Internal Schedule: When `32` is added to InputConfigA (A242) base number, then the Rooftop unit will be commanded to the occupied mode when the BACnet schedule returns a `True` value. Otherwise the Rooftop unit will be in unoccupied mode.
2. External schedule using OccupancyCommand (D1): When the point AspectScheduleOccupancyCmd (A40) is set to a value of `2`, the Rooftop unit will be commanded to the occupied mode when `OccupancyCmd` (a BACnet-visible point that can be controlled from the front end) returns a true value, otherwise the Rooftop unit will be in the unoccupied mode.
3. External schedule using AspectScheduleOccupancyCmd (A40): When the point OccupancyCommand (D1) is set to a true value, the Rooftop unit will be commanded to the occupied mode when AspectScheduleOccupancyCmd (A40) (a BACnet visible point that can be controlled from the front end) returns a value of `2`, otherwise the Rooftop unit will be in the unoccupied mode. The point AspectScheduleOccupancyCmd (A40) is designed to work with Aspect schedules so that a value of `2` puts the Rooftop unit into occupied mode and a value of `0` puts it into unoccupied mode.
4. Temporary occupancy: When a `2` is added to InputConfigA (A242) base number and during unoccupied times the strategy will respond to temporary occupancy by pressing the forward button on the CBT-STAT, tapping the touchscreen on the FusionAir Smart Sensor, or by shorting the space temperature sensor on an analog stat. Temporary occupancy time will be defined by the configuration MinutesTempOccupancy (A81) in minutes.

FAN SEQUENCE

The RTU strategy sequence can accommodate three different fan settings: `No fan`, `Intermittent fan` and `continuous fan`.

5. **No fan**: In order to disable the fan command do not add anything to the calculation for HeatConfigA (A243). The fan output will not become active via the RTU strategy.
6. **Continuous Fan**: In order to configure the Rooftop unit for `continuous fan`, add `64` to HeatConfigA (A243). The fan will run continuously during occupied mode, and will run when calling for heating or cooling in the unoccupied mode. If deadband mode is entered from heating mode the fan will turn off after a total time of FanOffTimerHeating (A82) in seconds. If deadband mode is entered from cooling mode, the fan will turn off after a total time of FanOffTimerCooling (A28) in seconds.
7. **Intermittent fan**: In order to configure the Rooftop unit for intermittent fan add `32` to HeatConfigA (A243). The fan will run when calling for heating or cooling in the occupied or unoccupied mode. If deadband mode is entered from heating mode, the fan will turn off after a total time of FanOffTimerHeating (A82) in seconds. If deadband mode is entered from cooling mode, the fan will turn off after a total time of FanOffTimerCooling (A28) in seconds.

SETPOINT SELECTION

1. The discharge air temperature setpoint DischargeAirCoolingSetpoint (A34) is reset based on how far the space temperature is off from the cooling setpoint ZoneOccupiedCoolSetpoint (A200).

   If the space temperature is higher than the cooling setpoint by the value of ZoneSetpointOffset (A9) the Discharge Air Cooling Setpoint DischargeAirCoolingSetpoint (A34) modulates to MaxCoolingDischargeAirSetpoint (A27).

   As the space temperature approaches the cooling setpoint, the Discharge Air Cooling Setpoint DischargeAirCoolingSetpoint (A34) modulates to MinCoolingDischargeAirSetpoint (A29) in a linear fashion.

2. The discharge air temperature setpoint DischargeAirCoolingSetpoint (A34) is reset based on how far the space temperature is off from the cooling setpoint ZoneOccupiedCoolSetpoint (A200).

   If the space temperature is lower than the heating setpoint by the value of ZoneSetpointOffset (A9) the Discharge Air Heating Setpoint DischargeAirCoolingSetpoint (A34) modulates to MaxHeatingDischargeAirSetpoint (A42).

   As the space temperature approaches the heating setpoint, DischargeAirCoolingSetpoint (A34) modulates to MinHeatingDischargeAirSetpoint (A36) in a linear fashion.

3. The four setpoints: are Occupied Heating Setpoint (ZoneOccupiedHeatSetpoint (A201)), Occupied Cooling Setpoint (ZoneOccupiedCoolSetpoint (A200)), Unoccupied Heating Setpoint (ZoneUnoccupiedHeatSetpoint (A203)), and Unoccupied Cooling Setpoint (ZoneUnoccupiedCoolSetpoint (A202)). In the Unoccupied mode, setpoints (ZoneUnoccupiedCoolSetpoint (A202) and ZoneUnoccupiedHeatSetpoint (A203)) are used and in Occupied mode the setpoints (ZoneOccupiedCoolSetpoint (A200) and ZoneOccupiedHeatSetpoint (A201)) are used. Also, if so configured, the setpoint offset from the setpoint adjust, either from the CBT-STAT, FusionAir Smart Sensor or the 5k analog slider are added to the occupied setpoints in occupied mode. If LoadShedEnable (D87) is enabled and the mode is occupied, the value of LoadShedOccupiedSetpointOffset (A98) will be added to the cooling setpoint and subtracted from the heating setpoint.

COOLING CALCULATION

When the Rooftop Unit is required to provide cooling, this is accomplished by one of three ways:

1. InputConfigA (A242) base number of `0`: The Discharge Air Temperature and the reset cooling setpoint is used in the direct acting PID calculation where
   - CoolingDemand (A51) is the process variable,
   - DischargeAirPIDGain (A37) is the proportional gain,
   - DischargeAirPIDIntegral (A38) is the integration time,
   - DischargeAirPIDDerivative (A39) is the derivative time,
   - DischargeAirControlDB (A131) is the deadband.

   The PID is enabled by the zone temperature rising above the active cooling setpoint DischargeAirCoolingSetpoint (A34) + ½ PIDEnableDeadband (A19). The result of this calculation /is then transferred to the configured cooling type to control the cooling for the unit.
2. InputConfigA (A242) base number of `8`: The CBT-STAT or FusionAir Smart Sensor temperature and active cooling setpoint ZoneOccupiedCoolSetpoint (A200) is used in the direct acting PID calculation where
   - CoolingDemand (A51) is the process variable,
   - ZonePIDGain (A232) is the proportional gain,
   - ZonePIDIntegral (A35) is the integration time,
   - ZonePIDDerivative (A43) is the derivative time and
   - ZonePIDControlDB (A133) is the control deadband for this PID.

   The PID is enabled by the CBT-STAT or FusionAir Smart Sensor temperature rising above the active cooling setpoint + ½ PIDEnableDeadband (A19). The result of this calculation is then transferred to the configured cooling type to control the cooling for the unit.
3. InputConfigA (A242) base number of `16`: The sensor connected to `UI1` (Zone or Return Air ZoneAirReturnAirInput (AI1)) and active cooling setpoint EffectiveCoolingSetpoint (A23) is used in the direct acting PID calculation where
   - CoolingDemand (A51) is the process variable,
   - ZonePIDGain (A232) is the proportional gain,
   - ZonePIDIntegral (A35) is the integration time,
   - ZonePIDDerivative (A43) is the derivative time and
   - ZonePIDControlDB (A133) is the control deadband for this PID.

   The PID is enabled by the Sensor connected to `UI1` (ZoneAirReturnAirInput (AI1)) temperature rising above the active cooling setpoint + ½ PIDEnableDeadband (A19). The result of this calculation is then transferred to the configured cooling type to control the cooling for the unit.

COOLING SEQUENCES

Staged Cooling

When SystemMode (A106) = 2 the Current Control Mode is Cooling and CoolConfigC (A84) equals either 2 or 66 the Mechanical Cooling Control is Mechanical Cooling, the strategy will sequence the Rooftop unit compressors based on the number of stages configured in CoolConfigDStages (A286) and the value of the Calculated Percent Cooling.

Assuming there are three stages of cooling configured, the strategy sequence operates as described in the paragraphs that follow.

When SystemMode (A106) = 0 the Current Control Mode is Deadband, the Calculated Percent is 0% and all Cooling outputs are OFF.

As the configured sensor temperature rises above the configured temperature setpoint, SystemMode (A106) = 2 and the Current Control mode changes to Cooling. The Calculated Percent Cooling CoolingDemand (A51) value increments from 0 to 100% based on the configured cooling PID constants and the amount of Error between the configured sensor temperature and the configured temperature setpoint.

As the amount of Error increases, the Calculated Percent Cooling CoolingDemand (A51) value increases. When the Calculated Percent Cooling value reaches 34%, the first stage Binary Output point (whichever is defined) turns ON. As each stage of cooling turns ON, the Cooling Inter-Stage Delay Timer (CoolingStagingDelay (A113)) starts timing.

As the Calculated Percent Cooling CoolingDemand (A51) increases to 67%, the second stage of cooling turns ON after the Cooling Inter-Stage Delay Timer CoolingStagingDelay (A113) expires. Once Stage 2 turns ON, the Cooling Inter-Stage Delay Timer CoolingStagingDelay (A113) starts timing.

As the Calculated Percent Cooling CoolingDemand (A51) value increases to 100%, the third stage of mechanical cooling turns ON after the Cooling Inter-Stage Delay Timer CoolingStagingDelay (A113) expires. Once Stage 3 turns ON, the Cooling Inter-Stage Delay Timer CoolingStagingDelay (A113) starts timing.

As the amount of Error decreases, the Calculated Percent Cooling CoolingDemand (A51) decreases. When the Calculated Percent Cooling CoolingDemand (A51) falls to 67%, the third stage of cooling turns OFF. As each stage of cooling turns OFF, the Cooling Inter-Stage Delay Timer CoolingStagingDelay (A113) starts timing.

As the Calculated Percent Cooling CoolingDemand (A51) value decreases to 34%, the second stage of cooling turns OFF after the Cooling Inter-Stage Delay Timer CoolingStagingDelay (A113) expires. Once Stage 2 turns OFF, the Cooling Inter-Stage Delay Timer CoolingStagingDelay (A113) starts timing.

As the Calculated Percent Cooling CoolingDemand (A51) value decreases to 0% or the Current Control Mode SystemMode (A106) changes to Deadband, the first stage of Cooling turns OFF after the Cooling Inter-Stage Delay Timer CoolingStagingDelay (A113) expires. Once Stage 1 turns OFF, the Cooling Inter-Stage Delay Timer CoolingStagingDelay (A113) starts timing.

The following table illustrates the percentage at which the mechanical cooling outputs are staged based on the number of stages configured.

Number of Cooling Stages	Stage 1		Stage 2		Stage 3		Stage 4	
	ON	OFF	ON	OFF	ON	OFF	ON	OFF
1	100%	0%	----	----	----	----	----	----
2	50%	0%	100%	50%	----	----	----	----
3	34%	0%	67%	34%	100%	67%	----	----
4	25%	0%	50%	25%	75%	50%	100%	75%

Note: Discharge Air Temperature Control with staged cooling is NOT recommended. It is extremely difficult to maintain discharge air temperature with staged cooling. American Auto-Matrix recommends that Discharge Air Control be used only when the type of cooling is configured for Analog or Tristate type control.

Analog cooling

Analog type cooling takes the Calculated Percent Cooling CoolingDemand (A51) and feeds it into a 0 ··· 10 V analog output so that if configured for direct action (ModulatingCoolingAction (D340) = `1`) a calculation of `0%` is 0 V dc on the output and a calculation of `100%` is 10 V on the output.

Tristate cooling

Tristate type cooling samples the heating calculation at intervals designated in seconds by CoolingResponseTime (A148) and uses that calculation to drive the cooling valve open or shut. Fully open or fully shut is calculated by how long it takes to drive the actuator fully open from a fully shut position. This quantity in seconds should be entered into CoolingTravelTime (A60).

HEATING CALCULATION

When the Rooftop unit is required to provide heating, this is accomplished in one of three ways:

4. InputConfigA (A242) base number of 0: The Discharge Air Temperature and the reset heating setpoint is used in the reverse acting PID calculation where:
   - HeatingDemand (A50) is the process variable,
   - DischargeAirPIDGain (A37) is the proportional gain,
   - DischargeAirPIDIntegral (A38) is the integration time
   - DischargeAirPIDDerivative (A39) is the derivative time and
   - DischargeAirControlDB (A131) is the deadband.

   The PID is enabled by the zone temperature falling below the active heating setpoint DischargeAirHeatingSetpoint (A26) – ½ PIDEnableDeadband (A19). The result of this calculation is then transferred to the configured heating type to control the heating for the unit.
5. InputConfigA (A242) base number of 8: The CBT-STAT or FusionAir Smart Sensor temperature and active heating setpoint EffectiveHeatingSetpoint (A22) is used in the reverse acting PID calculation where:
   - HeatingDemand (A50) is the process variable.
   - ZonePIDGain (A232) is the proportional gain,
   - ZonePIDIntegral (A35) is the integration time,
   - ZonePIDDerivative (A43) is the derivative time and
   - ZonePIDControlDB (A133) is the deadband for this PID.

   The PID is enabled by the CBT-STAT or FusionAir Smart Sensor temperature falling below the active heating setpoint EffectiveHeatingSetpoint (A22) – ½ PIDEnableDeadband (A19). The result of this calculation is then transferred to the configured cooling type to control the Heating for the unit.
6. InputConfigA (A242) base number of 16: The sensor connected to UI1 (Zone or Return Air) and active heating setpoint EffectiveHeatingSetpoint (A22) is used in the reverse acting PID calculation where:
   - HeatingDemand (A50) is the process variable.
   - ZonePIDGain (A232) is the proportional gain,
   - ZonePIDIntegral (A35) is the integration time,
   - ZonePIDDerivative (A43) is the derivative time and
   - ZonePIDControlDB (A133) is the deadband for this PID.

   The PID is enabled by the Sensor connected to UI1 temperature falling below the active heating setpoint EffectiveHeatingSetpoint (A22) – ½ PIDEnableDeadband (A19). The result of this calculation is then transferred to the configured heating type to control the cooling for the unit.

HEATING SEQUENCES

Staged Heating

When SystemMode (A106) = 1 the Current Control Mode is Heating and HeatConfigA (A243) equals either 34 or 66 the Mechanical Heating Control is Mechanical Heating, the Rooftop will sequence the heating stages based on the number of stages configured in HeatConfigBStages (A261) and the value of the Calculated Percent Cooling.

Assuming there are three stages of cooling configured, the Rooftop sequence operates as described in the paragraphs that follow.

When SystemMode (A106) = 0 the Current Control Mode is Deadband, the Calculated Percent is 0% and all heating outputs are OFF. As the configured sensor temperature falls below the configured temperature setpoint, SystemMode (A106) = 1 and the Current Control mode changes to Heating. The Calculated Percent Heating HeatingDemand (A50) value increments from 0 to 100% based on the configured cooling PID constants and the amount of Error between the configured sensor temperature and the configured temperature setpoint.

As the amount of Error increases, the Calculated Percent Heating HeatingDemand (A50) value increases. When the Calculated Percent Heating value reaches 34%, the first stage Binary Output point (whichever is defined) turns ON. As each stage of heating turns ON, the Heating Inter-Stage Delay Timer HeatingStagingDelay (A52) starts timing.

As the Calculated Percent Heating HeatingDemand (A50) increases to 67%, the second stage of heating turns ON after the Heating Inter-Stage Delay Timer HeatingStagingDelay (A52) expires. Once Stage 2 turns ON, the Heating Inter-Stage Delay Timer HeatingStagingDelay (A52) starts timing.

As the Calculated Percent Heating HeatingDemand (A50) value increases to 100%, the third stage of mechanical heating turns ON after the Heating Inter-Stage Delay Timer HeatingStagingDelay (A52) expires. Once Stage 3 turns ON, the Heating Inter-Stage Delay Timer HeatingStagingDelay (A52) starts timing.

As the amount of Error decreases, the Calculated Percent Heating HeatingDemand (A50) decreases. When the Calculated Percent Heating HeatingDemand (A50) falls to 67%, the third stage of heating turns OFF. As each stage of heating turns OFF, the Heating Inter-Stage Delay Timer HeatingStagingDelay (A52) starts timing.

As the Calculated Percent Heating HeatingDemand (A50) value decreases to 34%, the second stage of heating turns OFF after the Heating Inter-Stage Delay Timer HeatingStagingDelay (A52) expires. Once Stage 2 turns OFF, the Heating Inter-Stage Delay Timer HeatingStagingDelay (A52) starts timing.

As the Calculated Percent Heating HeatingDemand (A50) value decreases to 0% or the Current Control Mode SystemMode (A106) changes to Deadband, the first stage of Heating turns OFF after the Heating Inter-Stage Delay Timer HeatingStagingDelay (A52) expires. Once Stage 1 turns OFF, the Heating Inter-Stage Delay Timer HeatingStagingDelay (A52) starts timing.

This table illustrates the percentage at which the mechanical heating outputs are staged based on the number of stages configured.

Number of Cooling Stages	Stage 1		Stage 2		Stage 3		Stage 4	
	ON	OFF	ON	OFF	ON	OFF	ON	OFF
1	100%	0%	----	----	----	----	----	----
2	50%	0%	100%	50%	----	----	----	----
3	34%	0%	67%	34%	100%	67%	----	----
4	25%	0%	50%	25%	75%	50%	100%	75%

Calculated Percent Heating HeatingDemand (A50)

Note: Discharge Air Temperature Control with staged heating is NOT recommended. It is extremely difficult to maintain discharge air temperature with staged heating. It is recommended that Discharge Air Temperature control be used only when the type of heating is configured for Analog or Tristate type control.

Analog heating

Analog type heating takes the Calculated Percent Heating HeatingDemand (A50) and feeds it into a 0 ··· 10 V analog output so that if configured for direct action (ModulatingHeatingAction (D170) = `1`) a calculation of `0%` is 0 V dc on the output and a calculation of 100% is 10 V on the output.

Tristate heating

Tristate type heating samples the heating calculation at intervals designated in seconds by HeatingResponseTime (A99) and uses that calculation to drive the heating valve open or shut. Fully open or fully shut is calculated by how long it takes to drive the actuator fully open from a fully shut position. This quantity in seconds should be entered into HeatingTravelTime (A95).

ECONOMIZER SEQUENCE

To configure the Rooftop unit for an economizer cycle, add `64` to the base number in CoolConfigC (A84). The economizer will work as a first stage of cooling when enabled. The economizer is enabled when the mixed air temperature is greater than the mixed air temperature lockout MixedAirEconomizerLockout (A69) and when the outside air is greater than the outside air temperature lockout OutsideAirEconomizerLockout (A64) and when the economizer is enabled HeatingDemand (A50) greater than `64`. The economizer will modulate from 0 if the cooling PID is `0` up to `100` if the cooling PID reaches the EconomizerStagingPercent (A44). If the cooling PID rises above the EconomizerStagingPercent (A44), mechanical cooling will stage on as if the cooling PID minus the EconomizerStagingPercent (A44) was the cooling calculation. If the economizer is locked out or not configured, the cooling calculation will work directly off the cooling PID.

CO_2 SEQUENCE

A 0 ··· 10 V CO_2 sensor wired to `UI6` will enable this sequence. This sensor will be rescaled to read between CO2SensorBase (A253) and CO2SensorSpan (A254), and this reading will be sent to a forward-acting PID. If the CO_2 levels rise above CO2Setpoint (A255), the PID will ramp up and will open the outside air damper proportionally unless there is an economizer lockout condition or the economizer damper is being shut due to low mixed air temperature.

Initial values for the CO_2 control are:

- CO2SensorBase (A253) = `0`,
- CO2SensorSpan (A254) =`2000` and
- CO2Setpoint (A255) = `500`.

DEHUMIDIFYING SEQUENCE

De-Humidification cycle is enabled by configuring in CoolConfigC (A84). Relative humidity is sent to the controller through the CBT-STAT or FusionAir Smart Sensor. This reading is brought into a PID controlling to LocalDehumidificationSetpoint (A258) initially set to `65%` RH. If the PID reads greater than `99` the dehumidifying cycle will begin. It will end when the PID reads less than `1`. The dehumidifying cycle will replace the cooling calculation, which is normally `0` in heating or deadband mode with LocalDehumidificationCalc (A49) until the dehumidifying cycle ends. During the dehumidifying cycle the economizer is disabled. This allows for heating and cooling to run simultaneously.

5 Appendix : List of CBT-3T6-5R points

The tables in this Appendix list and describe the points in the CBT-3T6-5R Rooftop unit strategy, along with the units and the default value for each point.

ANALOG POINTS

HARDWARE (I/O)

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS
1	Analog Input	ZoneAirReturnAirInput (AI1)	Space or Return Air Temperature reading from sensor	°F
2	Analog Input	SetpointSliderResistance (AI2)	Value of Setpoint POT in Ohms	Ohms
3	Analog Input	DischargeAirTemp (AI3)	Discharge Air Temperature reading from sensor	°F
4	Analog Input	MixedAirTemp (AI4)	Mixed Air Temperature reading from sensor	°F
5	Analog Input	OudsideAirTemp (AI5)	Outside Air Temperature reading from sensor	°F
6	Analog Input	CO2HumidityInput (AI6)	CO2 or Humidity reading from sensor	%
14	Analog Output	HeatingValve (UN14)	Heating Valve Command Position	%
15	Analog Output	CoolingValve (UN15)	Cooling Valve Command Position	%
16	Analog Output	OutsideAirDamper (UN16)	Economizer Damper Command Position	%

VALUES

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS
2	Analog	Fusion_ZoneTemp (A2)	Current zone temperature for control (FusionAir variants only)	°F
10	Analog	ZoneTemp (A10)	Current zone temperature for control	°F
14	Analog	StratgeyBuildIndex (A14)	Revision Number of Strategy	no-units
17	Analog	SetpointSliderEffectiveOffset (A17)	Current offset to setpoint from sensor POT	°F
22	Analog	EffectiveHeatingSetpoint (A22)	Active Heating Setpoint	°F
23	Analog	EffectiveCoolingSetpoint (A23)	Active Cooling Setpoint	°F
26	Analog	DischargeAirHeatingSetpoint (A26)	Discharge air heating setpoint	°F
33	Analog	ZoneCoolPIDCalc (A33)	Cool Master Calculated Percent	%
34	Analog	DischargeAirCoolingSetpoint (A34)	Discharge air cooling setpoint	°F
49	Analog	LocalDehumidificationCalc (A49)	De-Humidification Master Calculated Percent	%
50	Analog	HeatingDemand (A50)	Heating Demand	%
51	Analog	CoolingDemand (A51)	Cooling Demand	%
73	Analog	CO2Value (A73)	Local CO2 Value	PPM
75	Analog	ZoneRelativeHumidity (A75)	Local Humidity value (CBT-STAT variants only)	%rh
75	Analog	Fusion_Humidity (A75)	Local Humidity value (FusionAir variants only)	%rh
106	Analog	SystemMode (A106)	Heating, Cooling or Deadband	no-units
110	Analog	Fusion_CO2(A110)	Local CO2 value (FusionAir variants only)	PPM
137	Analog	Fusion_ActiveOccCoolStpt	Fusion Sensor Occupied Cooling Setpoint (FusionAir variants only)	°F
138	Analog	Fusion_ActiveOccHeatStpt	Fusion Sensor Occupied Heating Setpoint (FusionAir variants only)	°F

SETPOINTS

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	IMPERIAL		METRIC		MIN	MAX
				DEFAULT VALUE	UNIT	DEFAULT VALUE	UNIT		
1	Analog Setpoint	SetpointAdjustStepSize (A1)	Value of Adjustment to the CBT-Stat (CBT-STAT variants only)	5	°F	0.25	°C	0	100
1	Analog Setpoint	Fusion_StptStepSize (A1)	Value of Adjustment to the Fusion Air Sensor (FusionAir variants only)	.5	°F	0.5	°C	0	100
9	Analog Setpoint	ZoneSetpointOffset (A9)	Deadband for Resetting of Discharge air Setpoint	0	°F	4	°C	0	100
19	Analog Setpoint	PIDEnableDeadband (A19)	Discharge Air Setpoint Enable Deadband	2	°F	2	°C	0	100

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	IMPERIAL		METRIC		MIN	MAX
				DEFAULT VALUE	UNIT	DEFAULT VALUE	UNIT		
27	Analog Setpoint	MaxCoolingDischargeAirSetpoint (A27)	Discharge Air Reset value for maximum Cooling Discharge air setpoint	55	°F	12.8	°C	0	100
28	Analog Setpoint	FanOffTimerCooling (A28)	If the state enters Deadband from cooling when in On Occupied delay fan from going off for this time	30	Sec	30	Sec	0	1000
29	Analog Setpoint	MinCoolingDischargeAirSetpoint (A29)	Discharge Air Reset value for minimum Cooling Discharge air setpoint	80	°F	26.7	°C	0	100
35	Analog Setpoint	ZonePIDIntegral (A35)	Zone PID Integral Time	900	no-units	900	no-units	0	10000
36	Analog Setpoint	MinHeatingDischargeAirSetpoint (A36)	Discharge Air Reset value for minimum Heating Discharge air setpoint	70	°F	21.1	°C	0	100
37	Analog Setpoint	DischargeAirPIDGain (A37)	Discharge Air PID Proportional Gain	5	no-units	5	no-units	0	1000
38	Analog Setpoint	DischargeAirPIDIntegral (A38)	Discharge Air PID Integral Time	30	no-units	30	no-units	0	10000
39	Analog Setpoint	DischargeAirPIDDerivative (A39)	Discharge Air PID Derivative Time	0	no-units	0	no-units	0	1000
40	Analog Setpoint	AspectScheduleOccupancyCmd (A40)	Aspect Schedule Connection Point	2	no-units	2	no-units	0	100
42	Analog Setpoint	MaxHeatingDischargeAirSetpoint (A42)	Discharge Air Reset value for maximum Heating Discharge air setpoint	100	°F	37.8	°C	0	100
43	Analog Setpoint	ZonePIDDerivative (A43)	Zone PID Derivative Time	0	no-units	0	no-units	0	1000
44	Analog Setpoint	EconomizerStagingPercent (A44)	Staging Control Point	30	%	30	%	0	100
52	Analog Setpoint	HeatingStagingDelay (A52)	Heating Inter-Stage Delay Time	5	Sec	5	Sec	0	1000
59	Analog Setpoint	AnalogDeHumidCoolingPct (A59)	Calculate Percent automatically for De-Humid if staged cool is called for.	34	%	34	%	0	100
60	Analog Setpoint	CoolingTravelTime (A60)	Tristate - Time it takes for Cooling Valve to go from full close to full open	120	Sec	120	Sec	0	1000
62	Analog Setpoint	MaxMixedAirTemperature (A62)	Mixed Air Temperature Setpoint	72	°F	65	°C	0	100
63	Analog Setpoint	MixedAirPIDGain (A63)	Mixed Air PID Proportional Gain	30	no-units	30	no-units	0	1000
64	Analog Setpoint	OutsideAirEconomizerLockout (A64)	Outside Air Temperature Lockout Setpoint for Economizer Dampers	0	°F	10	°C	0	100
69	Analog Setpoint	MixedAirEconomizerLockout (A69)	Mixed Air Temperature Lockout Setpoint for Economizer Dampers	30	°F	10	°C	0	100
70	Analog Setpoint	RemoteOutsideAir (A70)	Outside Air Temperature value if in remote mode	72	°F	22	°C	0	100
79	Analog Setpoint	OutsideAirDamperMinimumPosition (A79)	Normal Modes Economizer Dampers Minimum Position	20	%	20	%	0	100
81	Analog Setpoint	MinutesTempOccupancy (A81)	Temporary Occupancy Over-Ride Time	1000	Min	1000	Min	0	10000
82	Analog Setpoint	FanOffTimerHeating (A82)	If the state enters Deadband from heating when in On Occupied delay fan from going off for this time	30	Sec	30	Sec	0	1000
84	Analog Setpoint	CoolConfigC (A84)	Strategy Cooling configuration setpoint	2	no-units	2	no-units	0	255
95	Analog Setpoint	HeatingTravelTime (A95)	Tristate - Time it takes for Heating Valve to go from full close to full open	120	Sec	120	Sec	0	1000
97	Analog Setpoint	DehumidificationGain (A97)	De-Humidification PID Proportional Gain	10	no-units	10	no-units	1	1000
98	Analog Setpoint	LoadShedOccupiedSetpointOffset (A98)	Number of degrees by which occupied setpoints are offset when load shed mode is enabled.	2	°F	1	°C	0	100
99	Analog Setpoint	HeatingResponseTime (A99)	Tristate Heating output valve travel time	120	Sec	120	Sec	0	1000
108	Analog Setpoint	CoolingOnOff (A108)	Cooling Minimum On and Off Time	5	Sec	5	Sec	0	1000
113	Analog Setpoint	CoolingStagingDelay (A113)	Cooling Inter-Stage Delay Time	5	Sec	5	Sec	0	1000

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	IMPERIAL		METRIC		MIN	MAX
				DEFAULT VALUE	UNIT	DEFAULT VALUE	UNIT		
127	Analog Setpoint	OutsideAirDamperMinimumPosition (A127)	Normal Modes Economizer Dampers Minimum Position	20	%	20	%	0	100
131	Analog Setpoint	DischargeAirControlDB (A131)	Deadband for Control of the Discharge Air PID	1	no-units	1	no-units	0	1000
133	Analog Setpoint	ZonePIDControlDB (A133)	Deadband for Control of the Zone PID	1	°F	1	°C	0	1000
148	Analog Setpoint	CoolingResponseTime (A148)	Tristate Cooling output valve travel time	120	Sec	120	Sec	0	1000
200	Analog Setpoint	ZoneOccupiedCoolSetpoint (A200)	Occupied Cooling setpoint	75	°F	23	°C	0	100
201	Analog Setpoint	ZoneOccupiedHeatSetpoint (A201)	Zone Occupied heating setpoint	71	°F	21	°C	0	100
202	Analog Setpoint	ZoneUnoccupiedCoolSetpoint (A202)	Zone Unoccupied cooling setpoint	85	°F	26	°C	0	100
203	Analog Setpoint	ZoneUnoccupiedHeatSetpoint (A203)	Zone Unoccupied heating setpoint	65	°F	18	°C	0	100
230	Analog Setpoint	ZoneReturnAirCalibration (A230)	Calibration Point for Sensor on UI1	0	°F	0	°C	0	100
231	Analog Setpoint	SetpointSliderSpan (A231)	Zone control slider range setpoint	4	°F	2	°C	0	100
232	Analog Setpoint	ZonePIDGain (A232)	Zone temperature PID gain	30	no-units	30	no-units	0	1000
242	Analog Setpoint	InputConfigA (A242)	Strategy Input configuration setpoint	20	no-units	20	no-units	0	255
243	Analog Setpoint	HeatConfigA (A243)	Strategy Heating configuration setpoint	34	no-units	34	no-units	0	255
253	Analog Setpoint	CO2SensorBase (A253)	Base Value for conversion of UI6	0	P.P.M	0	P.P.M	0	100
254	Analog Setpoint	CO2SensorSpan (A254)	Range Value for conversion of UI6	2000	P.P.M	2000	P.P.M	0	10000
255	Analog Setpoint	CO2Setpoint (A255)	Setpoint when UI6 is used for CO2	500	P.P.M	500	P.P.M	0	1000
258	Analog Setpoint	LocalDehumidificationSetpoint (A258)	Setpoint when UI6 is used for De-Humidification	65	%rh	65	%rh	0	100
261	Analog Setpoint	HeatConfigBStages (A261)	Strategy Heating configuration setpoint	2	no-units	2	no-units	0	4
286	Analog Setpoint	CoolConfigDStages (A286)	Strategy Heating configuration setpoint	2	no-units	2	no-units	0	4

DIGITAL POINTS

HARDWARE (I/O)

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS 0/OFF	UNITS 1/ON
9	Digital Output	Fan (DO9)	Supply Fan Enable/Disable	On	Off
10	Digital Output	DO_2 (D10)	Either Heating or Cooling Enable/Disable (See Configuration for explanation)	On	Off
11	Digital Output	DO_3 (DO11)	Either Heating or Cooling Enable/Disable (See Configuration for explanation)	On	Off
12	Digital Output	DO_4 (DO12)	Either Heating or Cooling Enable/Disable (See Configuration for explanation)	On	Off
13	Digital Output	DO_5 (DO13)	Either Heating or Cooling Enable/Disable (See Configuration for explanation)	On	Off

VALUES

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS 0/OFF	UNITS 1/ON
4	Digital	HeatingMode (D4)	Heating Mode Active	On	Off
5	Digital	CoolingMode (D5)	Cooling Mode Active	On	Off
6	Digital	OccupancyStatus (D6)	Occupancy mode status	On	Off
10	Digital	DigVirtA (D10)	Internal BACnet Schedule Connection Point	On	Off
32	Digital	NoHeatingConfig (D32)	Is Heating not required	On	Off
35	Digital	AnalogModulatingHeating (D35)	Is Modulating Heat required	On	Off
36	Digital	TristateModulatingHeating (D36)	Is Tristate	On	Off
53	Digital	HeatingOnOff (D53)	Heating State	On	Off
73	Digital	DeadBandMode (D73)	De-Humidification is in deadband mode	On	Off
86	Digital	EconomizerEnable (D86)	Is Economizer Dampers enabled	On	Off
106	Digital	IllegalSetpoints (D106)	Is an Illegal Setpoint entered?	Alarm	Normal
191	Digital	NoCoolingConfig (D191)	Is Cooling not required	On	Off
192	Digital	DutyStageA (D192)	Staged Mechanical Cooling ND NO Duty Cycle needed	On	Off
193	Digital	StagedCooling (D193)	Staged Cooling not required	On	Off
194	Digital	AnalogModulatingCooling (D194)	Either Tristate or Modulating Cooling is required	On	Off
195	Digital	MODTRIC (D195)	Tristate Cooling Required	On	Off
332	Digital	LocalDehumidControl (D332)	De-Humidification Control Required	Enable	Disable
334	Digital	LocalCo2Control (D334)	CO2 Control Required	Enable	Disable
350	Digital	OneStageHeating (D350)	Only One Stage of Heating in System	On	Off
351	Digital	TwoStageHeating (D351)	Only Two Stages of Heating in System	On	Off
352	Digital	ThreeStageHeating (D352)	Only Three Stages of Heating in System	On	Off
353	Digital	FourStageHeating (D353)	Only Four Stages of Heating in System	On	Off
357	Digital	OneStageCooling (D357)	Only One Stage of Cooling in System	On	Off
358	Digital	TwoStageCooling (D358)	Only Two Stages of Cooling in System	On	Off
359	Digital	ThreeStageCooling (D359)	Only Three Stages of Cooling in System	On	Off
360	Digital	FourStageCooling (D360)	Only Four Stages of Cooling in System	On	Off

SETPOINTS

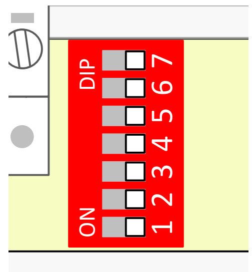
POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	DEFAULT VALUE	UNITS 0/OFF	UNITS 1/ON
1	Digital Setpoint	OccupancyCommand (D1)	Occupancy command	Occ	Occ	Non Occ
8	Digital Setpoint	House (D8)	CBT-Stat House Indicator	On	On	Off
14	Digital Setpoint	Fusion_OvrReset(D14)	Fusion Sensor override reset (FusionAir variants only)	Off	On	Off
87	Digital Setpoint	LoadShedEnable (D87)	Load Shed Enable Command	Disable	Enable	Disable
170	Digital Setpoint	ModulatingHeatingAction (D170)	Heating Valve Action	Reverse	Reverse	Forward
180	Digital Setpoint	ModulatingHeatingFailPosition (D180)	Heating Valve Fails in what position	Closed	Closed	Open
249	Digital Setpoint	EmergencyPurgeCmd (D249)	Put Unit into Purge Mode	Off	On	Off
250	Digital Setpoint	EmergencyStarveCmd (D250)	Put Unit into Starve Mode	Off	On	Off
330	Digital Setpoint	RemoteOutsideAirEnable (D330)	Enable Remote Outside Air Setpoint	On	On	Off
340	Digital Setpoint	ModulatingCoolingAction (D340)	Cooling Valve Action	Reverse	Reverse	Forward
341	Digital Setpoint	ModulatingCoolingFailPosition (D341)	Cooling Valve Fails in what position	Closed	Closed	Open

TIME SCHEDULES

POINT	POINT TYPE	OBJECTNAME	DESCRIPTION	UNITS 0/OFF	UNITS 1/ON
200	BACnet Schedule	InternalSchedule (D200)	BACnet Schedule	Unoccupied	Occupied

6 Appendix: List of DIP switch settings

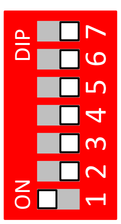
The following table illustrates the DIP switch settings for all possible controller MSTP address settings. See *Configuring the CBT-3T6-5R for BACnet communications* on page 16 for more details.



0000000
Software Selectable

Note: If the DIP switch is set to all zeros, the device will retain the address to which it was last set, but that address can be subsequently overridden by software.

If no address had previously been set (e.g. when the device is received from the factory), then a device that is powered-on with the DIP switch set to all zeros will use the last 2 digits of its serial number as its initial address.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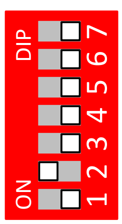
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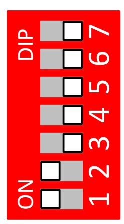
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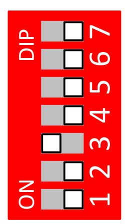
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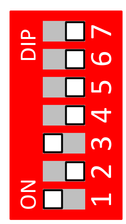
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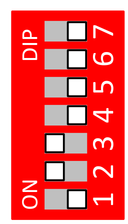
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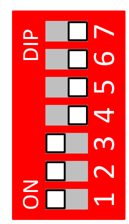
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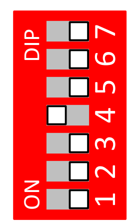
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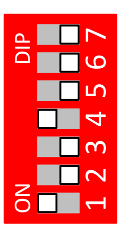
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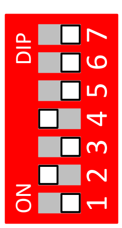
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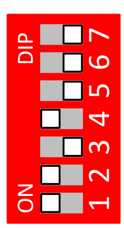
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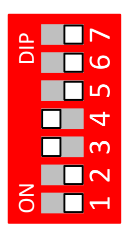
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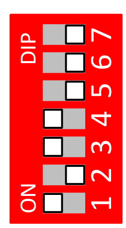
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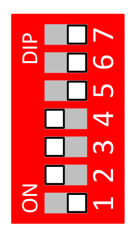
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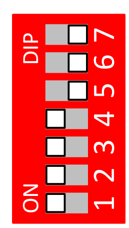
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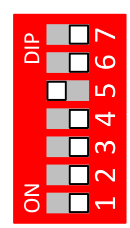
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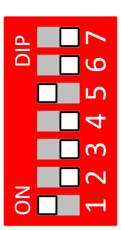
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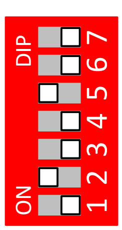
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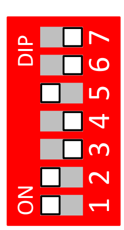
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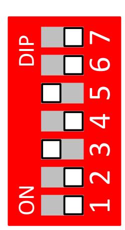
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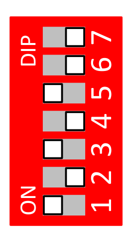
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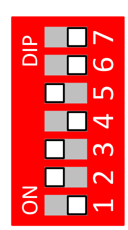
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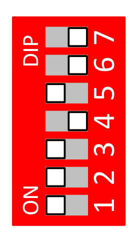
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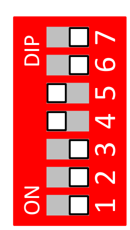
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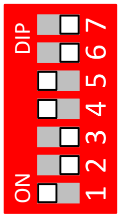

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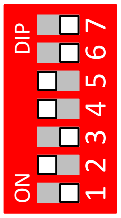

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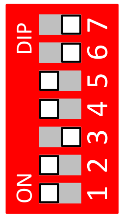

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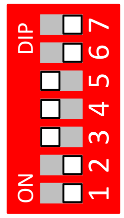

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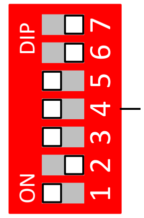

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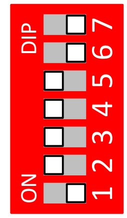

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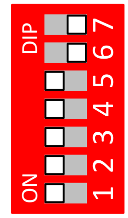

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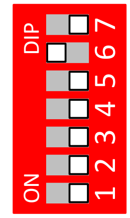

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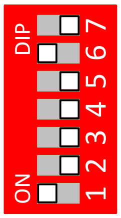

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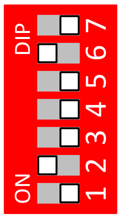

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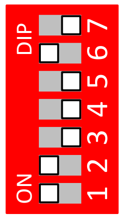

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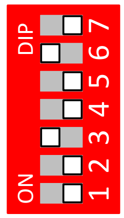

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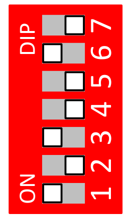

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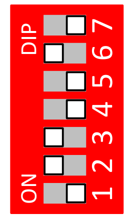

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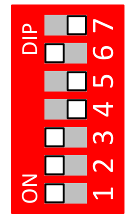

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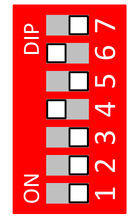

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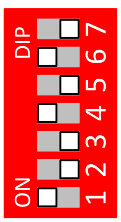

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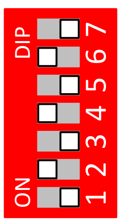

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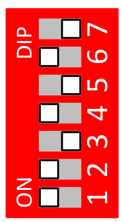

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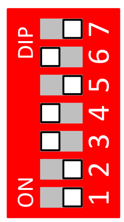

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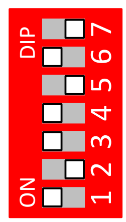

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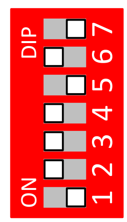

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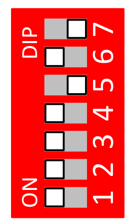

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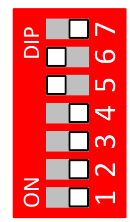

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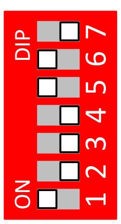

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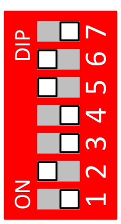

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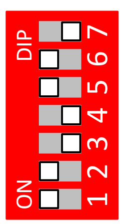

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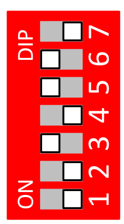

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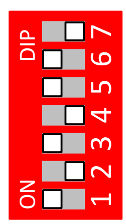

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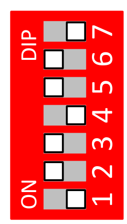

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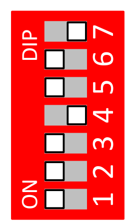

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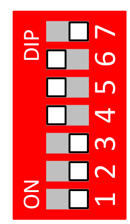

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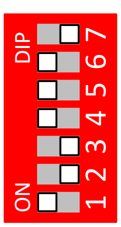

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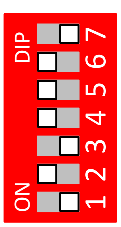

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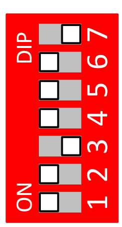

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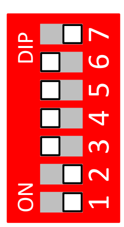

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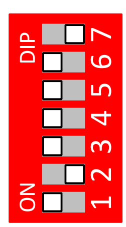

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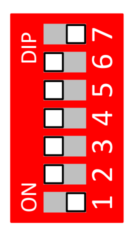

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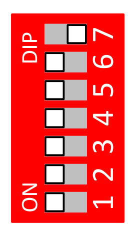

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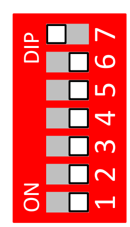

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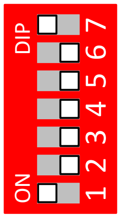
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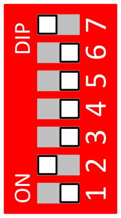
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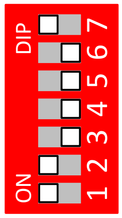
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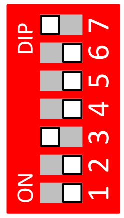
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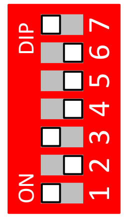
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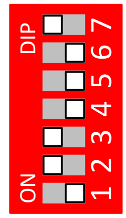
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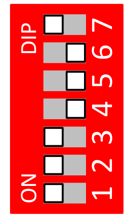
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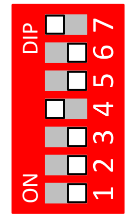
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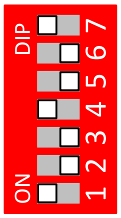
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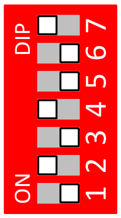
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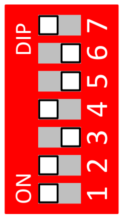
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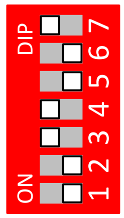
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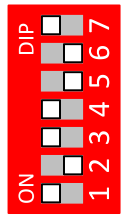
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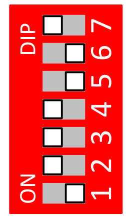
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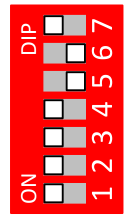
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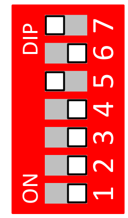
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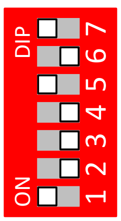
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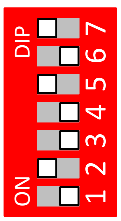
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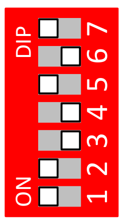
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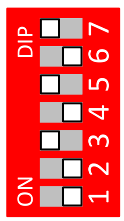
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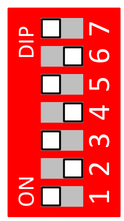
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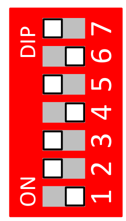
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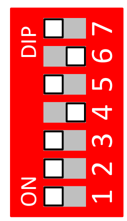
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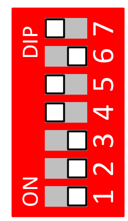
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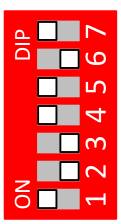
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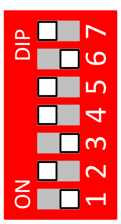
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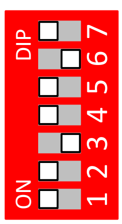
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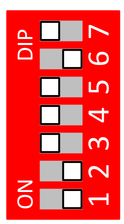
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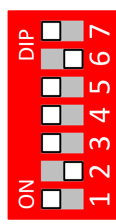
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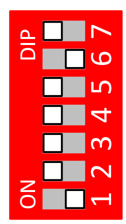
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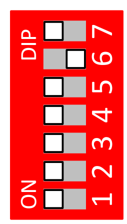
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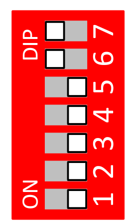
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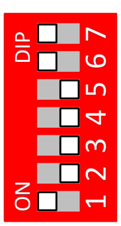
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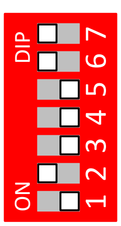
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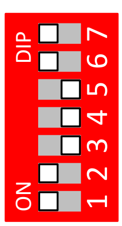
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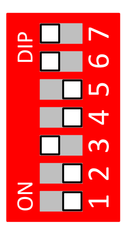
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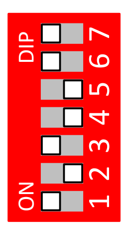
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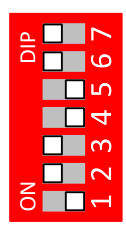
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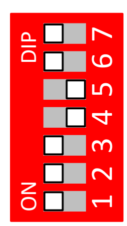
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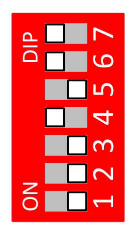
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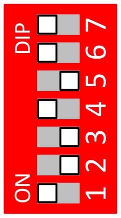

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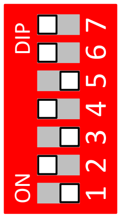

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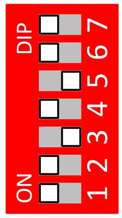

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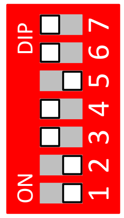

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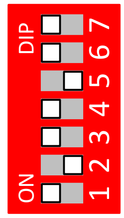

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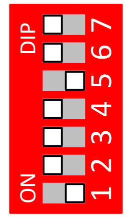

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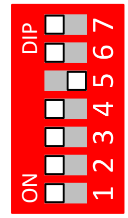

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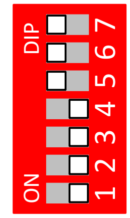

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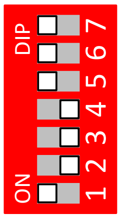

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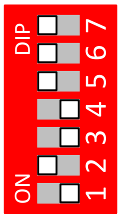

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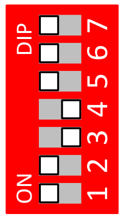

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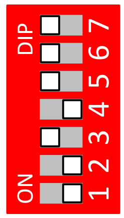

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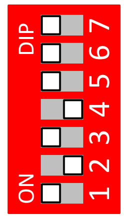

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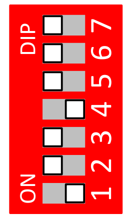

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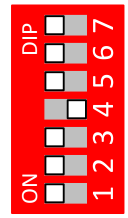

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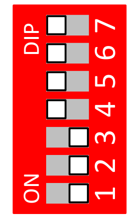

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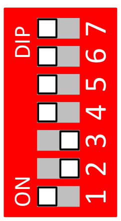

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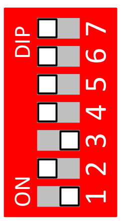

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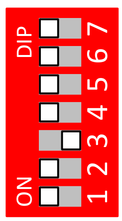

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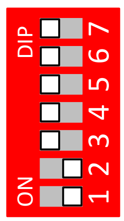

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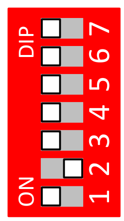

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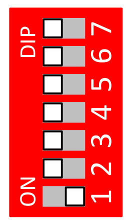

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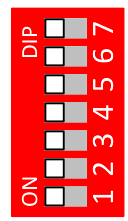

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