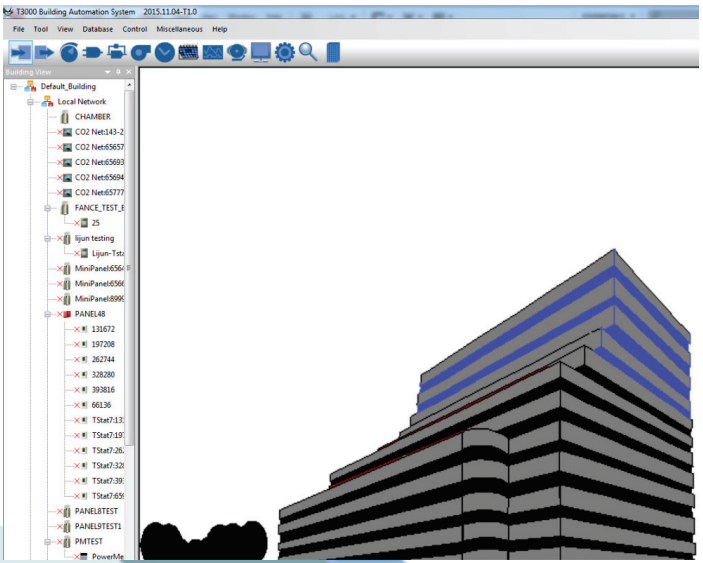
Description

This full-featured thermostat is designed for cooling and heating systems in residential and commercial buildings. The thermostat can be configured for use with air handlers,fan coils, VAV's, modulating valves and many other HVAC applications. All models support BACnet and Modbus protocols which allows for easy integration with big name control systems like Niagara, Siemens, Honeywell, Johnson Controls, Delta, Reliable and Kreuter just to name a few.There are five relays outputs and two analog outputs as well as 8 universal inputs. These can be configured using the T3000 free software avialable for download. There are more than 300 settings with many options. This makes it possible to configure these devices for most any HVAC application. Once the unit is configured, you can save the file and copy it to other controllers and backup project settings.
Options are available for occupancy, zigbee wireless and humidity / enthalpy control.

Highlights

- BACnet MS/TP and Modbus RTU protocols over RS485.
- Baudrates of 1.2k,4.8k,9.6k,14.4k,19.2k, 38.4k, 57.6k, 76.8k and 115.2k.
- Well documented register list for easy integration with other systems.
- 8 universal inputs for external temperature, voltage, contacts, etc.
- 5 relay outputs, rated at 12~24vac @ 2 amps each.
- 2 analog outputs, 0-10V @ 100ma each.
- Color LCD display with configurable scroll bar.
- Easily configure the thermostat for practically any application.
- On board clock with infinite life supercap battery backup.
- Uses a 32 bit Arm CPU with 12 bit analog resolution.

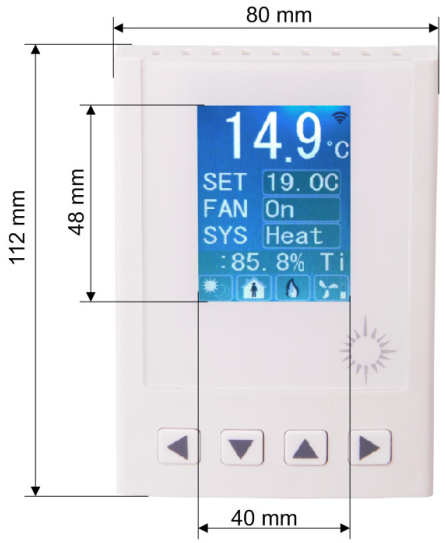
T3000 Software

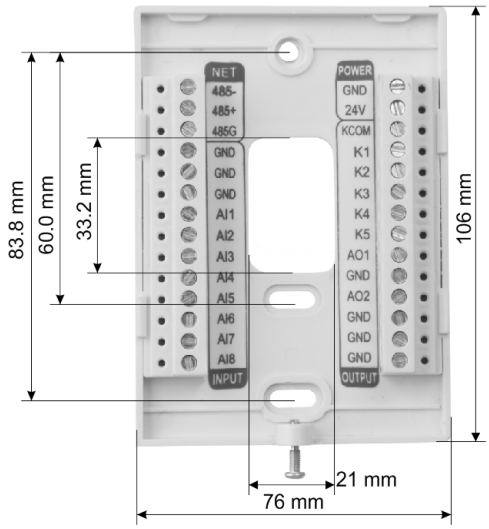


Typical Applications

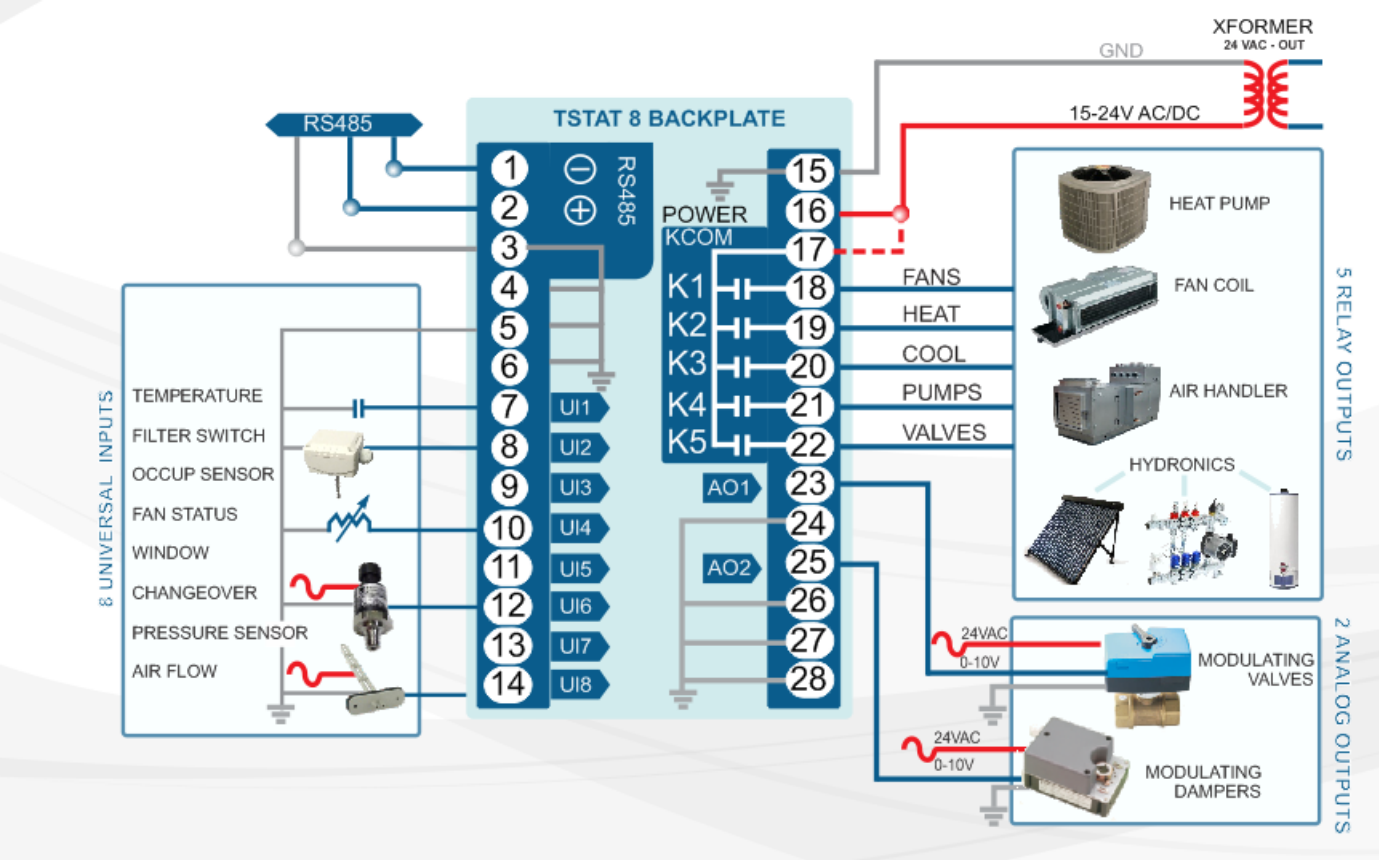
Specifications

Outputs	5 relay outputs 24vac @ 2 amps; 2 analog outputs 10V @100mA
8 Universal Inputs	10k therm, contacts, 4-20ma, 0-5V,0-10V
Operating range	-30~70°C(-22~158°F) / 0 to 99% RH
Supply voltage	12~24VAC/DC ±20%, 50-60Hz
Power consumption	100mA at 12VDC
Relay contacts	5 relays, 2A @ 24VAC UL File No.: E169380
Plastic Housing	Flammability rating UL 94 file E56070
Enclosure rating	IP31
Protocols	BACnet MS/TP and Modbus RTU RS485
Baudrate	9600, 19200, 38400, 57600, 76800, 115200
Temperature sensor	10K thermistor ±0.5°C
Setup Software	Free, no licensing, open source, down-load from website





Typical Applications



Approvals

Relay	UL File No. E169380
Plastic Enclosure	PA66 UL 94 V0 file E56070
PCB	FR-4 Epoxy Glass Cloth, UL E479892
Terminal Block	PA66 UL 94V-0

Software

- 8 analog inputs, 2 analog outputs; 5 digital outputs
- Industry standard BACnet MS/TP& Modbus proto cols
- Configurable user screen displays
- Day at home, work time, night at home, sleep and holiday Schedules

Bacnet Objects

Device	Object identifier;Object name;Object type;Vendor name;Vendor identifier;Model name;Firmware revision;Application software version;Protocol version;Protocol revision;Object list;Max apdu length accepted;Segmentation supported
Universal Input	UI1:temperature present value;UI2~UI9:present value Object identifier;Object name;Description;Object type;Present value;Out of service;Units
Analog Output	AO1:analog output 1 value;AO2:analog output 2 value Object identifier;Object name;Description;Object type;Present value;Out of service;Units;Priority array
Analog Value	AV0:baudrate select Object identifier;Object name;Description;Object type;Present value;Out of service;Units;Priority array
Binary Output	BO1~5:Relay Output 1~5 Object identifier;Object name;Description;Object type;Present value;Out of service;Units;Priority array;Polarity;Relinquish default;Active textInactive text

Part Number Scheme

* Tstat8 - Black :MOQ 50PCS

Tstat8 – H– OCC– B

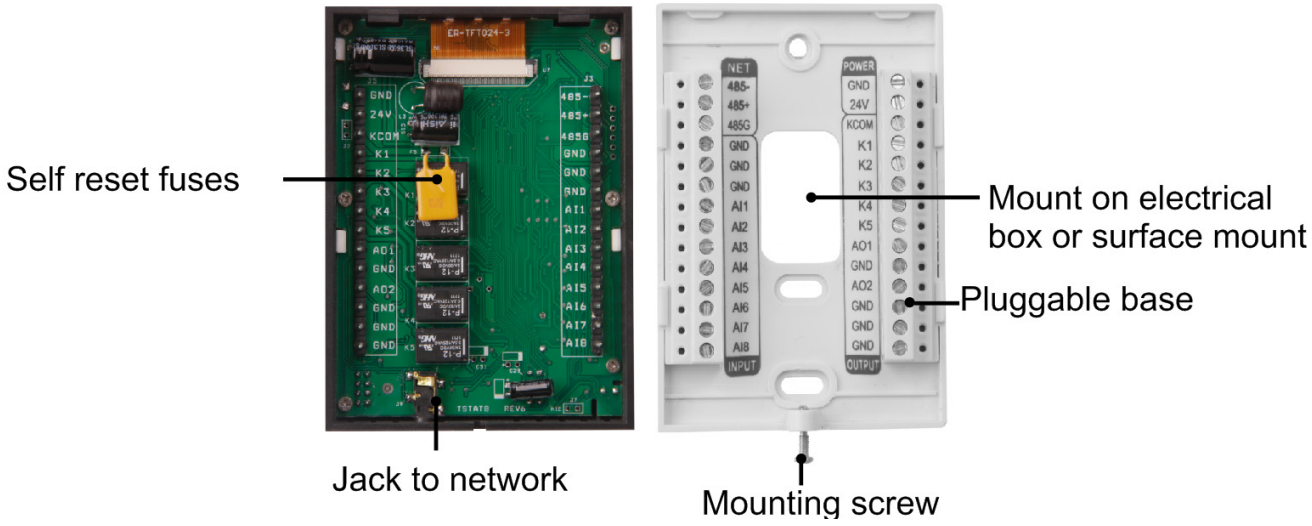
Code	Description
Tstat8	Thermostat

	Description
H	Humidity

	Description
	Basic model temperature and clock
WIFI	WIFI
OCC	Occupancy sensor
220	220V
ZIG	Zigbee

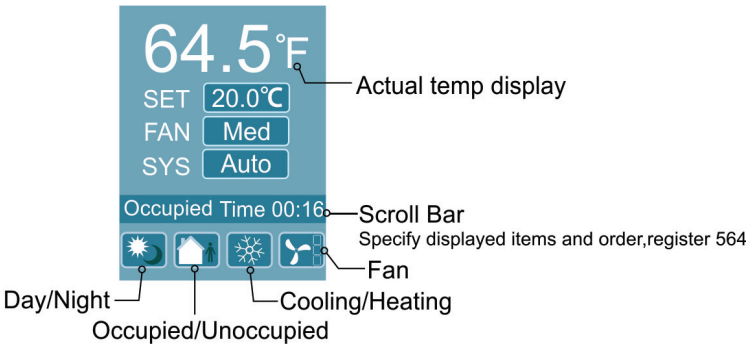
	Description
B	Black color

Structure Highlights



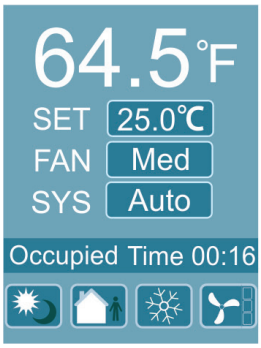
Menu Item Details

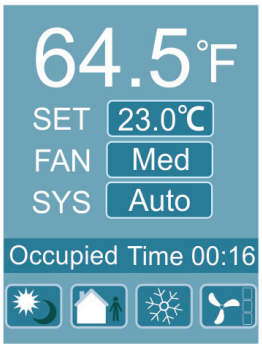
Tstat8 have several advanced menu items which can be adjusted in the field to suit the specific application and tune the operation of the thermostat. All the parameters are set up at the factory on an order-by-order basis and will give satisfactory results out of the box.

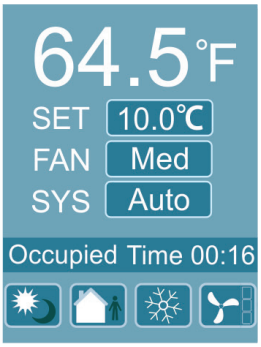


LCD Screen Display

1 .When you press ◀ or ▶ , it will increase or decrease the set point value. The value will flash two times, then it will confirm the setting automatically.







2.In normal mode, press both ◀ and ▶ at the same time,and hold for several seconds,this will switch to the menu mode. Press ◀ or ▶ to scroll through the menu options such as ‘Add’, ‘CAL’, ‘bAU’, ‘UNI TS’ and many others.To change the values at a particular menu, press ▲ or ▼ the value will be stored automatically.

To change the unit’s address, scroll through the menu until you reach ‘Add’. Press ▲ or ▼ to increase or decrease the unit’s address from 1 to 254.

To change the baudrate, locate ‘bAU’ within the menu and use ▲ and ▼ to choose 1 9200 or 9600.

Custom Enclosures and Logos

Black

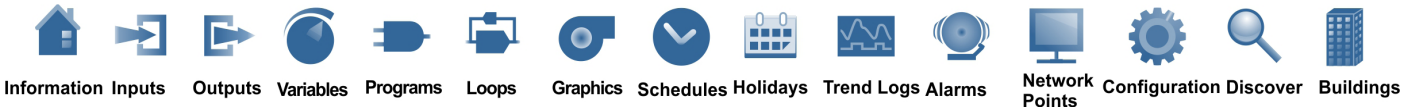
Tstat8

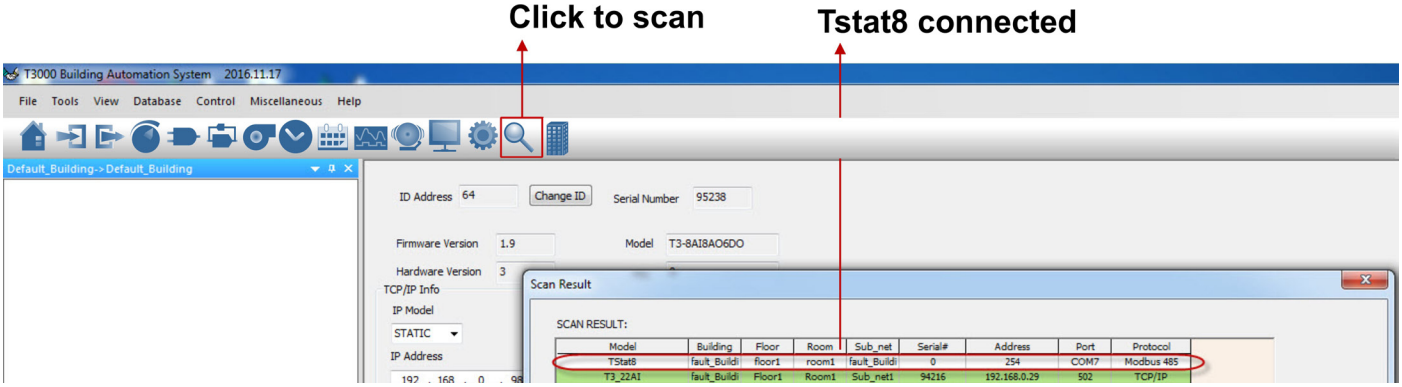
Tstat8-H-OCC

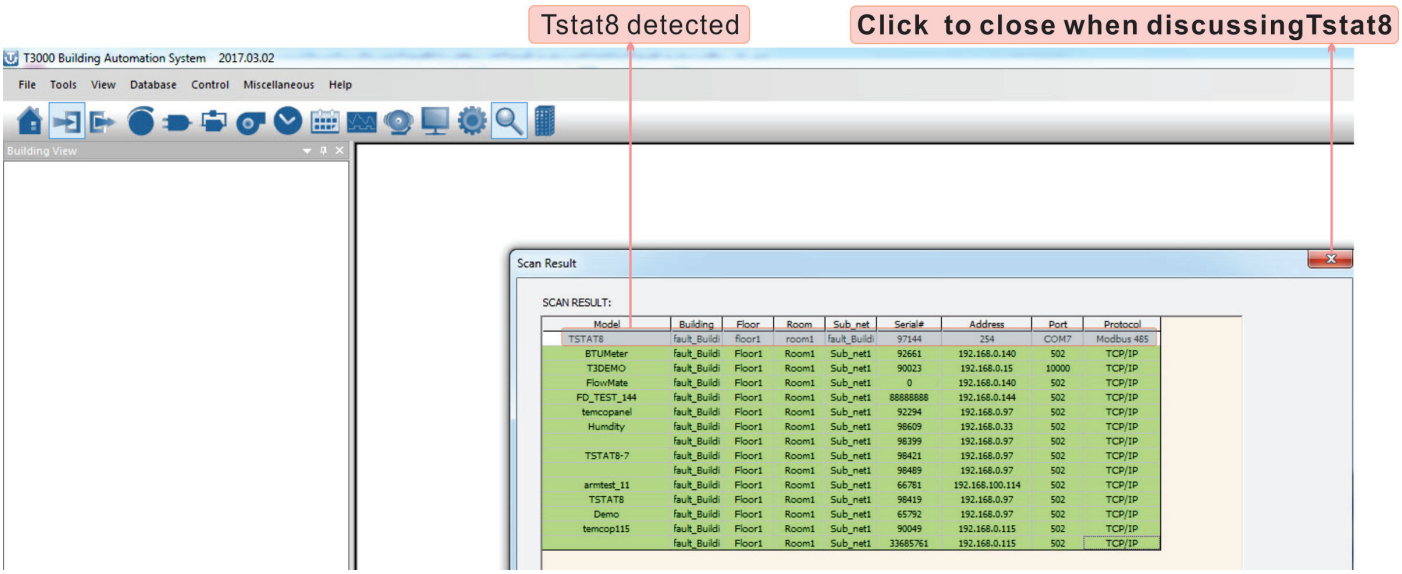
Tstat8-H-Zigbee

T3000 operation

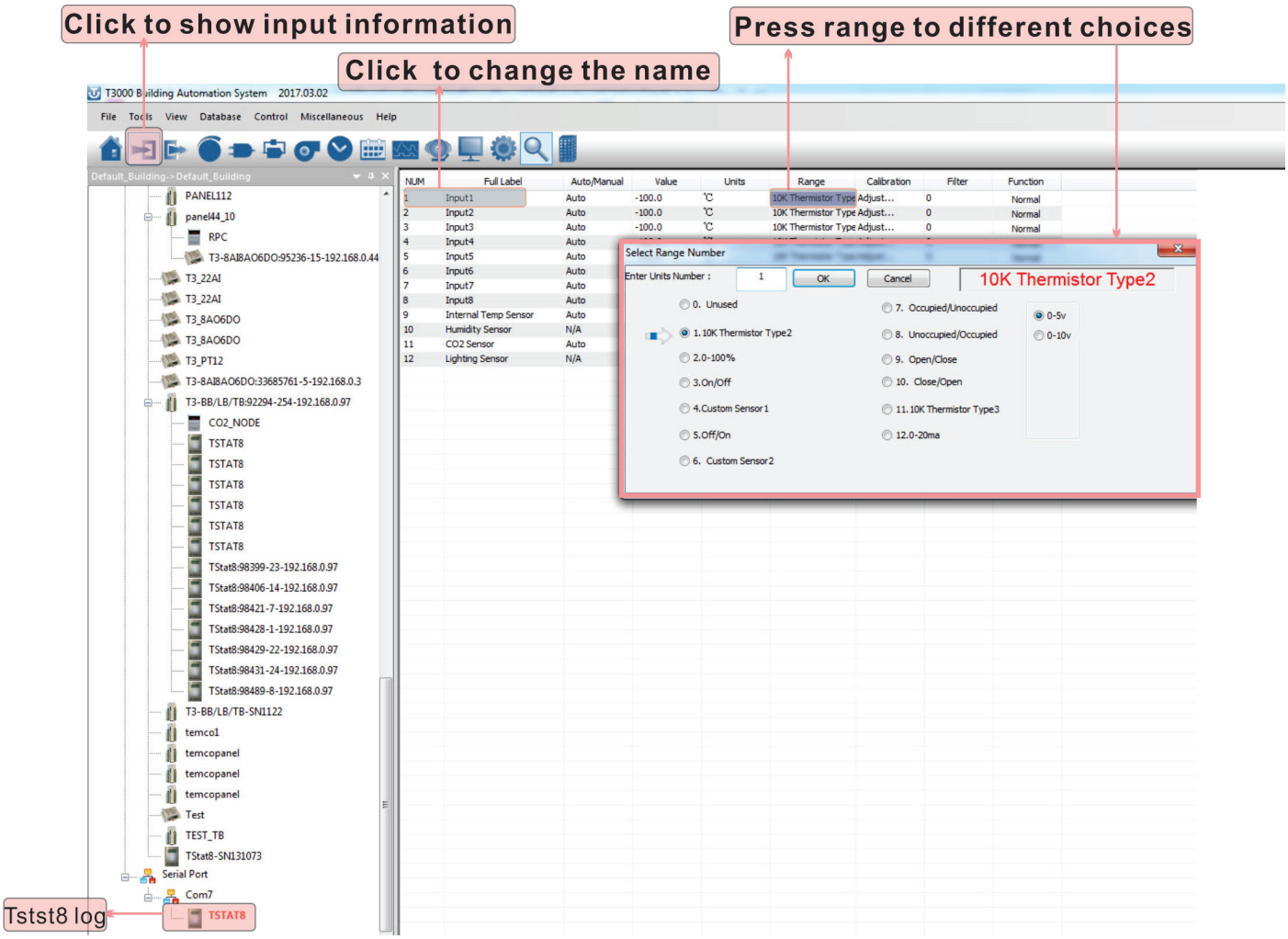
1.Visit https://tinyurl.com/y7uyu9n3, download T3000 software and install it;
2.Plug Tstat8 in power,connect the Tstat8 to a PC via RS485 or Ethernet;
3.Start the T3000 software,click to scan,the following view will appear. Close after the scan is complete.



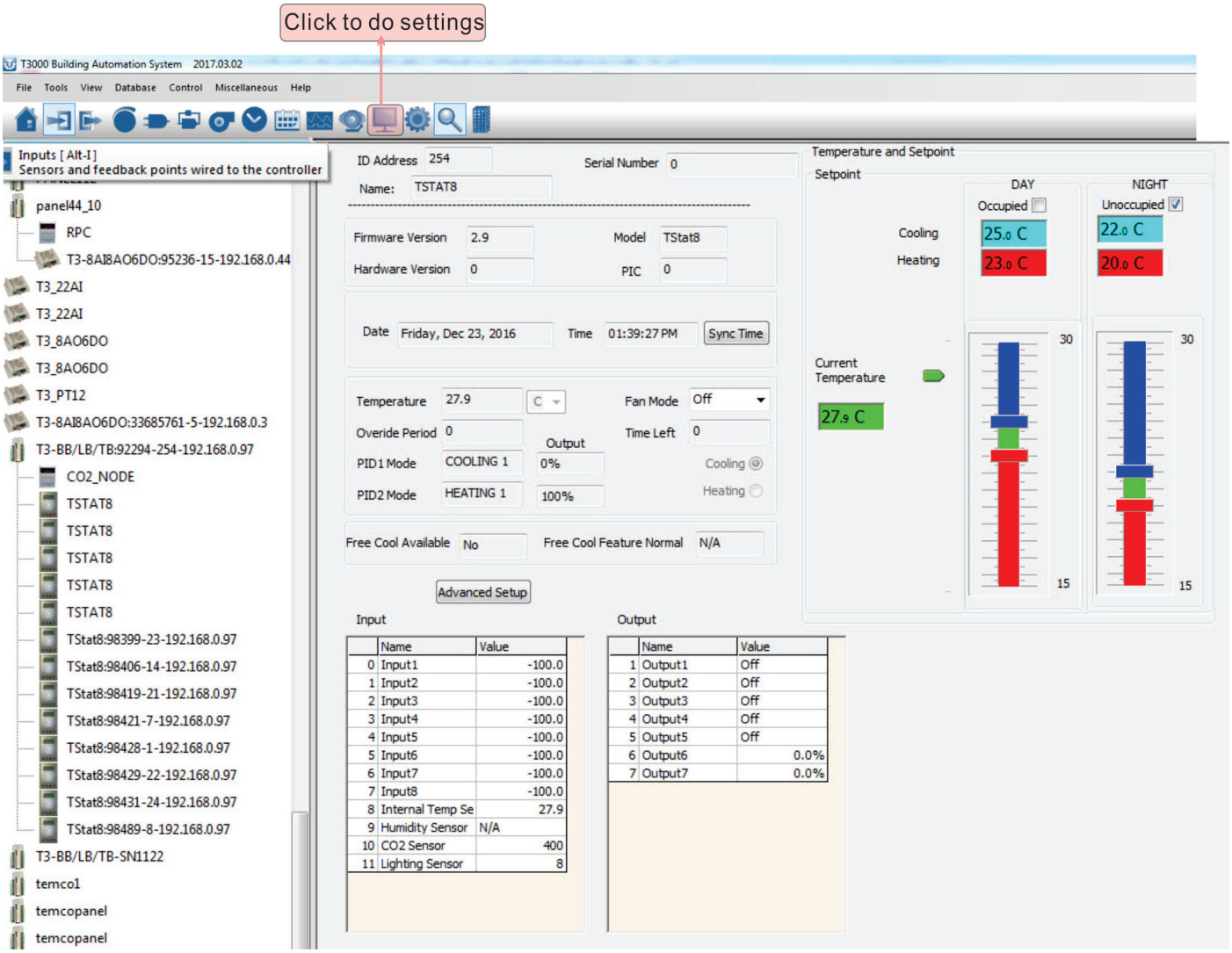




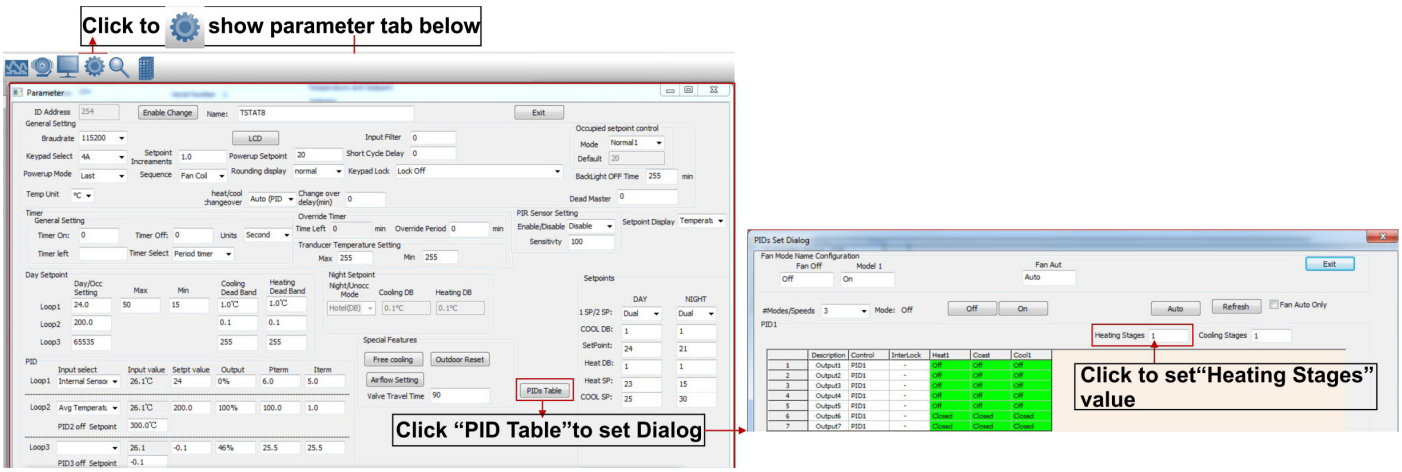
4. Click Tstat8 log, then click  , this will display all of the Tstat8 inputs. Change the name of the input and range that fits the application.



5.Click  to see the status of the Tstat8. This window will display setpoints, temperature, inputs and outputs.

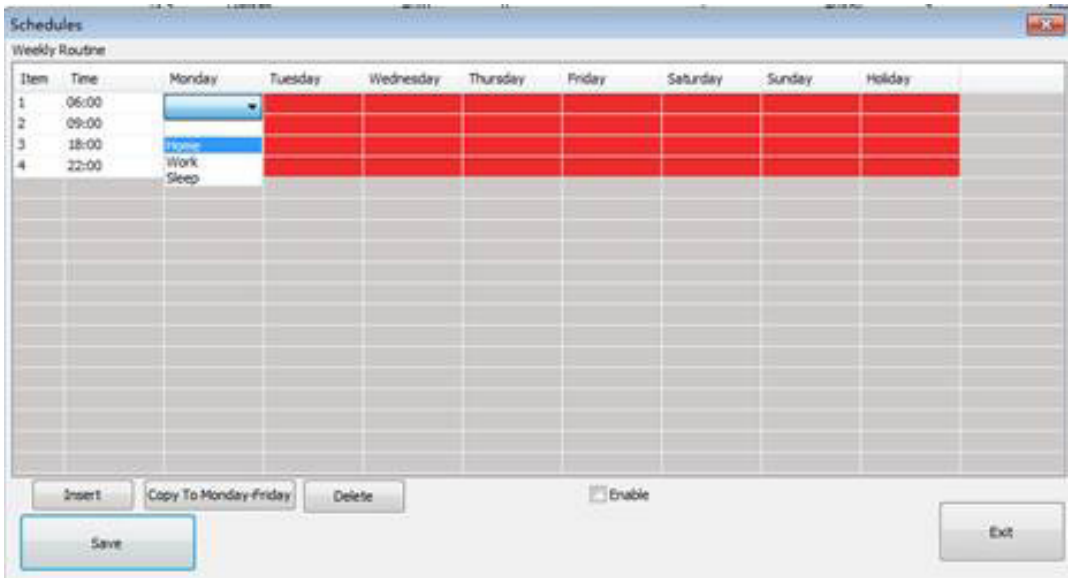


6.Click  to to edit advanced settings. The window below will open. Click “PIDs Tables” to edit PIDs and change the function of the outputs.

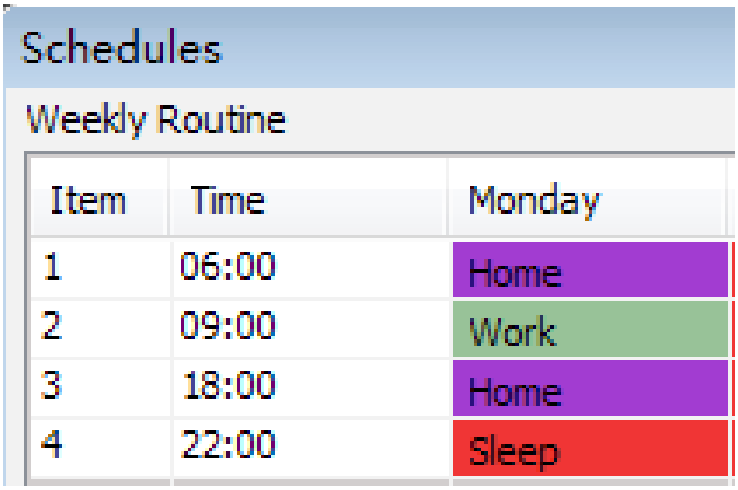


7.Click the schedule icon to go to schedule window,you can do schedule settings.

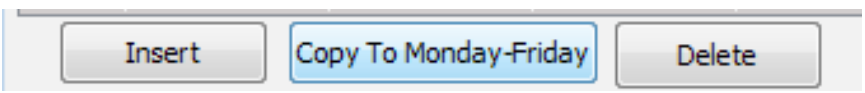
Each day we support 6 events, and you can select the mode for each event:
For home mode, unit will use day setpoint to control the outputs;
For work mode, it will use night setpoint to control the outputs;
For sleep mode, it will use sleep setpoint to control the outputs.

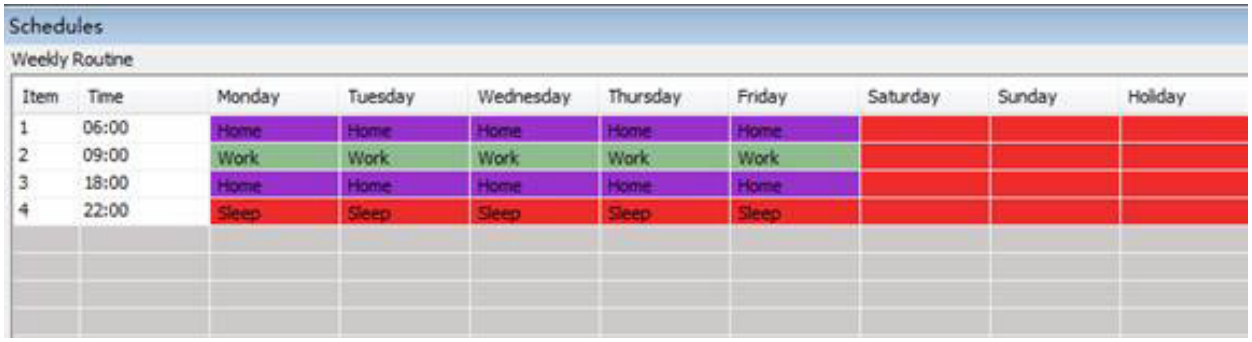


For example as below:
when time is between 6:00 to 9:00, unit will work on home mode;
when time is between 9:00 to 18:00, unit will work on work mode;
when time is between 18:00 to 22:00, unit will work on home mode;
when time is between 22:00 to Tuesday 6:00, unit will work on sleep mode.

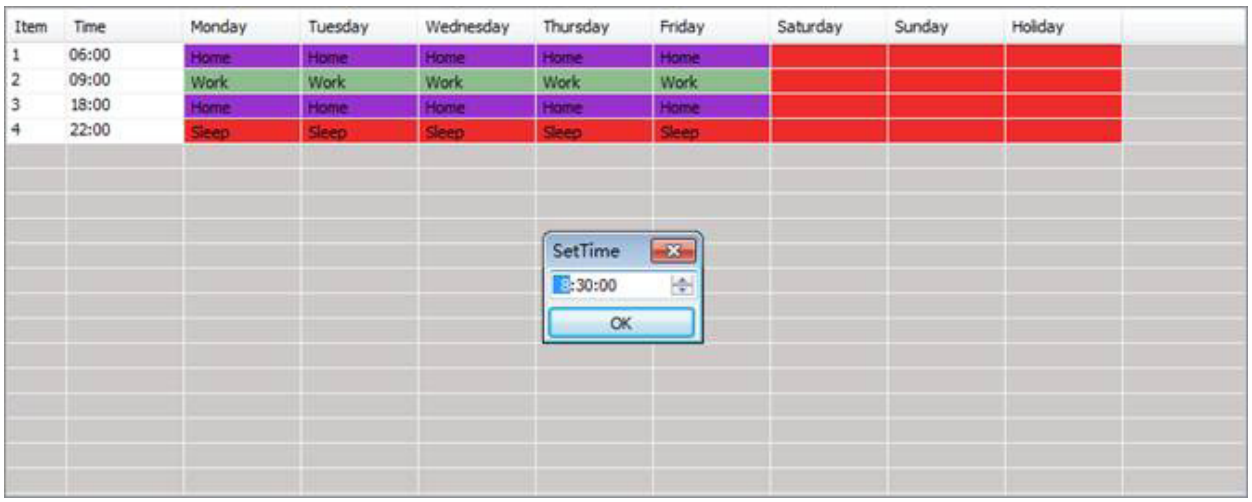


After you setup the Monday schedule, you can copy the Monday setting from Tuesday to Friday, then you can use the “Copy To Monday-Friday” function to copy the setting.





If you need different setting for each day, you can use insert function to edit your schedule, for example, on Saturday, double click the window and it will show a small dialog to insert new event and you can set up the time.



So on Saturday, when time is between 8:30 to 12:30, unit will work on home mode;when time is between 12:30 to 20:30, unit will work on work mode; when time is between 20:00 to 22:30, unit will work on home mode;when time is between 22:30 to Sunday 6:00, unit will work on sleep mode.

Note: Select “Enable” option to enable schedule function.After edit schedule, make sure click the save button to save the setting !

Tstat8-wifi Set Up

1.Configuration Settings

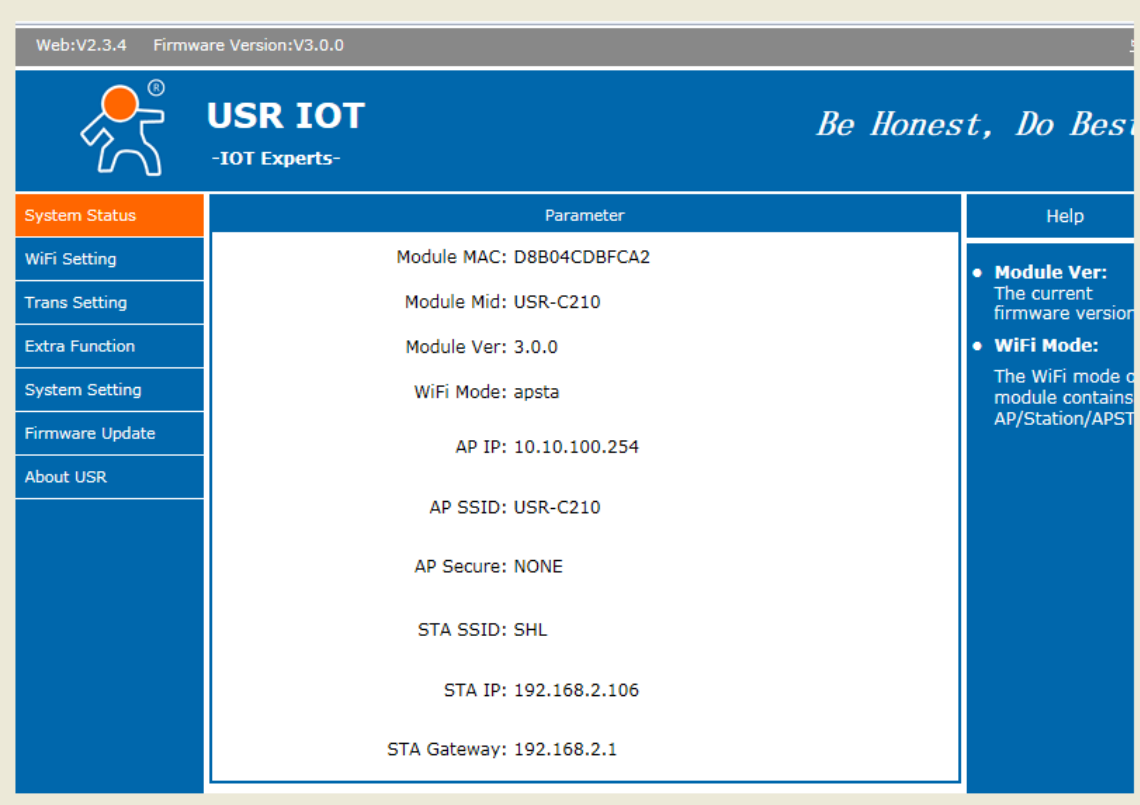
To set the password and IP address of the Tstat8, two methods are available:Key setting and AD-hoc setting, or using the T3000 software Key setting.

ADhoc setting

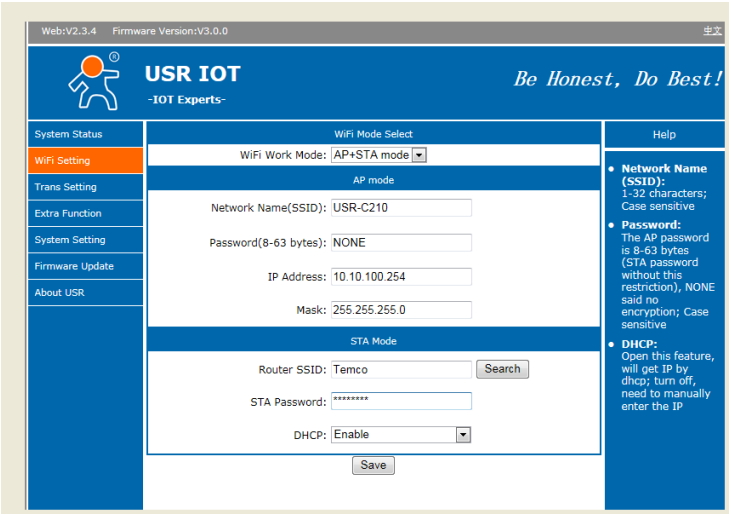
ADhoc is a singel hot model,which supports iphone,win7&8.The IP default address is 10.10.10.254

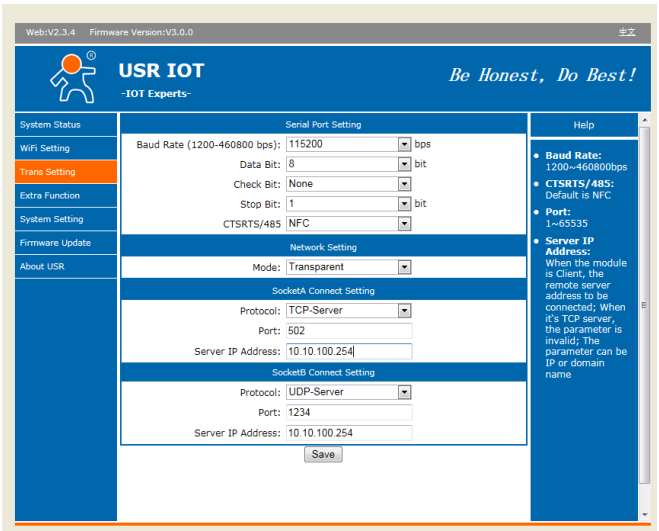
Step1.To set passwords and IP addresses in Adhoc mode, start the Tstat8 first, then scan for a wifi signal named ‘USR-C210’ from a computer with wifi, connect to the wifi.

Step2.Enter the Module MAC. The Module MAC:D8B04CDBFCA2



Step3.Open your browser,enter IP 10.10.100.254,then you can set your password and IP as below:





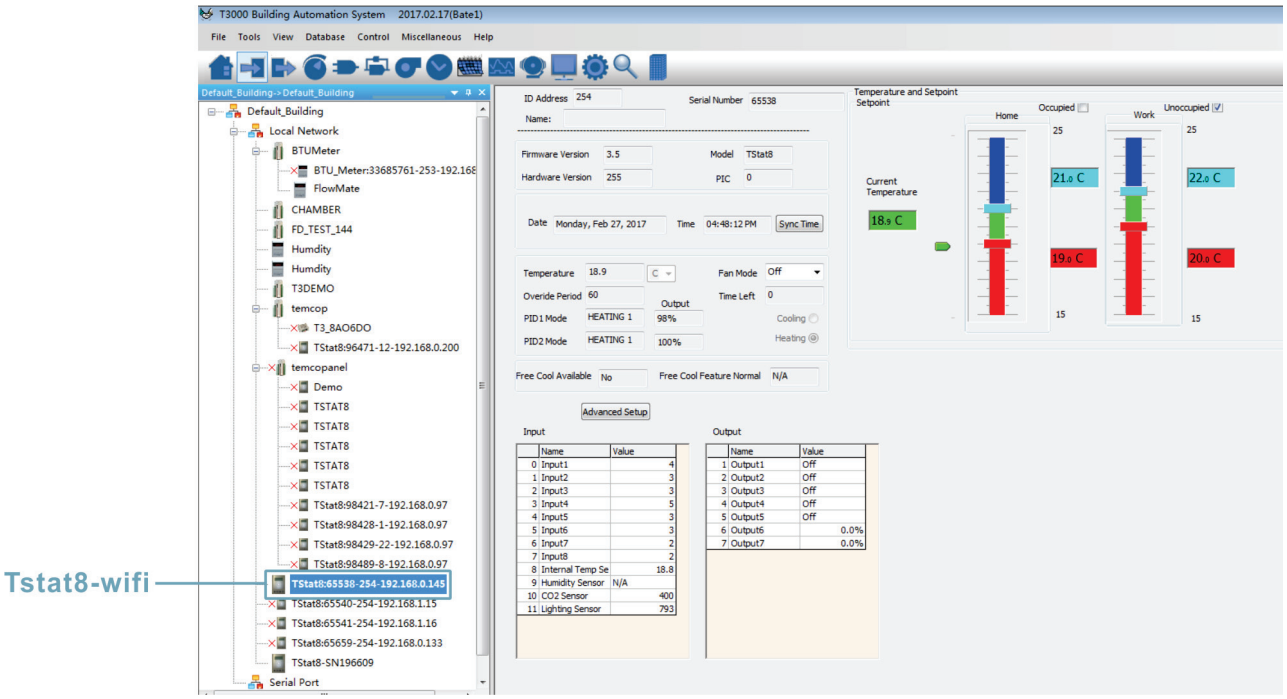
T3000 setting

The T3000 software also has the ability to set the password and IP of the Tstat8.

Step1.Visit https://temcocontrols.com/ftp/software/T3000.zip, download T3000 software and install it;

Step2. Apply power to the Tstat8, connect the Tstat8 to a PC via RS485 or Ethernet;

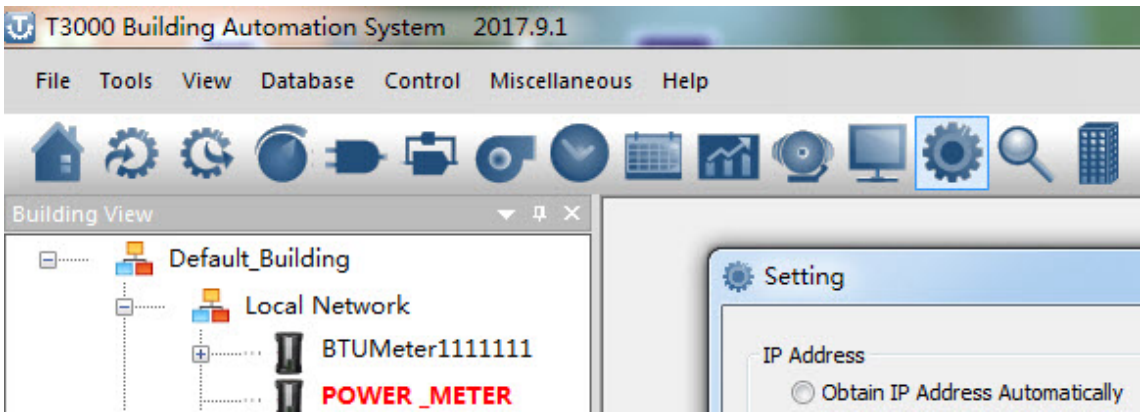
Step3.Start T3000 software,click to scan,then you can find Tstat8 as below.



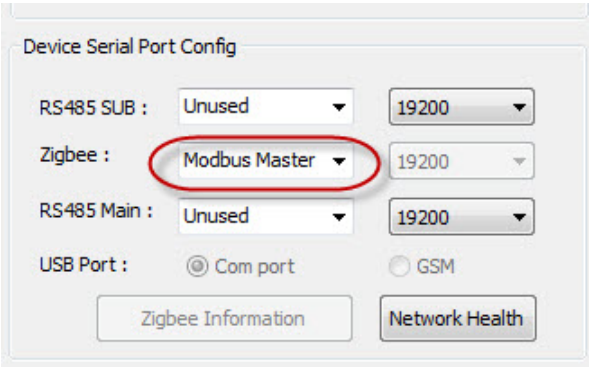
Tstat8-wifi

Zigbee Setup

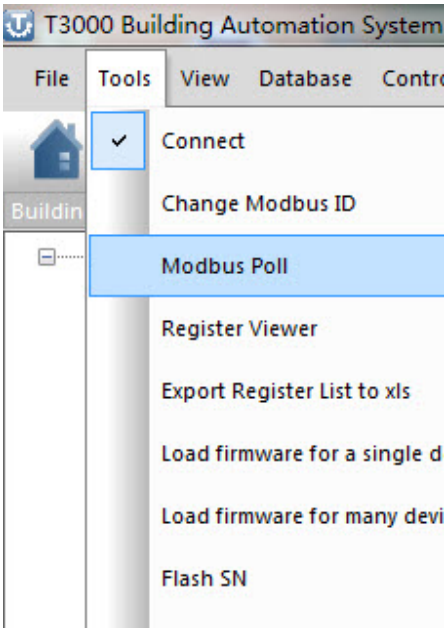
Click  to scan,you can find the Zigbee BB.



Connect one tstat6 and two tstat8,then you can set the parameters of Zigbee BB.



You can also get more information using Temco Modbus Poll tool.

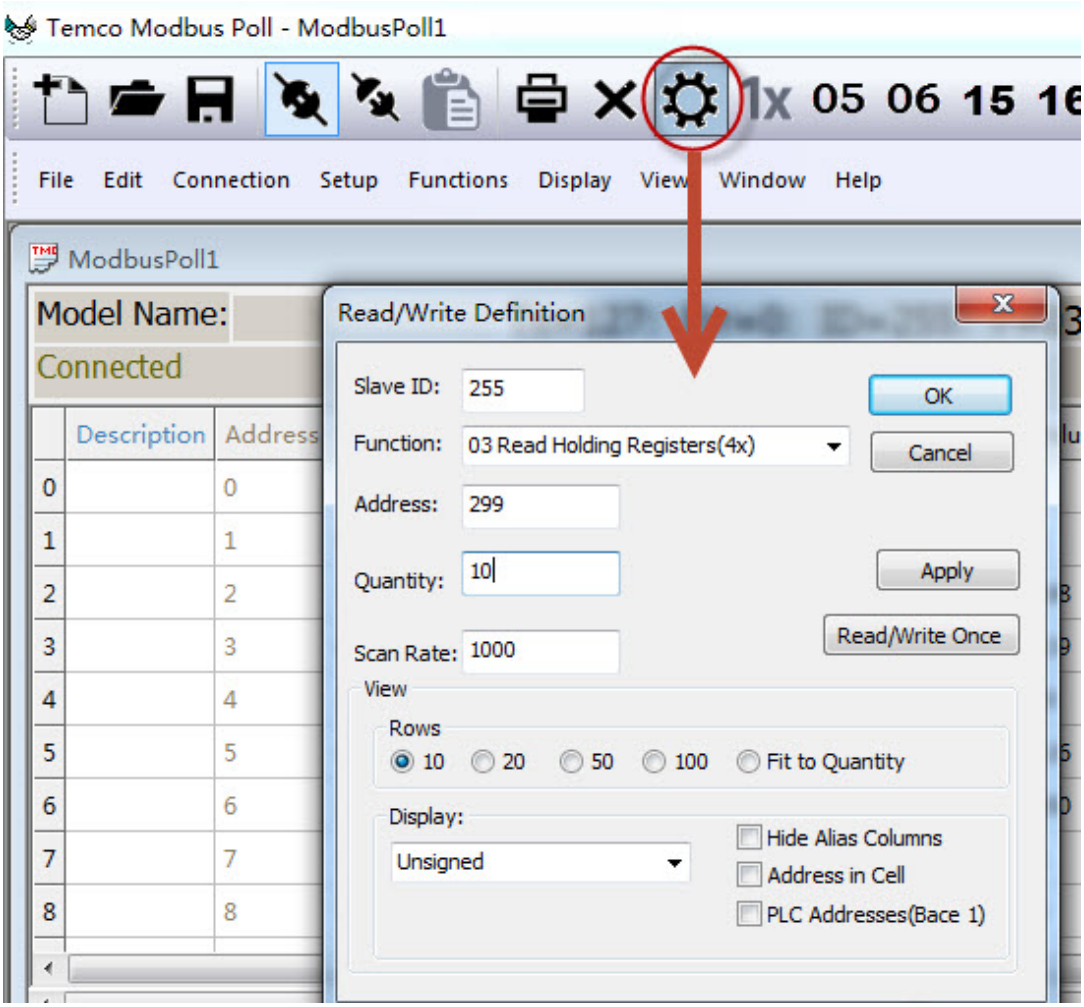


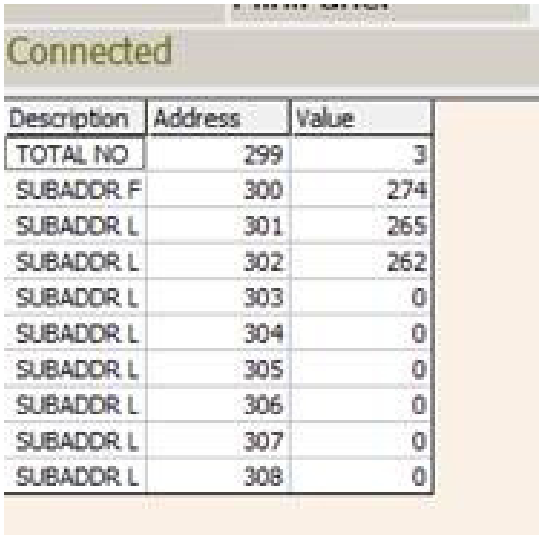
As below,ID 255 means reading zigbee BB itself. Address 299 indicates how many units are connecting

For this test, there are 3 units connecting:

reg300: ID + 256 of unit 1, the highest bit set to 1 means that device is online, if it is off line, reg300 = ID = 18

It's the same for reg301 and 302 and so on.





Connected

Description	Address	Value
TOTAL NO	299	3
SUBADDR F	300	274
SUBADDR L	301	265
SUBADDR L	302	262
SUBADDR L	303	0
SUBADDR L	304	0
SUBADDR L	305	0
SUBADDR L	306	0
SUBADDR L	307	0
SUBADDR L	308	0

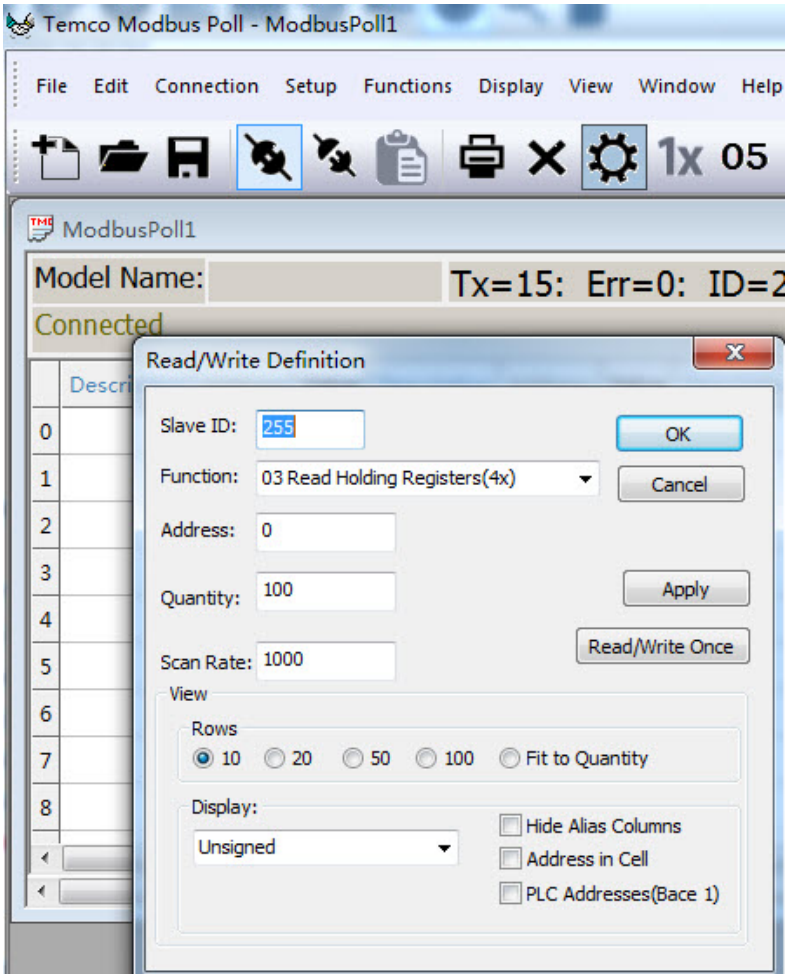
For debugging:

1. First make sure the zigbee unit is connected to the zigbee network, when it is connected you can see the red led keeps on, otherwise it will be flashing.
2. In these two situations you can try to re-power the zigbee BB

A. If you wait for a long time the zigbee BB cannot find the units

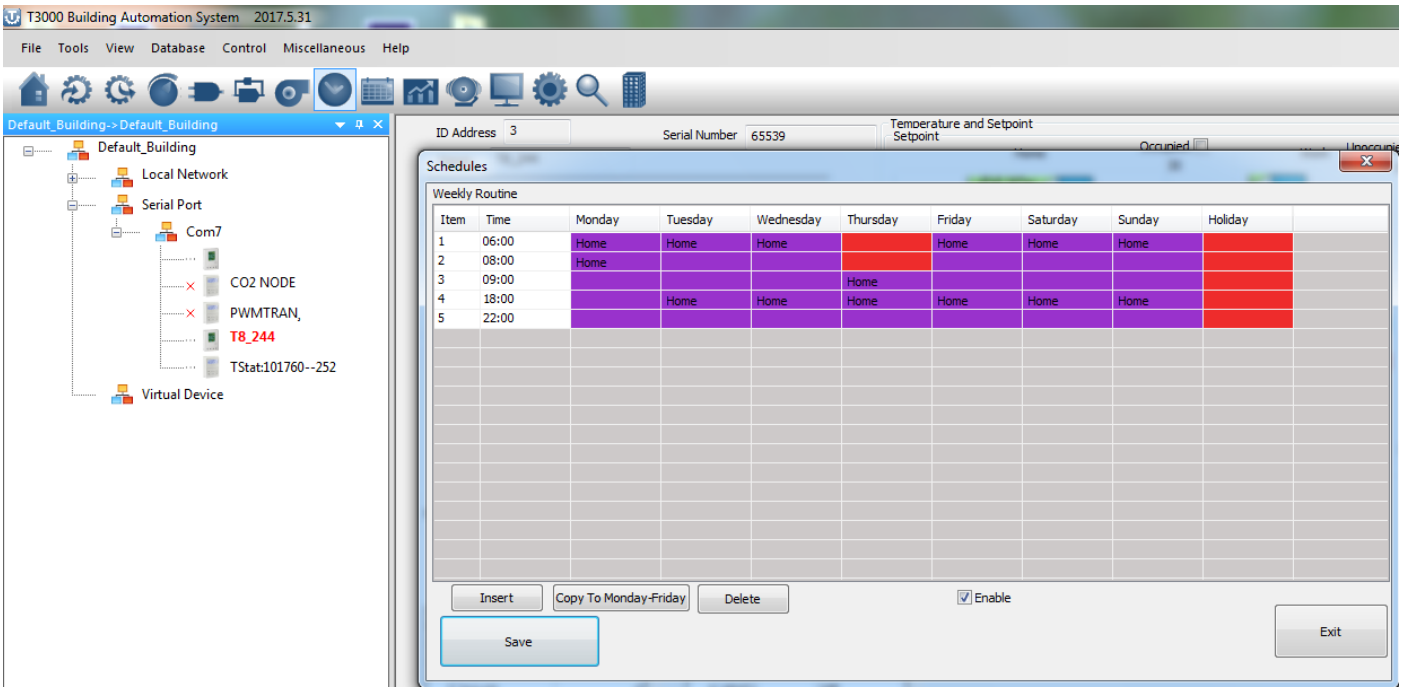
B. If you find the units by T3000,but when you click the unit icon you can not access them.

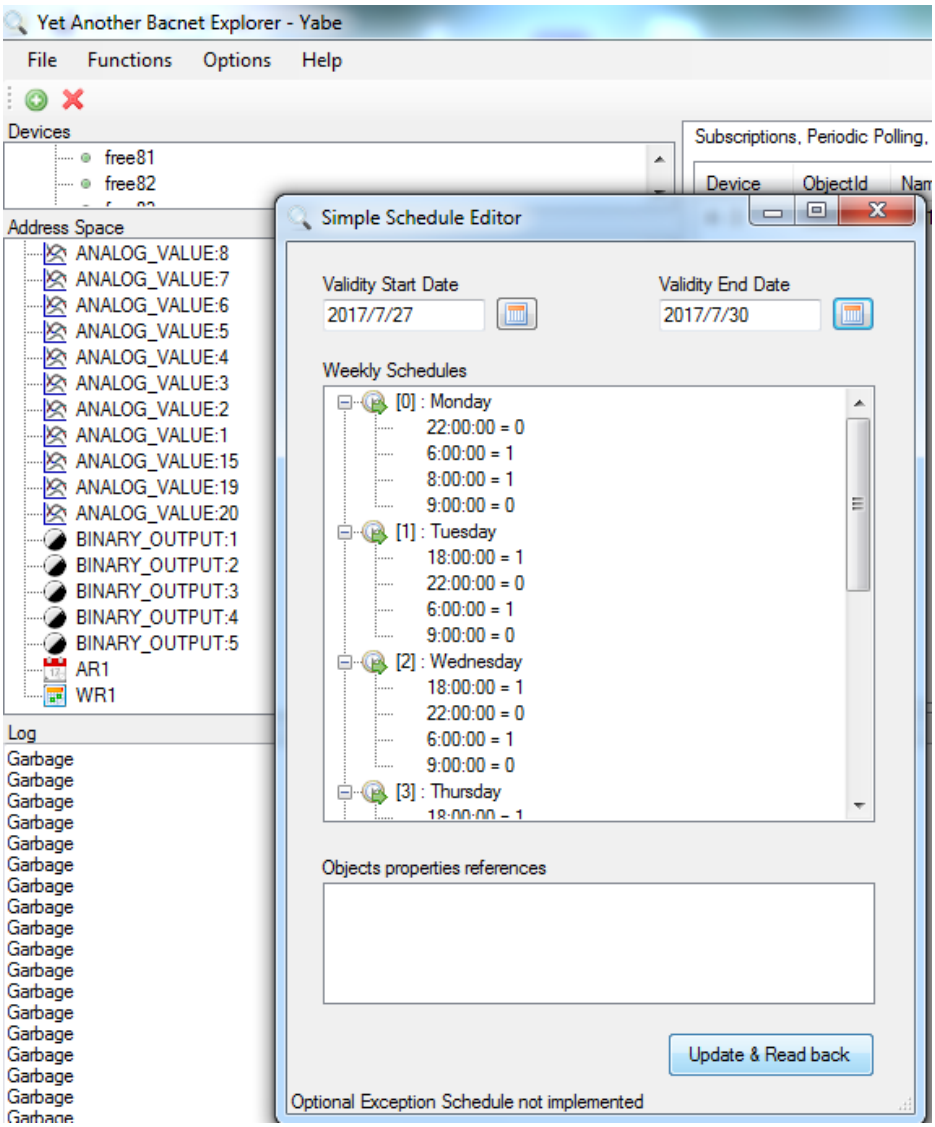
3. Using modbus poll to access each of the unit



Schedules

The schedules of Tstat8 can be managed using T3000 software and Bacnet.Select Modbus protocol when you use T3000,and Bacnet protocol when you use Bacnet.





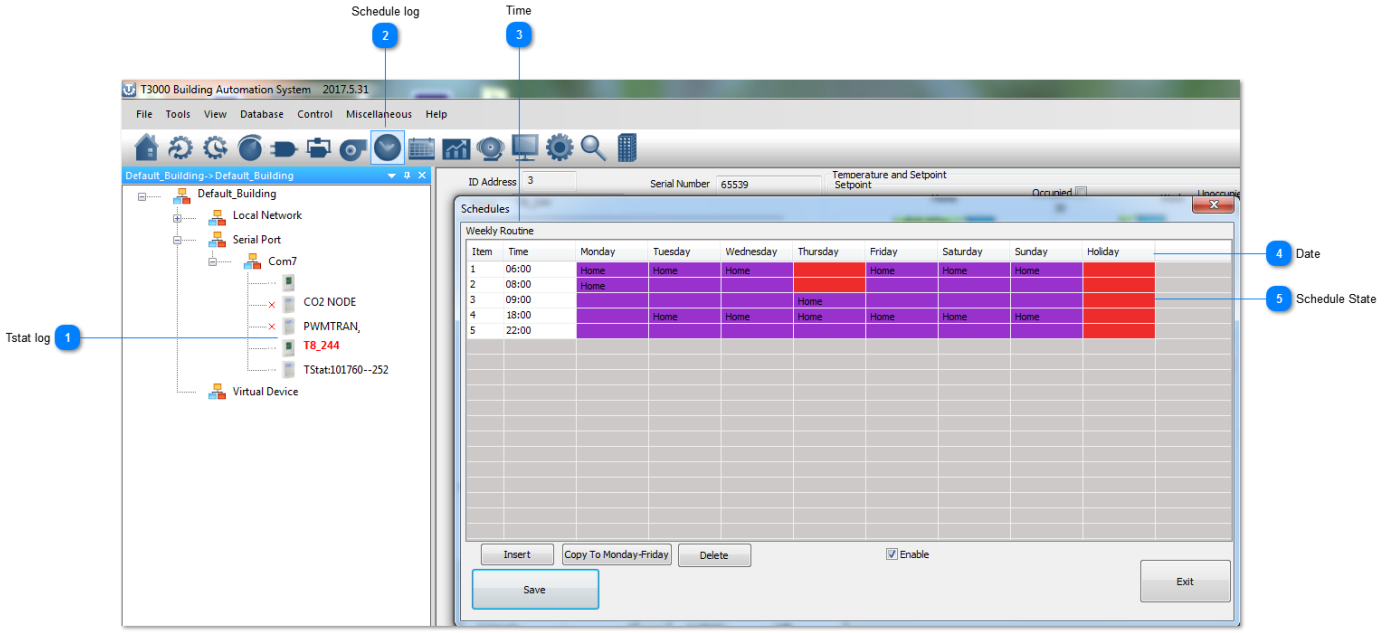
Managing schedules in T3000

The schedules can be managed using T3000 software.Below are the steps:

Step1.Visit *107.170.34.189/ftp/software/9TstatSoftware.zip* ,download T3000 software and install it;

Step2.Plug Tstat8 in power,connect Tstat8 to PC via RS485 or Ethernet;

Step3.Start T3000 software,click  to scan,then you can find Tstat8 as below.



1 Tstat log

 T8_244

Click to select the thermostat.

2 Schedule log

Click to show schedule details.

3 Time

Weekly Routine

Item	Time
1	06:00
2	08:00
3	09:00
4	18:00
5	22:00

This is the time list.

4 Date

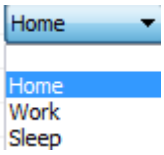
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Holiday

The date diaplays from Monday to Sunday and Holiday.

5 Schedule State

Home	Home	Home		Home	Home	Home	
Home							
			Home				
	Home	Home	Home	Home	Home	Home	

The tab shows the schedule state:Home/Work/Sleep.



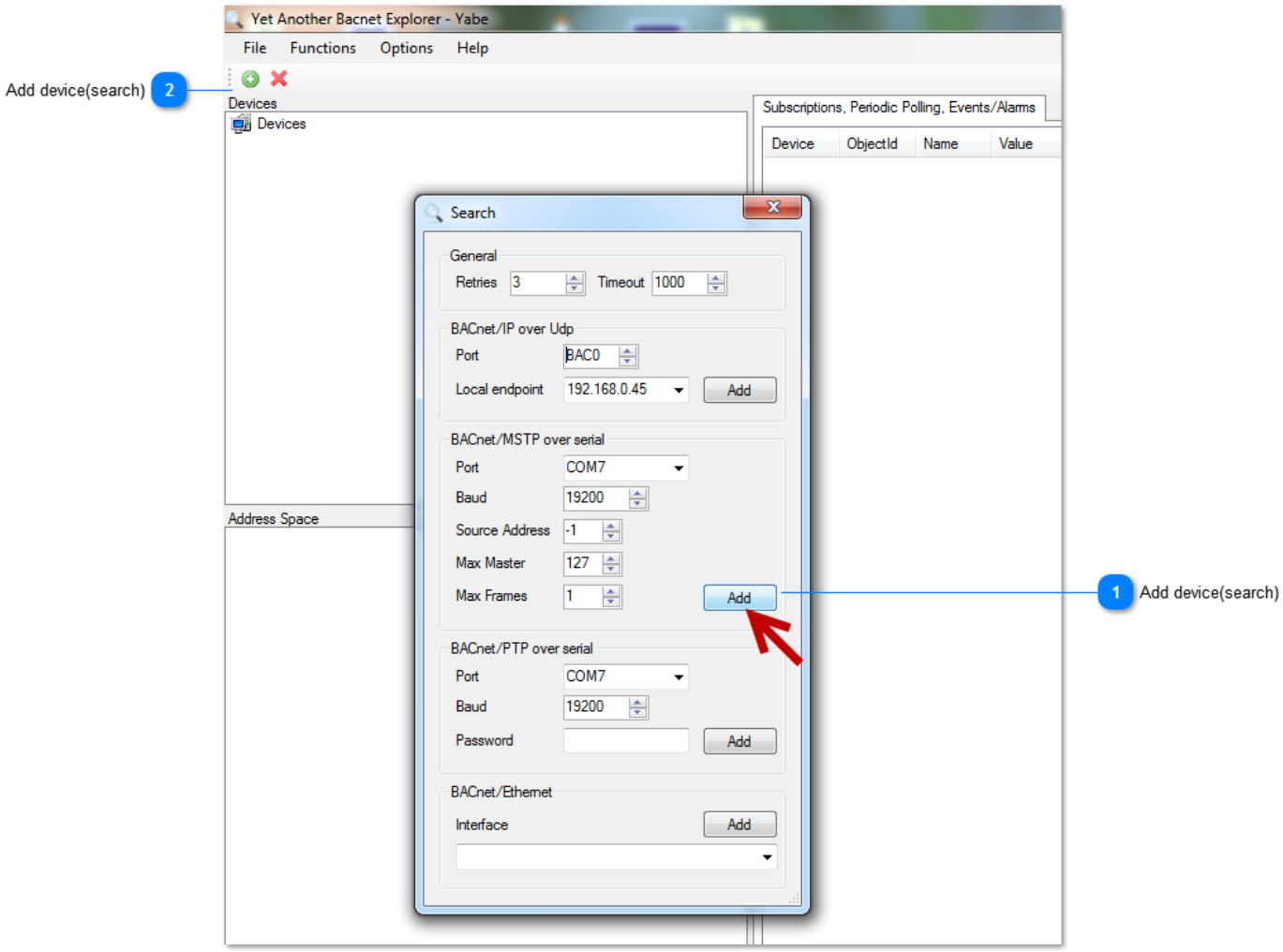
Managing schedules using Bacnet

The schedules can be managed using Bacnet.Download Yabe software as the link:*107.170.34.189/ftp/software/yabe.zip* and install it.Connect Tstat8 to the computer,select Bacnet protocol.Start the Yabe software,add the device.

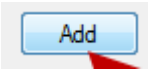
Secure | https://www.bravocontrols.com/ftp/software/

Index of /ftp/software/

../	
10SoftwareManualRev3.zip	13-Apr-2016 06:
12AccessDatabaseEngine.zip	03-Mar-2015 02:
13Zigbee_SupportDocs.zip	27-Dec-2014 00:
14GK_7000_Linux.zip	27-Dec-2014 00:
1ModbusDll.zip	27-Dec-2014 00:
20SoftwareManualRev2.0.chm	29-Jun-2015 03:
2ModbusDll.zip	27-Dec-2014 00:
5ModbusDllTestForVB.zip	27-Dec-2014 00:
6ModbusDllforVc.zip	27-Dec-2014 00:
7ModbusDllForVC_Example.zip	27-Dec-2014 00:
9TstatSoftware.zip	15-May-2017 02:
Blank_RMA.doc	15-Feb-2017 08:
CC2531_Driver.zip	09-Mar-2017 08:
ExamplePRGFiles.zip	14-Jun-2017 03:
ISPTool_NoCheckingHex.zip	19-Apr-2016 07:
ModbusBacnetRegistersListRev9.xls	06-Jun-2017 05:
T3000.zip	24-Jul-2017 07:
T3000Update.zip	07-Jul-2017 07:
yabe.zip	15-Mar-2017 09:



1 **Add device(search)**



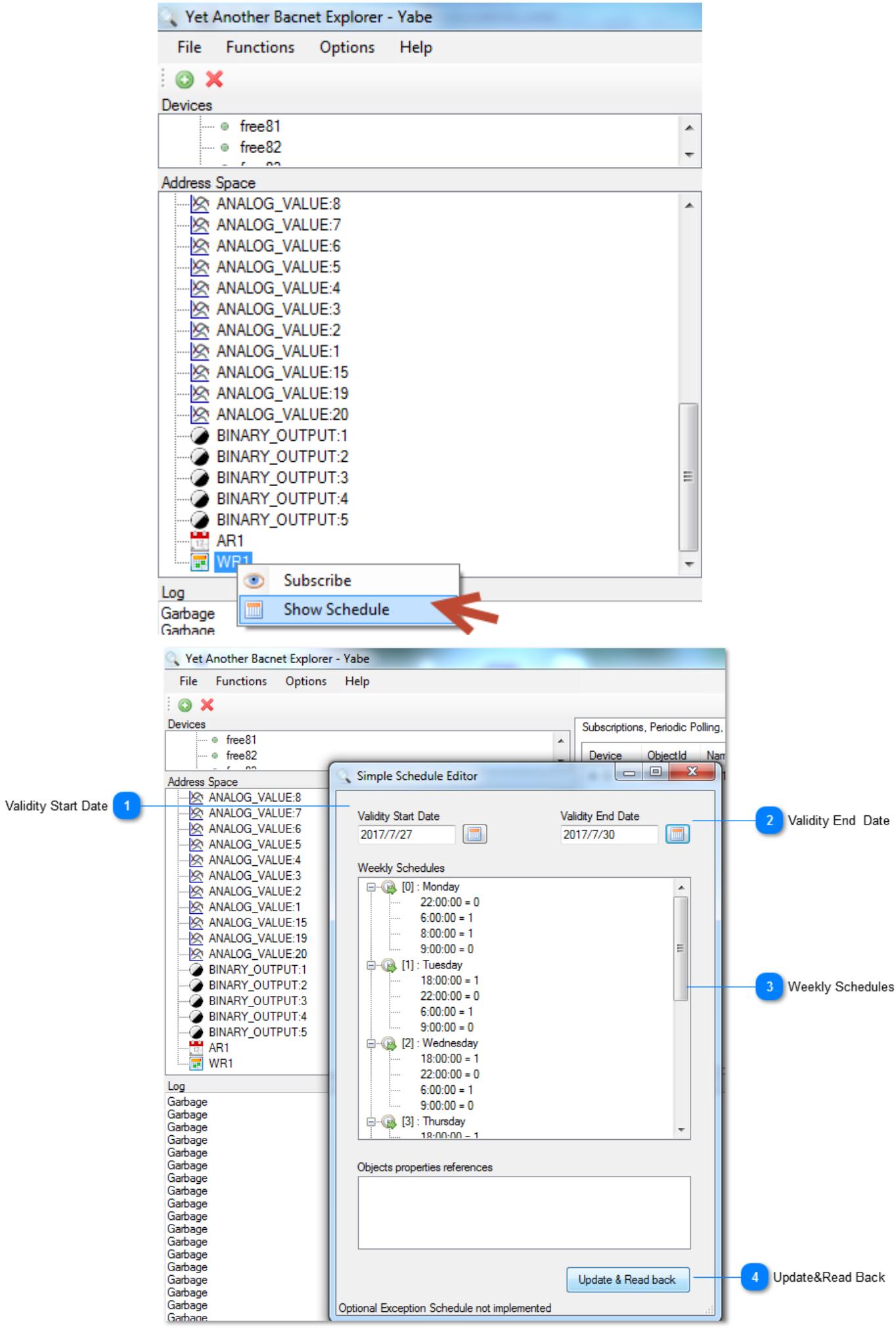
Click to add via BACnet/MSTP .

2 **Add device(search)**

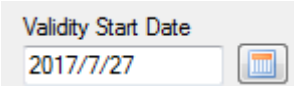
Click to add device.

Weekly routines schedule

Right click “WR1” log (weekly routines) to set up the weekly schedule date.For the weekly routine, if status = 1, means unit will go to occupied and if status = 0, means unit will go to unoccupied. When the time is set up, click “Update & Read back” button to save and read the setting back.

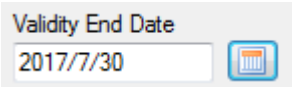

Yet Another Bacnet Explorer - Yabe
File
Functions
Options
Help
Devices
free81
free82
Address Space
ANALOG_VALUE:8
ANALOG_VALUE:7
ANALOG_VALUE:6
ANALOG_VALUE:5
ANALOG_VALUE:4
ANALOG_VALUE:3
ANALOG_VALUE:2
ANALOG_VALUE:1
ANALOG_VALUE:15
ANALOG_VALUE:19
ANALOG_VALUE:20
BINARY_OUTPUT:1
BINARY_OUTPUT:2
BINARY_OUTPUT:3
BINARY_OUTPUT:4
BINARY_OUTPUT:5
AR1
WR1
Subscribe
Show Schedule
Log
Garbage
Garbage
Yet Another Bacnet Explorer - Yabe
File
Functions
Options
Help
Devices
free81
free82
Address Space
ANALOG_VALUE:8
ANALOG_VALUE:7
ANALOG_VALUE:6
ANALOG_VALUE:5
ANALOG_VALUE:4
ANALOG_VALUE:3
ANALOG_VALUE:2
ANALOG_VALUE:1
ANALOG_VALUE:15
ANALOG_VALUE:19
ANALOG_VALUE:20
BINARY_OUTPUT:1
BINARY_OUTPUT:2
BINARY_OUTPUT:3
BINARY_OUTPUT:4
BINARY_OUTPUT:5
AR1
WR1
Log
Garbage
Subscriptions, Periodic Polling,
Device
ObjectId
Simple Schedule Editor
Validity Start Date
2017/7/27
Validity End Date
2017/7/30
Weekly Schedules
[0] : Monday
22:00:00 = 0
6:00:00 = 1
8:00:00 = 1
9:00:00 = 0
[1] : Tuesday
18:00:00 = 1
22:00:00 = 0
6:00:00 = 1
9:00:00 = 0
[2] : Wednesday
18:00:00 = 1
22:00:00 = 0
6:00:00 = 1
9:00:00 = 0
[3] : Thursday
Objects properties references
Update & Read back
Optional Exception Schedule not implemented
1
Validity Start Date
2
Validity End Date
3
Weekly Schedules
4
Update&Read Back

1 Validity Start Date



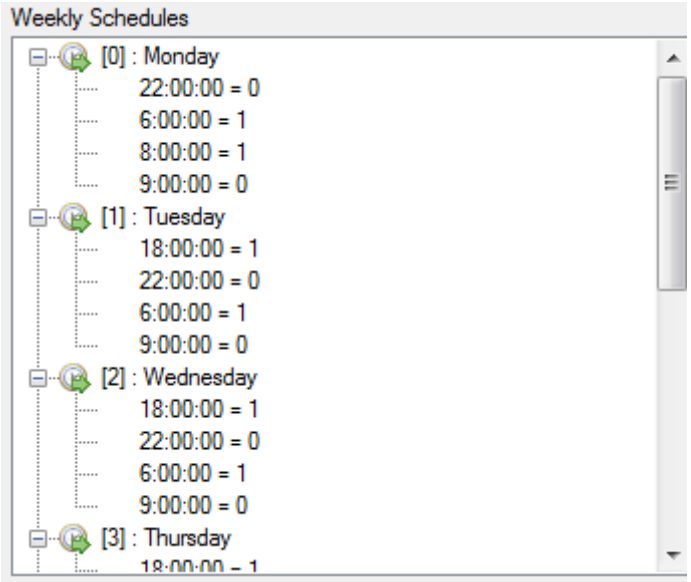
Click to set the start date.

2 Validity End Date



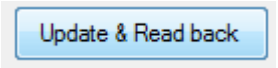
Click to set the End date.

3 Weekly Schedules



This tab shows the Weekly Schedules details.

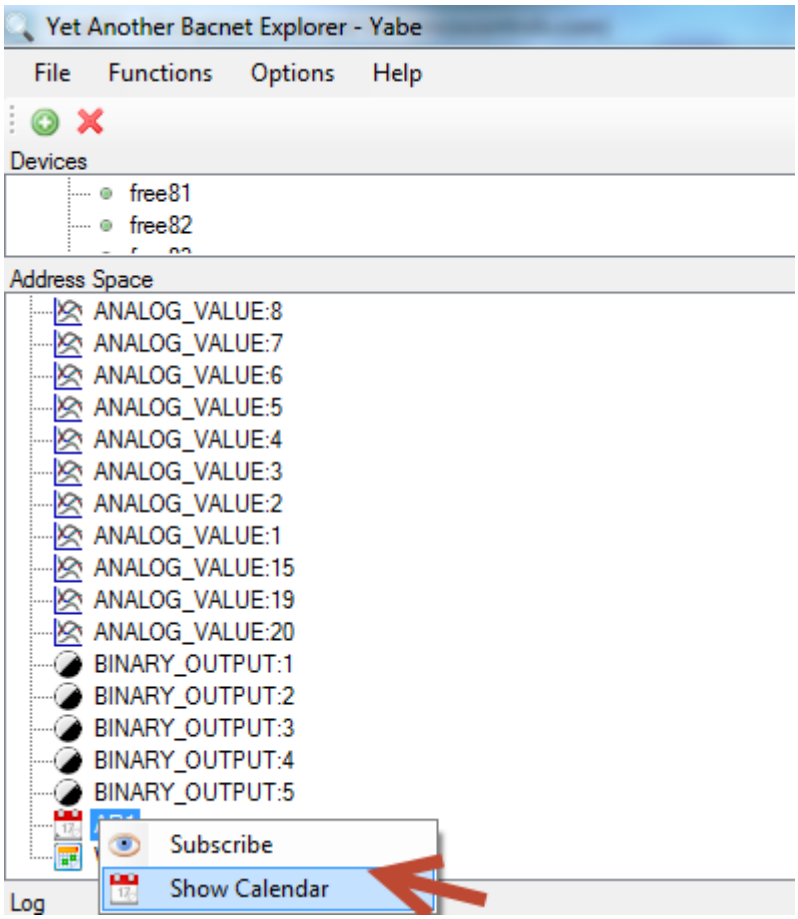
4 Update&Read Back

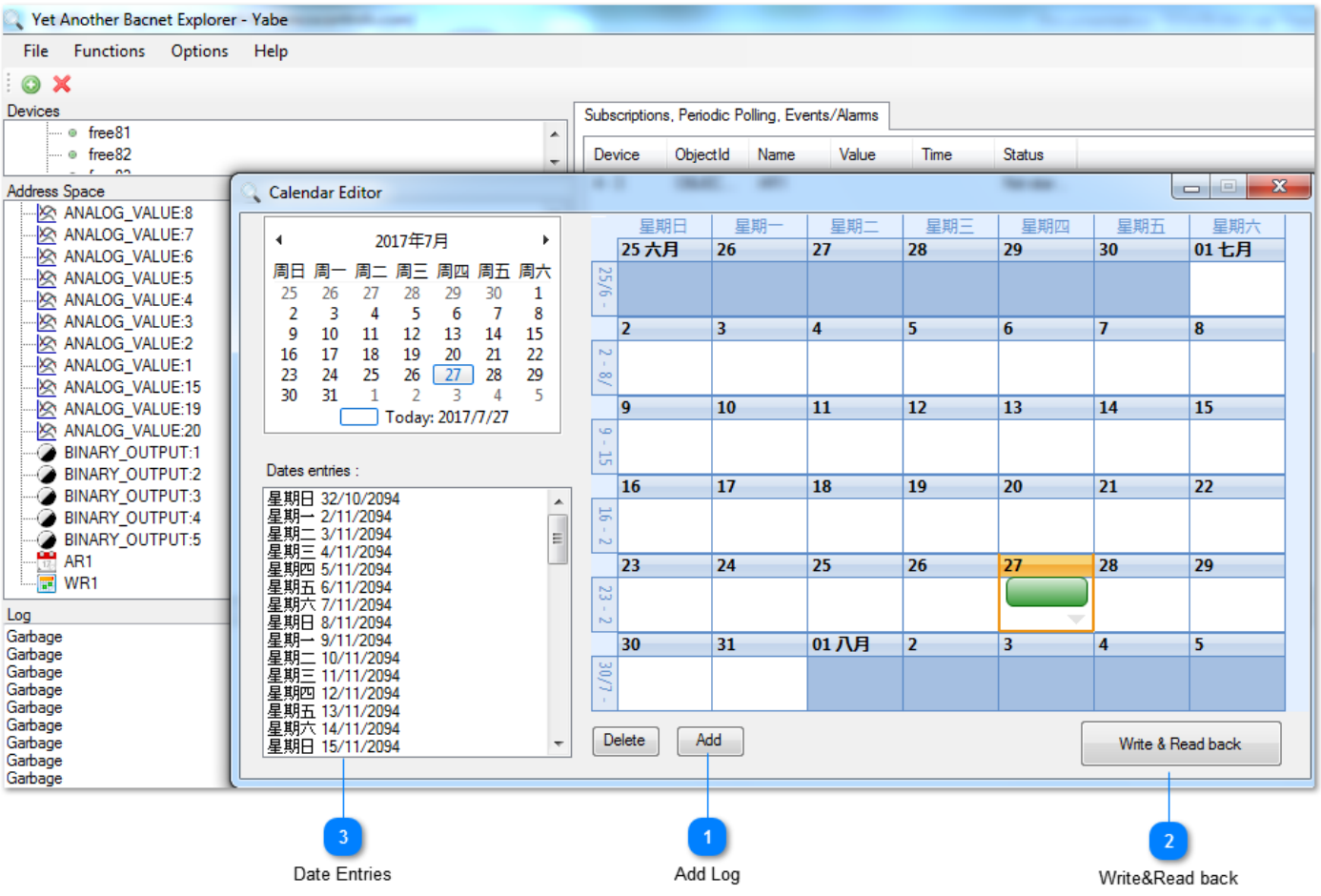


Click the log to update &Read Back.

Annual routine schedule

Step4.Right click “AR1” log to set up annual routine date.You can set up the annual date from this tab.

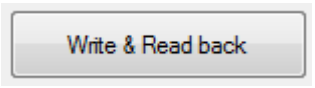




1 Add Log

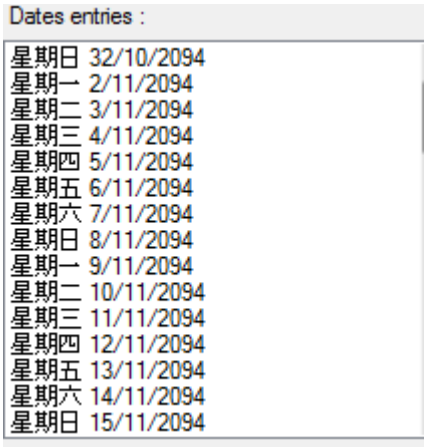
Click to add the date.

2 Write&Read back



Click to write & read back.

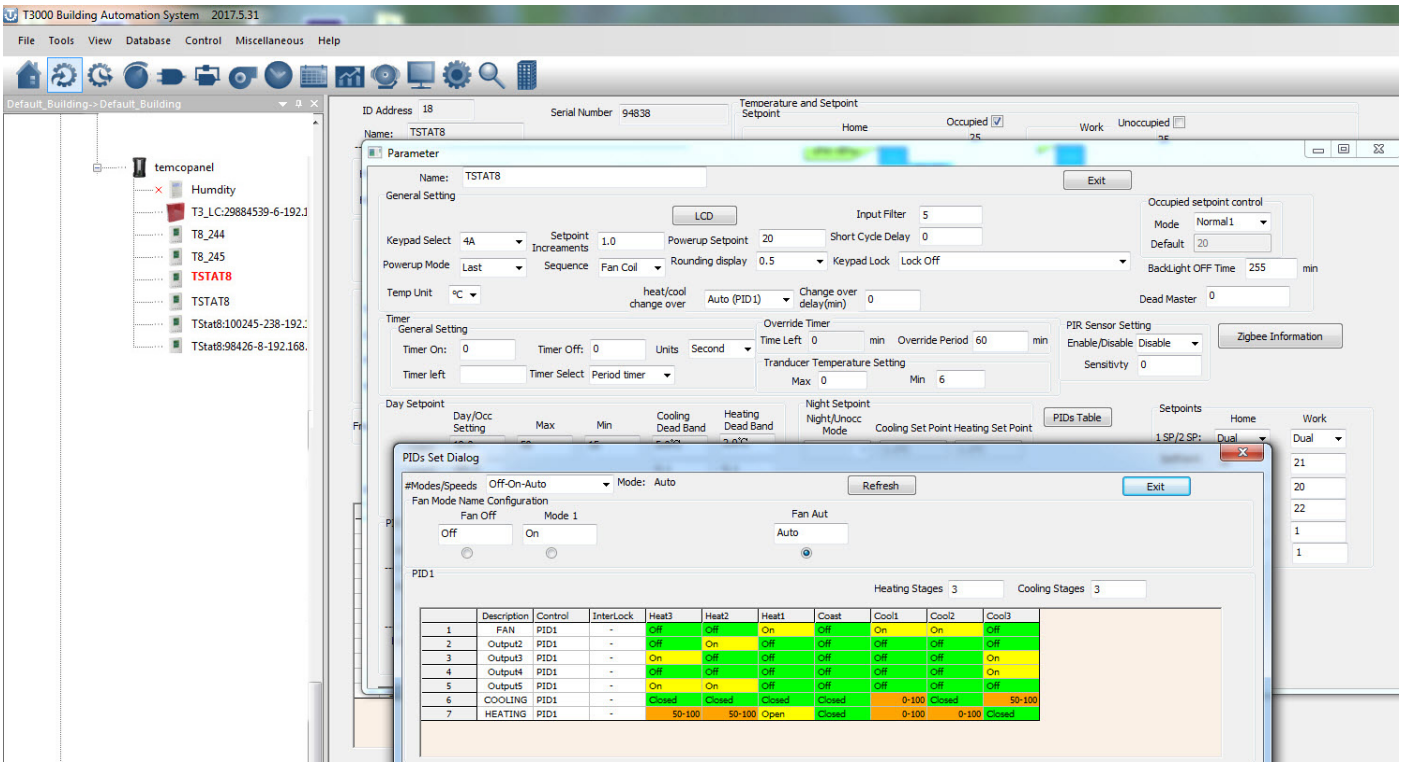
3 Date Entries



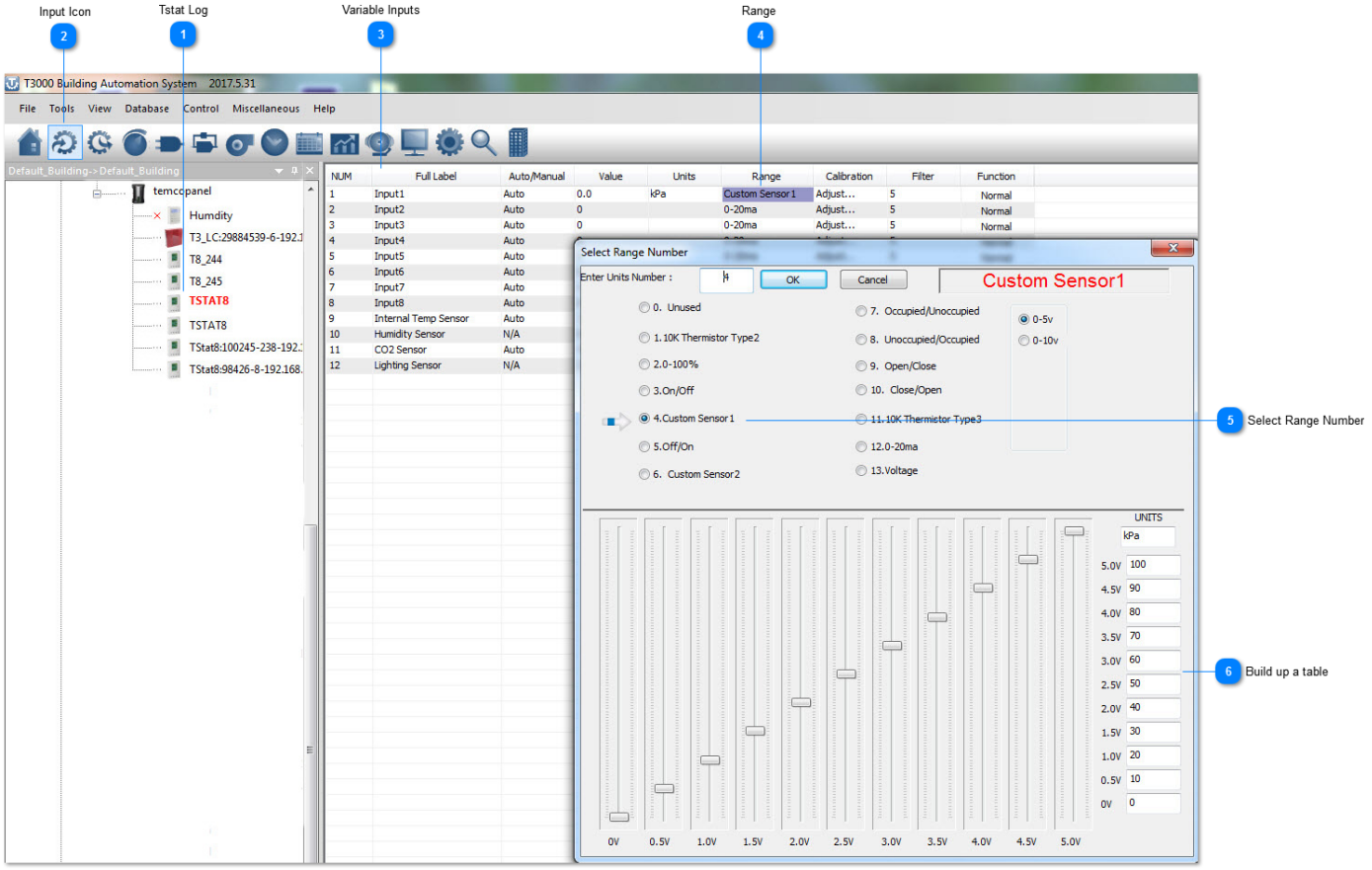
Click to choose the date.

Heating/Cooling Configuration

About Heating Cooling Mode Configuration,here are two examples: one heat one cool setting and two heat two cool setting.



Input Setting



As an example of a custom sensor, here we have built up a table for a custom sensor operating from 0 to 5V over the range of 0-100psi.

1 Tstat Log

Select the thermostat from the tree.

2 Input Icon

Click on the INPUTS icon.

3 Variable Inputs

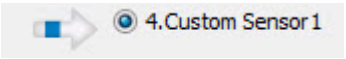
NUM	Full Label
1	Input1
2	Input2
3	Input3
4	Input4
5	Input5
6	Input6
7	Input7
8	Input8
9	Internal Temp Sensor
10	Humidity Sensor
11	CO2 Sensor
12	Lighting Sensor

Give each input a name.

4 Range

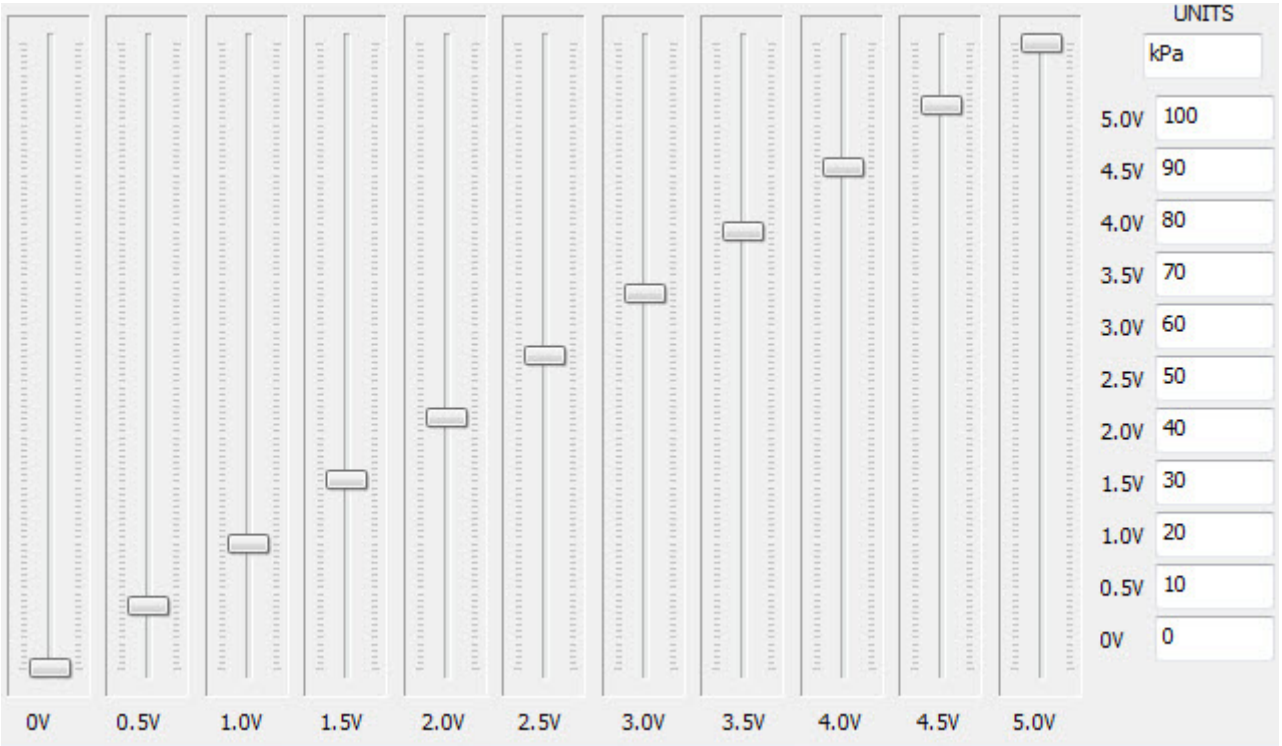
Set the range for the input by clicking on this column.

5 Select Range Number



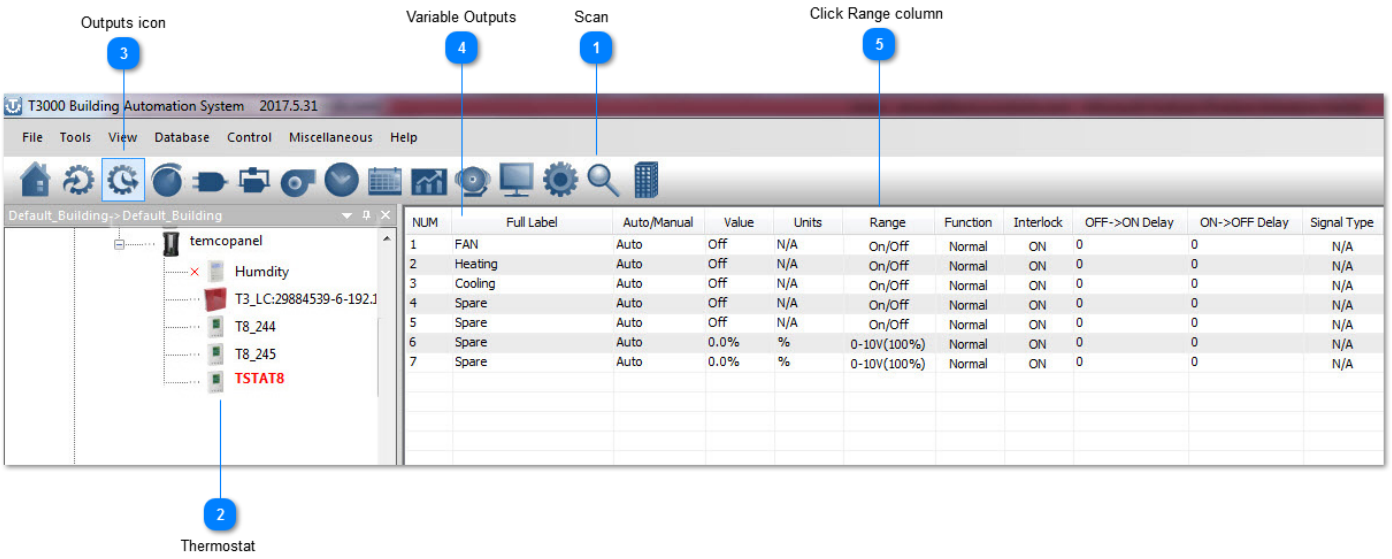
Select from the various ranges or build your own.

6 Build up a table



As an example of a custom sensor, here we have built up a table for a custom sensor operating from 0 to 5V over the range of 0-100psi.

Output Setting

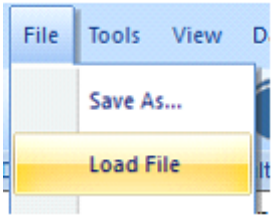


1 Scan

Scan the network and discover all devices.

2 Thermostat

Select the thermostat from the tree.
For a fast way to set up the stat you can just load the config file, attached. The steps I did to create this config file are explained below.



3 Outputs icon

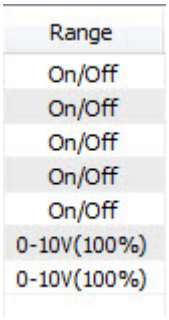
Select the outputs icon.

4 Variable Outputs

NUM	Full Label
1	FAN
2	Heating
3	Cooling
4	Spare
5	Spare
6	Spare
7	Spare

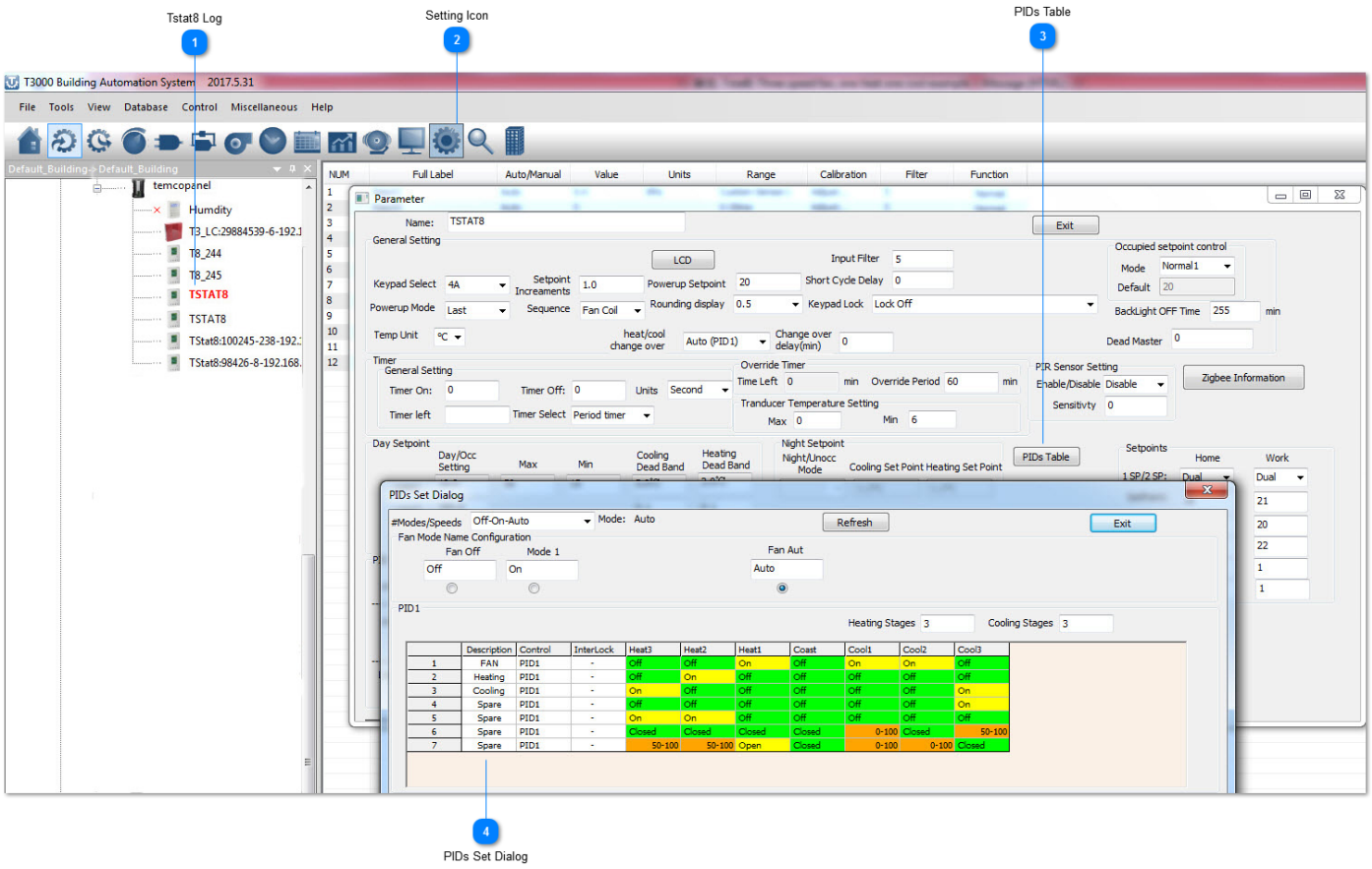
Click to give each output a name and a range, in the case of the fan the outputs are on-off and the valves are modulating 0-10V = 0-100% which are the default ranges already.

5 **Click Range column**



Click the Range column to see many options available for the range setting such as PWM and floating three wire control for modulating actuators using two relay outputs.

One heat one cool setting



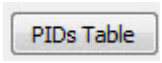
1 Tstat8 Log

Select the thermostat from the tree.

2 Setting Icon

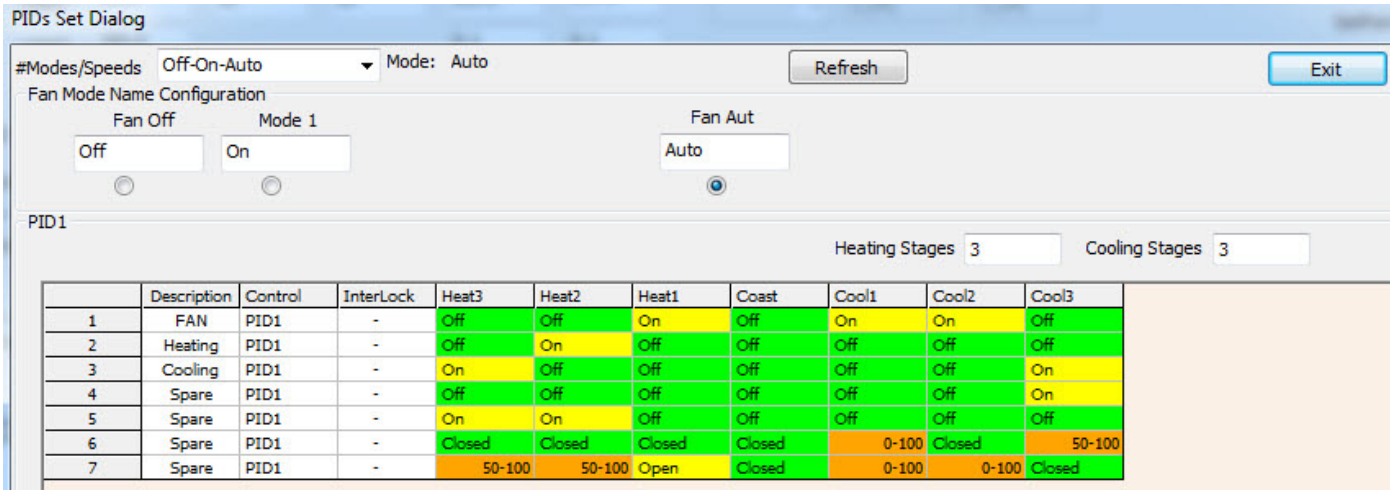
Click on the gear icon to get to the advanced settings.

3 PIDs Table



Click to get to the PID tables, this is where we assign outputs to act over each stage of heating and cooling.

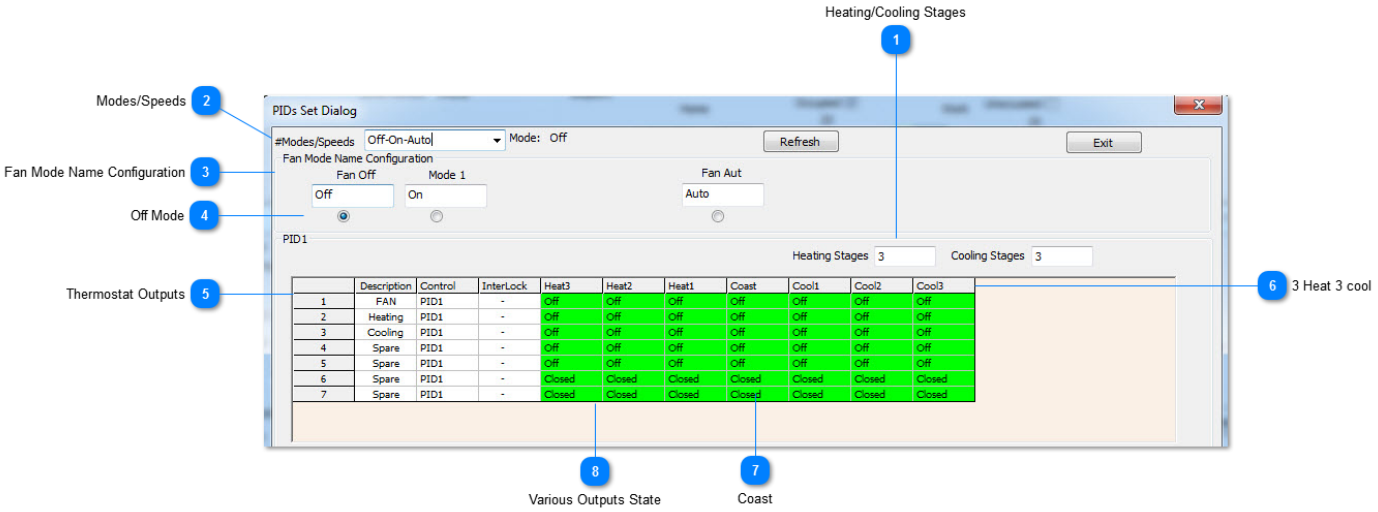
4 PIDs Set Dialog



	Description	Control	InterLock	Heat3	Heat2	Heat1	Coast	Cool1	Cool2	Cool3
1	FAN	PID1	-	Off	Off	On	Off	On	On	Off
2	Heating	PID1	-	Off	On	Off	Off	Off	Off	Off
3	Cooling	PID1	-	On	Off	Off	Off	Off	Off	On
4	Spare	PID1	-	Off	Off	Off	Off	Off	Off	On
5	Spare	PID1	-	On	On	Off	Off	Off	Off	Off
6	Spare	PID1	-	Closed	Closed	Closed	Closed	0-100	Closed	50-100
7	Spare	PID1	-	50-100	50-100	Open	Closed	0-100	0-100	Closed

PIDs Set Dialog shows the details of the setting.

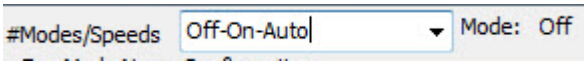
OFF Mode



1 Heating/Cooling Stages

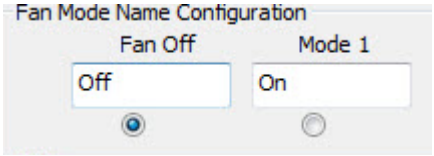
Here we set how many stages of heating and cooling the system will have. Since this is a three speed fan we can set three heating/cooling at this tab.If we set 2 or other number of heating and cooling stages,there will be corresponding quantity of tabs.

2 Modes/Speeds



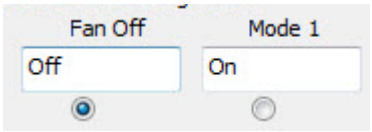
Select here from the available options, this establishes the various modes the thermostat will operate in and also whether the user will be able to set the stat in certain modes or not. For example if you select OFF-ON-AUTO the user will be able to select up to three modes from the keypad: OFF, ON and AUTO mode. If we had selected only OFF-AUTO, the user will only be able to see select from the OFF and AUTO modes. Keep in mind that the keypad can be locked as well, this is a separate setting, but this is where we set the number of modes the system will operate in.

3 Fan Mode Name Configuration



Each of these modes we established in the tab at 2 can be renamed along the row here at tab 3.

4 Off Mode



Now we set up which of the outputs will do what in each of the various stages and modes. We have selected the OFF mode and the state of the outputs is for the off mode.

5 Thermostat Outputs

	Description
1	FAN
2	Heating
3	Cooling
4	Spare
5	Spare
6	Spare
7	Spare

Each row represents one of the thermostat outputs.

6 3 Heat 3 cool

Heat3	Heat2	Heat1	Coast	Cool1	Cool2	Cool3

Each column represents a certain stage of heating or cooling. Heating is to the left and Cooling is to the right. The columns to the left represent increasing responses to the temperature being below setpoint. Moving to the right are increasing responses to the room temperature being over setpoint.

7 Coast

Coast
Off
Off
Off
Off
Off
Closed
Closed

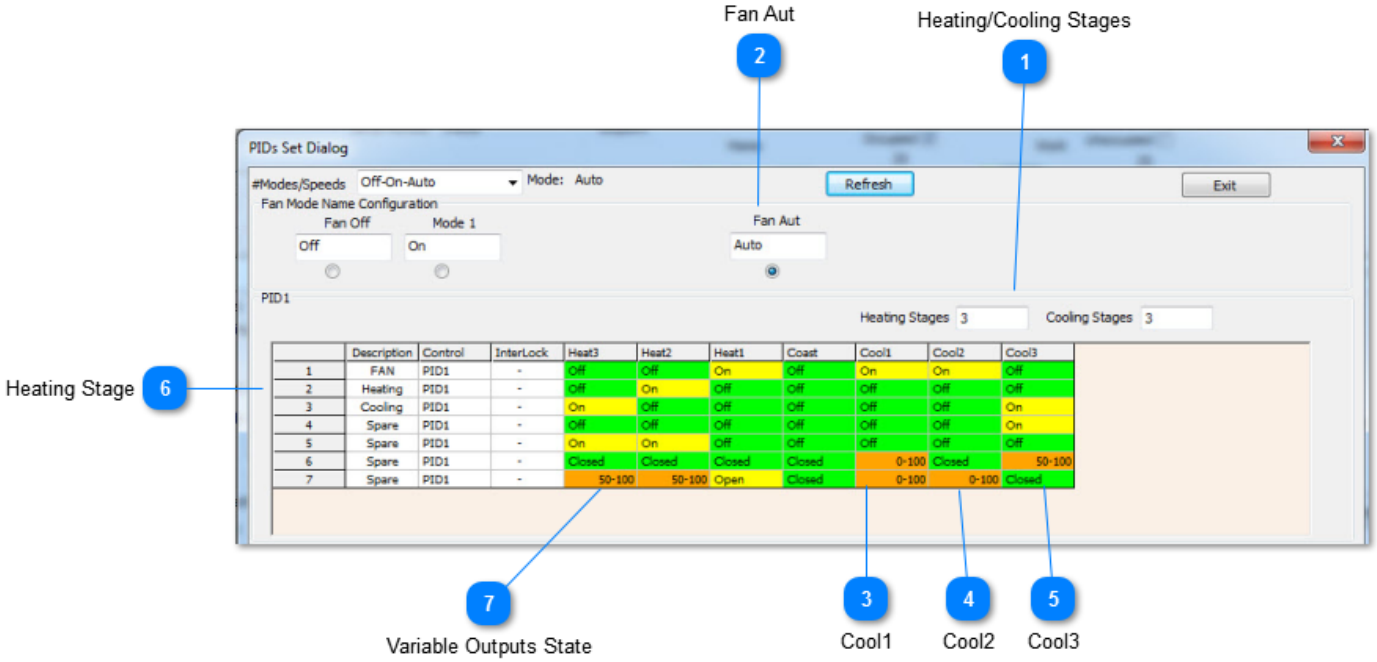
The center column represents the thermostat at rest, the setpoint is satisfied and the system is coasting.

8 Various Outputs State

Off	Off	Off	Off	Off	Off	Off
Off	Off	Off	Off	Off	Off	Off
Off	Off	Off	Off	Off	Off	Off
Off	Off	Off	Off	Off	Off	Off
Off	Off	Off	Off	Off	Off	Off
Closed	Closed	Closed	Closed	Closed	Closed	Closed
Closed	Closed	Closed	Closed	Closed	Closed	Closed

Here are the states for the various outputs to each stage of cooling, heating and coasting. Since we have selected the OFF mode at tab18, all the outputs will be OFF with the system is set to OFF mode.

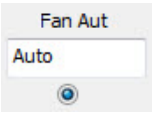
AUTO Mode



1 Heating/Cooling Stages

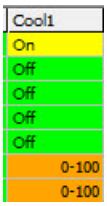
Here we set how many stages of heating and cooling the system will have. Since this is a three speed fan we can set three heating/cooling at this tab.If we set 2 or other number of heating and cooling stages,there will be corresponding quantity of tabs.

2 Fan Aut



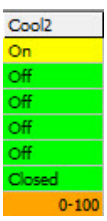
Now select the Auto mode. The state of each of the outputs has been set to on, off or modulating on all of the various states.

3 Cool1



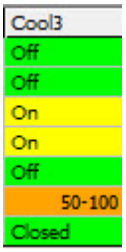
In the first stage of cooling, output1 is on for low speed fan operation and the cooling valve is modulating open from 0-50%.

4 Cool2



In stage 2 of cooling, the medium fan speed is on and the valve is opening up from 50 to 100%.

5 Cool3



In stage 3 cooling the high speed fan is on and the valve is set once again to modulate from 50 to 100% .

6 Heating Stage

2	Heating	PID1	-	Off	On	Off	Off	Off	Off	Off

The same sequence is set up to the right of the table for the three stages of heating. The heating valve modulates open as shown and the cooling valve is closed for all stages of heating.

7 Variable Outputs State

Off	Off	On	Off	On	On	Off
Off	On	Off	Off	Off	Off	Off
On	Off	Off	Off	Off	Off	On
Off	Off	Off	Off	Off	Off	On
On	On	Off	Off	Off	Off	Off
Closed	Closed	Closed	Closed	0-100	Closed	50-100
50-100	50-100	Open	Closed	0-100	0-100	Closed

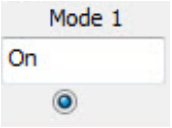
Each cell represents the state of a particular output at a certain stage of heating, cooling or coasting. In the coasting stage, all the outputs are off.

ON Mode

1 Heating/Cooling Stage

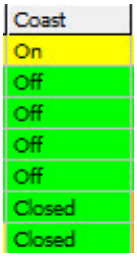
Here we set how many stages of heating and cooling the system will have. Since this is a three speed fan we can set three heating/cooling at this tab.If we set 2 or other number of heating and cooling stages,there will be corresponding quantity of tabs.

2 ON Mode



Now select the ON mode, this is generally used if you would like to allow the user to manually turn on the fan to get some fresh air in the zone.

3 Coast



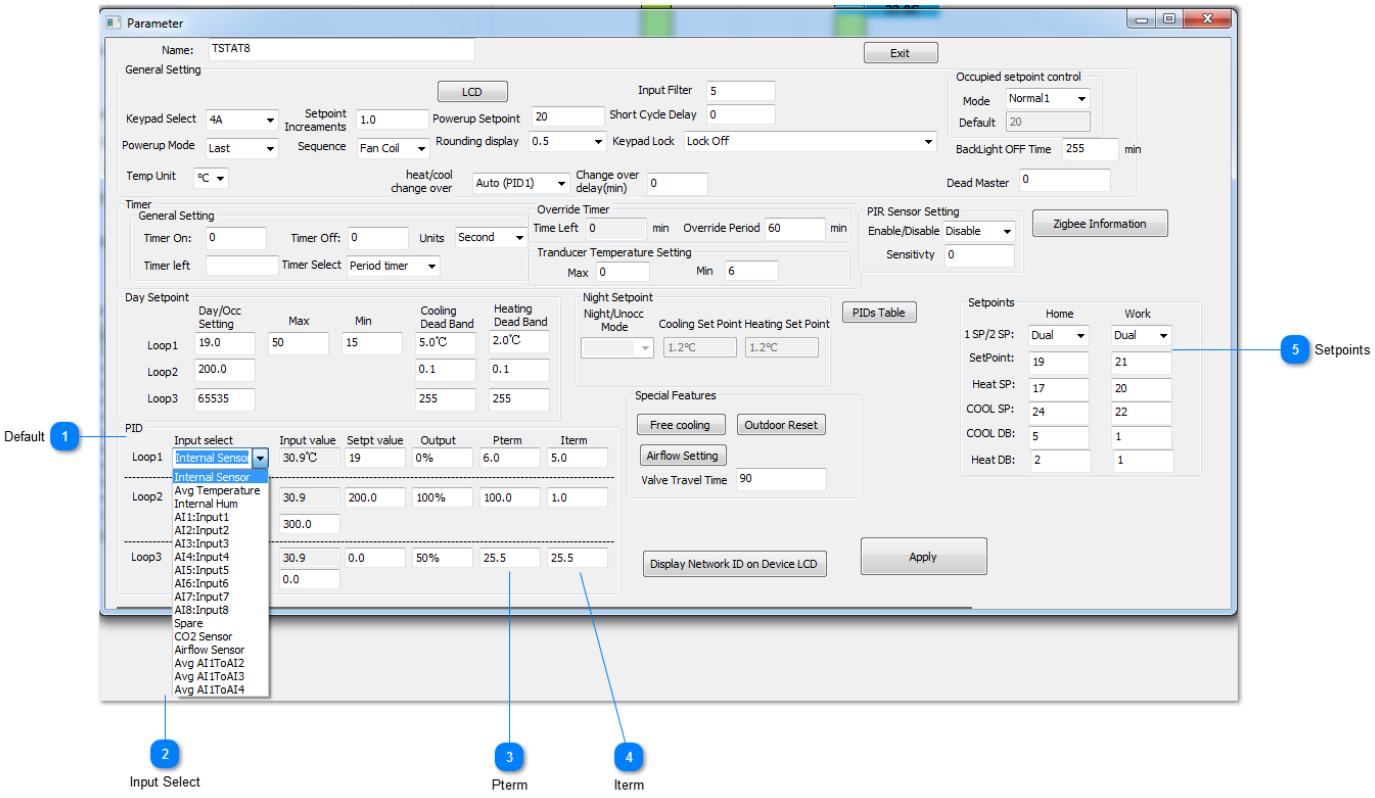
The stages of heating and cooling are set up exactly as everything was done in the Auto mode,the only difference is the Coast tab, you can see that the fan will be on in the coasting mode. This means even when the setpoint is satisfied at least the low speed fan will be on and the heating & cooling valves will be closed.

4 Variable Outputs State

On	On	On	On	On	On	On
Off	Off	Off	Off	Off	Off	Off
Off	Off	Off	Off	Off	Off	Off
Off	Off	Off	Off	Off	On	On
On	Off	Off	Off	Off	Off	Off
Closed	Closed	Closed	Closed	0-100	Closed	50-100
50-100	50-100	Open	Closed	0-100	0-100	Closed

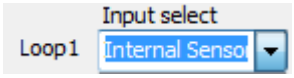
In all other stages of heating stage three on over to cooling stage3, the fan and valve are sequenced just like they were in the auto table.

PID Loop Setting



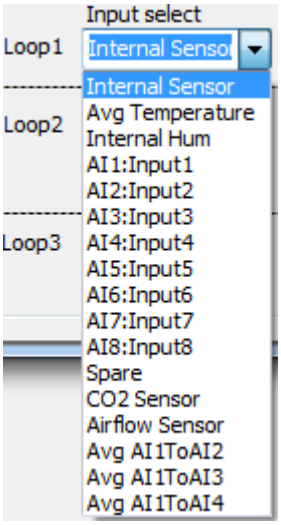
PID loop

1 Default



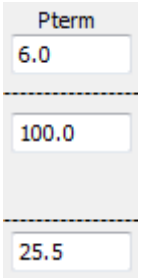
Now we set up the PID loop, for the most part you can leave the settings at their default.
You can select which of the inputs will provide feedback for the PID loop, the default is the internal temperature sensor.

2 Input Select



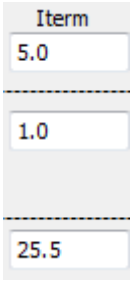
For the PID feedback you can select from many options such as the average of some sensors, any of the 8 external sensors or the internal humidity or C02 sensor if it has one.

3 Pterm



This is the PID proportional setting. The default value of 6 means that the PID loop will output a full response when the temperature error is 6 degrees, in this case celcius, away from setpoint. So if the setpoint were 20C, the maximum heating to the maximum cooling will occur over a span of 6 degrees. When we're three degrees below setpoint we'll be in stage 3 heating and when we're 3 degrees above setpoint the PID will be at stage 3 cooling.

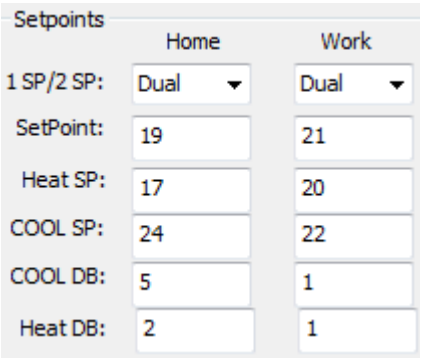
4 Iterm



This is the integral term. This is a nudge factor so that if the temperature is hovering a little ways below the setpoint for a long period eventually the integral term will accumulate some error over time and begin to bring on the next stage of heating. During commissioning this term can be set to zero because it can wind-up and cause confusion. For example the room is just below the setpoint by half a degree or so you would think the unit will be in stage1 heat yet it is running at high speed. It is the integral term which has wound up and is calling for stage three. When commissioning is done you can enter something for the I term to get better PID loop action, the default value of 5 is reasonable and means you can get an extra 5% of PID action for every degC – hour of accumulated error.
A small value for the P term means the PID loop will be more sensitive to a deviation from setpoint. A small term for the I term means the PID loop will be lazy over time.

Small P = hyperactive
Small I = lazy, over time.

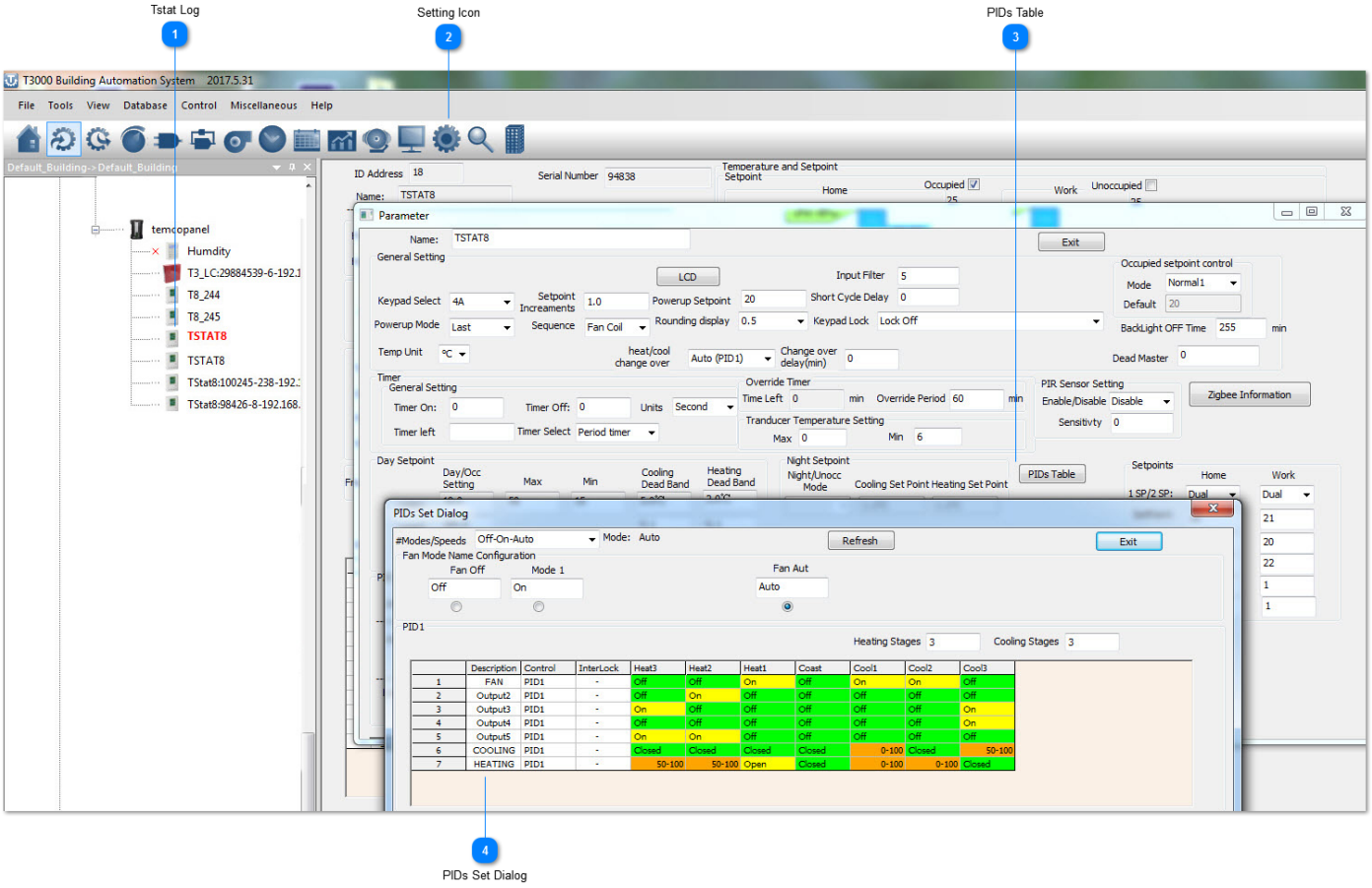
5 Setpoints



Finally set up the setpoints. Dual setpoints operate like a residential thermostat where you can set up a separate heating and cooling setpoint. Single setpoints are more for commercial settings where you would like to keep things simple and let the user adjust only a single setpoint up or down. The HOME and WORK columns show the heating and cooling setpoints for occupied (home) and unoccupied modes (work). There are other modes which we need to add to this dialog, SLEEP and AWAY which are common with residential thermostats. In single setpoint mode there is only one setpoint we talk about, so the heating setpoint is calculated from the

‘setpoint’ minus the heating deadband. Similarly, the cooling setpoint is equal to the ‘setpoint’ plus the cooling deadband.

Two heat two cool setting



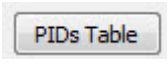
1 Tstat Log

Click on the gear icon to get to the advanced settings.

2 Setting Icon

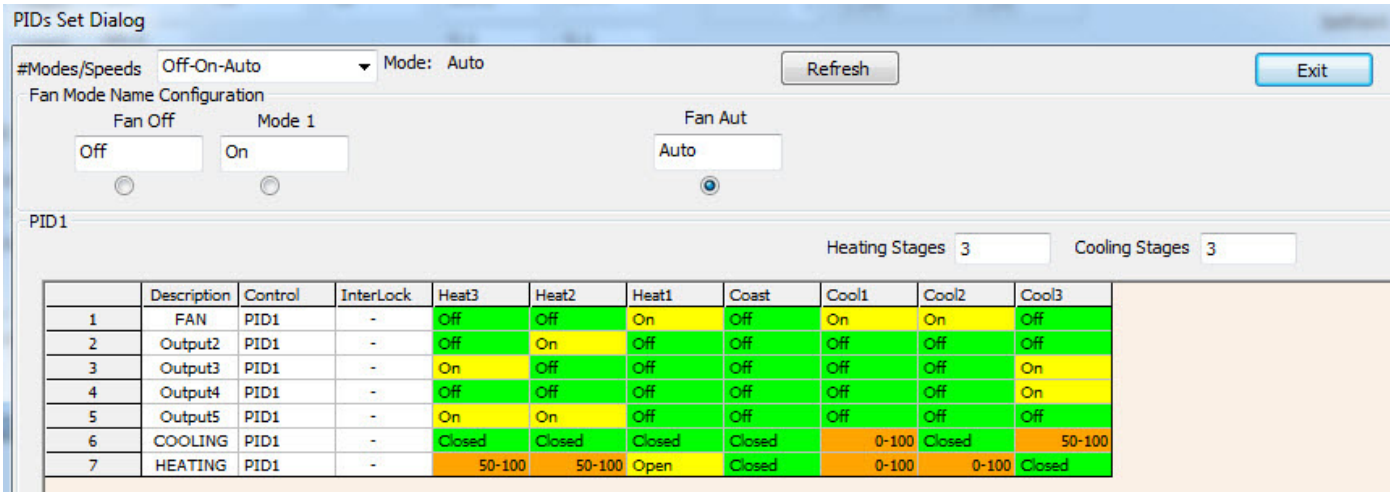
Click to get to the PID tables, this is where we assign outputs to act over each stage of heating and cooling.

3 PIDs Table



<TODO>: Insert description text here...

4 PIDs Set Dialog

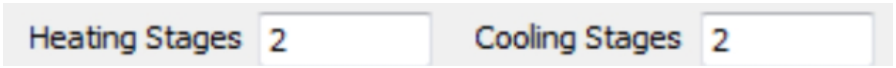


	Description	Control	InterLock	Heat3	Heat2	Heat1	Coast	Cool1	Cool2	Cool3
1	FAN	PID1	-	Off	Off	On	Off	On	On	Off
2	Output2	PID1	-	Off	On	Off	Off	Off	Off	Off
3	Output3	PID1	-	On	Off	Off	Off	Off	Off	On
4	Output4	PID1	-	Off	Off	Off	Off	Off	Off	On
5	Output5	PID1	-	On	On	Off	Off	Off	Off	Off
6	COOLING	PID1	-	Closed	Closed	Closed	Closed	0-100	Closed	50-100
7	HEATING	PID1	-	50-100	50-100	Open	Closed	0-100	0-100	Closed

PIDs Set Dialog shows the details of the setting.

OFF Mode

1 Heating/Cooling Stage

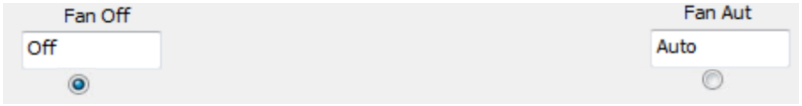


Set the number of stages of heating and cooling.

2 Modes Setting

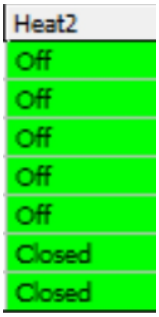
You can set the number of modes at the tab, two modes have been selected here with the default names as Off and Auto.

3 OFFSelecting



You can rename them by editing the names at the tab.Next we'll edit the Off table by selecting the radio button. The grid shown represents the outputs when the stat is in the off mode.

4 Heat2



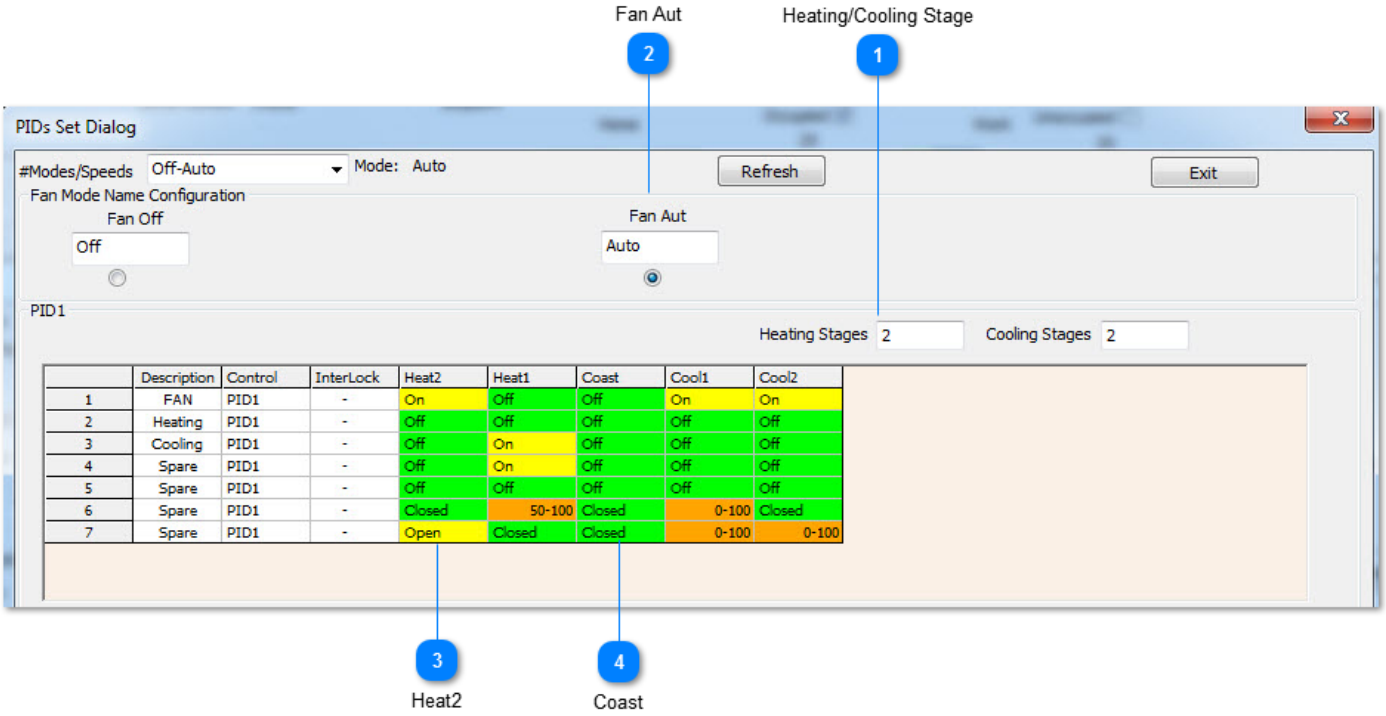
The center column represents the coasting mode, everything is off there as well.

5 Various Outputs State

Heat2	Heat1	Coast	Cool1	Cool2
Off	Off	Off	Off	Off
Off	Off	Off	Off	Off
Off	Off	Off	Off	Off
Off	Off	Off	Off	Off
Off	Off	Off	Off	Off
Closed	Closed	Closed	Closed	Closed
Closed	Closed	Closed	Closed	Closed

Each row is one output and the columns represent the outputs in each of the stages of heating and cooling. In this example, everything is off for all 2 stages of heat and two cool.

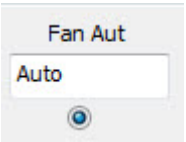
AUTO Mode



1 Heating/Cooling Stage

Set the number of stages of heating and cooling.

2 Fan Aut



Fill in the grid for the Auto mode.

3 Heat2

Heat2
On
Off
Off
Off
Off
Closed
Open

Heat2 will be on in the column called Heat2 and off for the other stages and so on. The fan is on all the time as shown by the FAN row with all yellow entries.

4 Coast

Coast
Off
Off
Off
Off
Off
Closed
Closed

You could optionally turn the fan off during coasting by setting the cell to OFF.

Tstat8 Configuration Menu manual

Code and description

Code	Description [Menu Display] (Range, Default)
Modbus Address	**[Add] Modbus Device Address (1-254, 254)** This is the modbus address of the tstat. It is the address to which the stat will respond to when receiving serial communication. Each tstat must have a unique address on the network.
Temperature Calibrate	**[CAL] Calibration of the on board Temperature Sensor (0-1000, 500)** To calibrate the temperature sensor on the tstat use a accurate hand held mercury or digital thermometer. Both the thermostat and the temperature meter need to be in equilibrium with the space before calibration can occur. Hold the meter close to the thermostat. Use the keypad to get into the menu mode until CAL is shown on the display. Adjust the reading using the up and down buttons till the temperature shown matches the handheld meter. This sequence can be repeated if necessary till the readings on the thermostat and meter are the same. The thermostat will store the calibration figures even through extended power outages and will not need to be adjusted. The thermostat should be powered up for 5 minutes prior to any calibration and the thermometer should be left near the thermostat for the same amount of time. The calibration value is centered around 500 (50.0°) This means that anything above 500 will be added on to the raw temperature and anything below 500 will be subtracted from the raw temperature. Calibration units are in increments of 0.1° (i.e. 500 means 50.0°) and are in the same units (C or F) as the tstat. Some calibration tips: *The main error in calibration comes from not waiting long enough for the handheld thermometer to come to equilibrium. *Calibrate using the customer's thermometer, even if it is not an accurate one so that all subsequent measurements are compared to the same benchmark. *The sensor inside the thermostat is a digital chip capable of readings down to 0.06°C so the weak link in calibrating is usually the procedure used rather than the tstat accuracy. *Make sure the tstat is mounted in a location free of drafts. Drafts from the back will also affect readings.
Temperature Select	**[tSS] Temperature Sensor Select (0-3, 0)** The tstat has an extra input which can be used as an external temperature sensor. Use this menu to select which sensor to use. tSS = 0: The tstat will use the internal IC temperature sensor for the display and PID calculations. tSS = 1: The tstat will use an external thermistor which is shown on the display and used for PID calculations. tSS = 2: The tstat will use an internal thermistor which is shown on the display and used for PID calculations. tSS = 3: The tstat will use an average of the internal thermistor and the external thermistor which is shown on the display and used for PID calculations.

Code	Description(Range, Default)
Temperature Filter	**[FIL] Temperature Sensor Filter (0-10, 5)** Filter used for the raw temperature being read by the sensor. This configures the weighted average used when filtering the raw temperature. 0 corresponds to no filter. 10 corresponds to a high level of filtering. Set this to a low value if you want the input to respond quickly, a high value will smooth the readings more but make them respond more slowly. This setting should not need to be adjusted for most applications.
Baudrate Select	**[bAU] Baud Rate (1200-115200, 9600)** This will adjust the speed (baud rate) of which the thermostat communicates. This value must match the device it is connected too.
Short Cycle Delay	**[dSC] Short Cycle Delay (0-20, 0)** This parameter adjusts the delay between cycling between the modes of operation. It is the number of minutes after entering the coasting mode until the tstat can re-enter the mode it came from. For example, if the tstat is in Cooling1 mode and then enters Coasting mode, it will take a delay of dSC minutes until it can re-enter into Cooling1 mode. This value is in increments of 1 minute.
Change-Over Delay	**[dCH] Changover Delay (0-200, 0)** This parameter adjusts the delay between switching from a heating mode of operation to a cooling mode of operation or vice versa. It is the number of minutes after leaving cooling or heating mode before the tstat can enter the opposite mode. This value is in increments of 1 minute.
Proportional Term	**[PPr] Proportional Term (10-255, 20)** The proportional term is the 'P' term of the familiar PID control strategy and determines how fast a valve will react to a deviation from setpoint at a particular instant in time. The default value of 2.0° (C or F) is fine for most applications where a 2.0° deviation is required to make the valve respond to 100%. For example, with the PPr term set to 2.0 (°C) and the cooling setpoint is set to 20°C the valve will be open 100% by the time the room hits 22°C. A larger PPr term will make the valve open less since the deviation from setpoint will have to be greater before it opens 100%. A smaller value makes the valve respond more quickly. The factory setting of 2.0° (Cor F) is fine where the thermostat is located out of the direct airflow in an office size room. For a smaller room or if the thermostat is located directly under the air vent, a slower acting valve is required to avoid short cycling, so set the value of PPr to 3.0° or 4.0°. The PPr term acts in cooperation with the PIn term which is described next. The P value is in increments of 0.1° (i.e. 20 means 2.0°) and is in the same units (Cor F) as the tstat.

Code	Description(Range, Default)
Integral Term	**[PIn] Integral Term (0-255, 50)** The integral term is the 'I' term of the familiar PID control strategy and determines how fast a valve will react to a deviation from setpoint over time.For example, with the room slightly above setpoint the 'P' term may be basically satisfied but a small deviation still exists. This deviation is summed up or 'Integrated' over time and the Iterm will gradually open the valve to make up the final small deviation from set-point. The default value of 5.0(%/Deg per minute) is fine for most applications and will cause the valve to open 5% for one degree (Cor F) of error per minute. For example, when the PIn term set to the default of 5.0 (%/Deg per minute), the cooling setpoint is set to 20°C and the room temperature is 21°C, the valve will be open partially due to the "P" term described earlier but the condition continues and we would like the valve to be opening up slowly to make up the final temperature error. If this situation of 1.0°C error continues for one minute, the error accumulates and the Iterm nudges the valve open an additional 5%. If the previous explanation is not clear, a couple of helpful reminders are as follows: Think of the Iterm as the opposite of the Pterm, "a bigger I means faster valve, smaller I means slower valve". The default value of 5% will work fine for most applications. If the valve is short cycling, make the Iterm smaller. The I value is in increments of 0.1 %/°minute (i.e. 50 means 5.0%/°minute) and is in the same units (Cor F) as the tstat.
Operation Sequence	**[SOP] Sequence of Operations (0-2, 1)** The Sequence of operation is normally set at the factory and does not need to be adjusted. The thermostat supports field adjustment of the operation to suit different variations of mechanical equipment. Setting this value to a different value will cause the thermostat to stop working properly so be careful not to adjust this value unless you are familiar with the various sequences. Standard Operation (1): When SOP is set to 1 the sequence of operations is stored in a table that allows for basically any arbitrary sequence of operation. For example, the tstat could be set up to control 5 stages of cooling and 5 stages of heating or anything in between. Each output is individually assigned to be active in any particular section of the cooling or heating cycle. There are 7 discreet steps: Heat3, Heat2, Heat1, Coasting, Cool1,Cool2 and Cool3. So the table is 5 outputs x 7 steps via a spread sheet arrangement and you fill in the blanks to suit the application. The settings can be stored in an external text file that is easily read and modified in a text editor. The "TstatFactory" software utility on our website(http://www.temcocontrols.com/ftp/tstat5software.zip) allows you to send your favorite sequence of operations table to a new tstat speeding up the configuration process. Transducer Mode (2): Setting SOP to 2 puts the Tstat into transducer mode. In this mode the cooling analog output corresponds directly to the room temperature in degrees C (i.e. at 25°C, the output would be 2.5V). The heating analog output corresponds directly to the setpoint in degrees C. and relay1 corresponds to the occupied/unoccupied mode (occupied= relay1 ON, unoccupied= relay1 OFF). Test Mode (0): A special sequence of operations is embedded in the tstat that assists in the commissioning and testing of the installation. When SOP is set to '0' this will start the testing sequence and the unit will cycle the relay outputs on and off in a slow rotation. The analog outputs are also cycled in a slow ramp. The cooling goes from 0

Code	Description(Range, Default)
	to 10 Volts while the heating goes in reverse from 10 to 0 Volts. The duty cycle of this rotation is approximately 20 seconds. **Be sure the mechanical system is able to handle this sort of cycling before using this feature. Damage may occur if used improperly.**
HeatCool Config	**[HC] Heating Cooling Mode Configuration (0-5, 0)** This item configures the method by which the tstat determines the heating or cooling mode. HC = 0: mode is controlled automatically by the on board PID control. PID > 52 is heating mode, PID < 48 is cooling mode. PID between 48 and 52 is Coasting. This is used for most applications. HC = 1: mode is controlled by the keypad or serial communication. This is for keypad configurations in which the user or serial comminication can manually set heating or cooling mode. HC = 2: mode is controlled by the active high digital input. High is heating, low is cooling. HC = 3: mode is controlled by the active low digital input. High is cooling, low is heating. HC = 4: mode is controlled by difference in temperature of setpoint and analog input 1 temperature sensor. If the temperature of the sensor is greater than the setpoint, the tstat will be in cooling mode and if the temperature of the sensor is less than the setpoint the tstat will be in heating mode. This is primarily used for 2-pipe systems. Analog input 1 would be a well or strap on temperature sensor located in the supply piping of a 2-pipe system to detect if heating or cooling is being supplied to the equipment. HC = 5: same as mode 4 but using the analog input 2 sensor instead of analog input 1
Heating Deadband Cooling Deadband	**[Cdb] [Hdb] Heating & Cooling Deadbands (1-200, 10)** If there is one setpoint then heating setpoint follows the cooling setpoint and is calculated by: Heating Setpoint = Setpoint - Heating Deadband. Cooling Setpoint = Setpoint + Cooling Deadband. If there are two setpoints heating and cooling are separately adjusted. The setpoints are calculated as follows: Heating Setpoint = Max(Cooling Setpoint + Cooling Deadband , Heating Setpoint) Cooling Setpoint = Min(Cooling Setpoint, Heating Setpoint - Cooling Deadband) The minimum value for Cdb and Hdb is 1.0° (C or F) to ensure that simultaneous heating and cooling is never allowed. The maximum value is arbitrarily set to 20.0°. The deadband values are in increments of 0.1° (i.e. 20 means 2.0°) and are in the same units (C or F) as the tstat.
Degree C/F	**[C_F] Degrees C/Degrees F (0-1, 0)** The display can be switched to show Degrees C or Degrees F. 0 = C, 1 = F.
FanSpeed Select	**[FAn] Number of Fan Speeds to show on the display (0-3, 3)** The number of fan speeds allowed. FAn = 3, the user will see “Off/On/Med/Hi/Auto”; FAn = 2, the user will see “Off/On/Med/Auto”FAn = 1, the user will see “Off/On/Auto”;Fan = 0 then the user will see “Off/Auto”
NightHeat Deadband NightCool Deadband	**[nCd] [nHd] Night Cooling Deadband (0-99, 10) for deg C and F / Night Heating Deadband (0-35, 10) for deg C, (0-95, 10) for deg F.** When the tstat is in unoccupied mode and APP is set to 0 then the heating setpoint is adjusted downwards by the amount of the nHd. The cooling setpoint is adjusted

Code	Description(Range, Default)
	upwards by the amount of nCd. The night deadband values are in increments of 1° (i.e. 10 means 10°) and are in the same units (C or F) as the tstat. Note: The night heating setpoint is prevented through an internal software interlock from being set below 5°C, regardless of the user heating setpoint and the value stored in NHS.
NightHeat Setpoint NightCool Setpoint	**Set night heating setpoint and night cooling setpoint, in degree C or degree F**
Applica-tion Mode	**[APP] Application (0-1, 0)** 0 - OFFICE applications mode The night time setpoints are specified value Night Heating Setpoint = nHS value. Night Cooling Setpoint = nCS value. 1 - HOTEL or RESIDENTIAL applications mode The night time setpoints are a specified deadband in relation with the day time set-points Night Heating Setpoint = Cooling Setpoint - nHd value. Night Cooling Setpoint = Cooling Setpoint + nCd value.
PowerUp Setpoint	**[POS] Power on setpoint (0-255, 20) for deg C, (0-255, 68) for deg F** Certain applications require the thermostat to power up with a known setpoint that is stored through a power outage. This feature is useful in some of the transducer modes where the central DDC controller can cycle the power to the thermostats to reset the room setpoints to a known value everyday. The power on setpoint value is in increments of 1° (i.e. 20 means 20°) and is in the same units (C or F) as the tstat.
PowerUp On/Off	**[POn] Power on Mode (0-3, 3)** This setting allows the thermostat to power up in one of three modes: 0 = power off,1 = power up in on mode, 2 = last value(default),3 =auto mode. The on and off settings are self explanatory and are useful in certain DDC applications where the central controller can cycle the power to each thermostat to sweep them off each evening for example. The default value is “last value” and will cause the thermostat to power up in whatever state it was in before the power outage.
Analog-Out1 Setting Analog-Out2 Setting	**[Ou1] [Ou2] Output settings (0-4, 0)** Sets the full-scale voltage of the analog outputs. Ou1 sets analog out 1 (Cooling). Ou2 sets analog out 2 (Heating). This setting is used to match the analog outputs to various types of actuators, transducers or other controllers. For example, by set-ting the output range to act over a 5VDC scale can be used to set the tstat up as a transducer to interface into a master DDC controller. This also works with a valve that operates over the 2-10VDC range, this ‘output’ type setting lets you tailor the tstat to the particular application. Setting OuX to 0 will set the output to act in ON/OFF mode. There are 4 types of tstats. Only the Tstat5A and Tstat5CM have analog output capability. For Tstat5B and Tstat5C, the firmware recognizes the relays and this will be perma-nently set to 0 and is not adjustable. For Tstat5A and Tstat5CM with analog outputs, the output will be 0V when OFF and 10V when ON. This is useful when using a Tstat5A or Tstat5CM and need extra ON/OFF outputs.

Code	Description(Range, Default)
	OuX = 1, the outputs will modulate from 0V to 10V over the 0-100% range of any particular stage of heating or cooling. OuX = 2, same as the '1' setting but the output modulates over the 0-5V scale OuX = 3, same as the '1' setting but the output modulates over the 2-10V full scale OuX = 4, same as the '1' setting but the output modulates in reverse i.e. 10V-0V Note: For a 4-20ma actuator it is simple to convert the 2-10VDC signal to a 4-20ma signal by installing a 250 ohm, 1/2 watt resistor in series with the output and making sure the grounds of the actuator and tstat are common to each other.
Max Set-point Min Set-point	**[SLO] Setpoint Minimum (0-255, 15) for deg C, (0-255, 55) for deg F [SHI] Setpoint Maximum (0-255, 50) for deg C, (0-255, 99) for deg F** The maximum and minimum allow able user setpoint settings. The occupants cannot adjust the setpoint above or below these settings. The min and max setpoint values are in increments of 1° (i.e. 20 means 20°) and are in the same units (C or F) as the tstat. Note: the heating and cooling deadbands act in a way that reduces these settings by the amount of the deadband. For example, if the highest setpoint allowed is 'SHI' = 30°C and the heating deadband 'Hdb' = 2°C, heating will actually only be active up to 28°C. Similarly, if the 'Cdb' cooling deadband parameter is at 2°C and the minimum setpoint is at 20°C, then cooling takes place only as low as 22°C.
MenuLock mode	**[LOC] Keypad lockout (0-3, 0)** Rev25 only: This setting is useful to keep the building occupants from experimenting in the menu system. When the LOC parameter is set to '1' the keypad will be locked out from all menu operations. The normal operation of the keypad is not affected; the fan and setpoint buttons work as usual. When the LOC parameter is set to '2' the keypad will be locked out from partial menu operations allowing maintenance personnel to access some of the less critical menu parameters while maintaining a LOC on functions reserved for the primary administrator.This option allows access to calibration of the internal and external temperature sensor (CAL and CAE) and the override time parameter(ORT). LOC= 3, The user cannot do anything from keypad except enter the menu mode. In the menu mode, the user can set the setpoint,fan speed, calibration and override timer. When the menu system is locked out, the only way to adjust the tstat parameters is through the network port or through the communications jack at the bottom of the tstat. The parameter can be set back to '0' only though the communications ports as well.
ValveTravle Time	**[Vtt] Valve Transient Time (10-255, 0)** This setting allows the user to adjust the valve transient time from fully open to fully closed. Value ranges from 10 to 255 seconds.
RS485/ ZGB Select	**Selet RS485 or ZIGBEE communication mode. This is only for Tstats with wireless ZIGBEE**
MODBUS BACNET	**Switch between Modbus protocol or BACnet protocol**
WIFI Mode	**Select ADHOC mode or Infra mode network. This is only for Tstat wifi product.**
Factory Default	**[FAC] Factory Default Setting (0-1, 0)** This returns the Tstat back to factory default settings. "YES" will reset the Tstat back to original settings. "NO" will keep the changes made.

Modbus register list

Tstat8	Count	Register and Description
0 to 3		Serial Number - 4 byte value. Read-only
4 to 5		Software Version– 2 byte value. Read-only
6		ADDRESS. Modbus device address
7		Product Model. This is a read-only register that is used by the microcontroller to determine the product model.
8		Hardware Revision. This is a read-only register that is used by the microcontroller to determine the hardware revision.
9		PIC firmware version
10		PIC version of Humidity module
11		PLUG_N_PLAY_ADDRESS, 'plug n play' address, used by the network master to resolve address conflicts. See VC code for algorithms
12~14		Spare
15		Bau - Baudrate, 0=9.6kbaud, 1=19.2kbaud 2=38.4kbaud 3=57.6kbaud 4=115.2kbaud 5=76.8kbaud 6=1.2kbaud 1=4.8kbaud 1=14.4kbaud
16		Update Register, used to show the status of firmware updates. Writing 143 sets the config back to out of the box except for Modbus ID and baud rate. Write 159 to fix the current config as the user defaults, this is done automatically by T3000 any time a config file is loaded. Writing 175 resets the unit back to the user defaults.
17~19		Spare
20		Hardware Options Register, starting with LSB: Bit0=Clock present or not, Bit1 = Humidity present or not, Bit2 = C02 Sensor, Bit3=CO sensor, Bit4 = Motion Sensor
21		PANID for zigbee devices
22		Device type of zigbee. 0 means coordinator, 1 means router
23~24		Channel of Zigbee, default channel is channel 13, 0x00002000
25		Zigbee module software revision
26~33		Zigbee extented address(MAC address)
34		Set 1 to reboot zigbee module
35~50		Security key
51		The number of zigbee neighbors around
52		The modbus ID of the 1st zigbee neighbor
53		The signal strength of the 1st zigbee neighbor
54		The modbus ID of the 2nd zigbee neighbor
...		

*The register list is very long ,it can be downloaded as an excel spreadsheet (03ModbusBacnetRegisterList.xls) at the following link:*http://tinyurl.com/ybaj9d3u*

Bacnet object list

Supported BACnet Object Types
analog-input, analog-output, analog-value, binary-input, binary-output, device
Supported BACnet Services
who-is, i-am
object-identifier, object-name, object-type, present-value, units, object-list, vendor-id, vendor-name, system-status, confirmed-service, unconfirmed-service

Tstat8	MSTP Object
Analog-value	AV0:baudrate select
Universal-input	UI1:temperature present value UI2~UI9:present value
Analog-output	AO1:analog output 1 value AO2:analog output 2 value
Binary-output	BO1~5:Relay Output 1~5
Device	device-identifier,device-name