

# **CentraLite EMS**

## **Operations, Maintenance & Service Manual**

### **Energy Management Control System**

**CentraLite Systems, Inc.**

6420 Wall Street  
Mobile, AL 36695

Phone: 251-607-9119

Fax: 251-607-9117

# CentraLite EMS Operations, Maintenance & Service Manual

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# CentraLite EMS

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### Introduction

The CentraLite Energy Management System (EMS) has been installed to reduce energy costs by minimizing HVAC usage when a guest room is Unrented or Vacant. The EMS system allows continuous monitoring of all online devices within the property.

### ***System Operation***

The highest priority EMS design criterion was to maintain guest comfort while minimizing HVAC energy usage in every hotel room.

The opportunities for hotel in-room energy savings are created when a room is unoccupied. And an increased amount of savings can be garnered when the room is also Unrented.

The CentraLite EMS uses the concept of SETPOINT temperature settings to manage activation of HVAC systems in hotel guest rooms. The EMS sets individual room thermostats at different SETPOINT temperature settings depending on whether the room is unoccupied along with whether the guest has checked-in. The EMS allows the room temperature to fluctuate up or down a pre-determined number of degrees from the SETPOINT temperature before activating the HVAC system based upon "Standard Differentials", "Setbacks" and "Deep Setback" settings. The purpose of these variable fluctuations is to ensure that the proper SETPOINT temperature is maintained while reducing the number of times the HVAC system is activated. A guest can change the room thermostat SETPOINT temperature at any time. When the thermostat setting is changed manually, the new setting will be used as the SETPOINT temperature until the guest is checked-out.

There are three room conditions used by the EMS to control energy usage under all in-room Heating and Cooling conditions; "Occupied", "Setback" and "Deep Setback". A SETPOINT temperature is allowed to fluctuate within "Differential" and "Setback" settings to maintain guest comfort levels and to maximize energy savings by minimizing HVAC activation.

The "Deep Setback" cooling and heating SETPOINT temperature is automatically set by the EMS when a room becomes Unrented.

When a guest is checked-in the EMS system immediately sets the room thermostat into "AUTO" mode and changes the room thermostat setting to the RENTED default SETPOINT temperature. The purpose is to ensure that the temperature is suitable to the guest by the time the room is entered. When the guest arrives at the room temperature is allowed to fluctuate according to a pre-determined "Differential" number of degrees around the SETPOINT temperature.

The SETPOINT temperature can be changed at the thermostat at any time. If the thermostat setting is changed manually, the SETPOINT room temperature is changed to the new setting. The EMS will use the manually set temperature as the room SETPOINT temperature until the guest is checked-out. The manually set SETPOINT temperature is automatically kept within the range of UPPER and LOWER limits set in the Room Thermostat Settings.

When the room is RENTED but UNOCCUPIED the thermostat will go into SETBACK mode. It will be allowed to drift by the SETBACK differential(default 3 degrees) above or below the SETPOINT temperature before the HVAC will activate.

When the room becomes UNRENTED, the EMS system sets the thermostat to the UNRENTED default SETPOINT temperature and puts the thermostat into the DEEP SETBACK mode. The thermostat will be allowed to drift by the DEEP SETBACK differential(default 6 degrees) above or below the SETPOINT temperature.

Training rooms or other special purpose hotel rooms can be automatically controlled by the EMS in

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the same way as guest rooms, or can be manually controlled through the online EMS.

### ***In-Room Components***

The in-room components of the EMS include a Zigbee motion sensor, a Zigbee door sensor, and a Zigbee thermostat. The door and motion sensors are battery powered using a CR-2 type lithium battery. The typical battery life is 2 years for each sensor.

### **Thermostat**

The Centralite thermostat is used to control the HVAC equipment in the guest rooms. Each thermostat uses 2 independent Zigbee radios. One radio is used for the local Room Area Network(RAN) within the room and the other radio is used to attach to the Hotel Area Network(HAN). The thermostat requires 24V AC from the HVAC equipment it controls.

### **Motion Sensor (PIR)**

The motion sensor uses a Passive Infrared (PIR) sensor to detect heat patterns in the room. Motion will be signaled to the thermostat if the heat pattern changes. The thermostat combines PIR motion sensor signals in a logic sequence with door switch signals to determine whether a room is occupied or unoccupied. The PIR is wireless and can be mounted in the best location. The motion sensor uses a CR-2 lithium battery.

### **Door Sensor**

The door sensor consists of a base(containing the Zigbee radio, magnetic sensor, and battery) and separate magnet. It is very important that the base and magnet line up correctly and be within ½” when the door is closed. The door sensor uses a CR-2 lithium battery.

### **Occupancy Logic**

The room thermostat receives signals from the door and motion sensor in the room. These sensors are specifically addressed to the thermostat in that room. Whenever the door opens and closes the exit delay timer is started. The thermostat is looking for any motion signals during this 15 minute(default) timer. If any motion signals are received, then the room is considered occupied. If no motion signals are received then the room is considered Unoccupied and goes into a setback mode.

If at any time during the Unoccupied mode the thermostat receives any motion signals, then the thermostat will immediately consider the room occupied and go back to normal mode.

If the door opens while in unoccupied mode the thermostat will go into normal mode and immediately begin conditioning the room.

In unoccupied mode, the thermostat does not turn itself off. It allows the room temperature to drift more around the guest's SETPOINT temperature. The goal is to allow room temperature to drift enough to save energy but not enough to make the guest uncomfortable upon their return. And when the room is Unrented the room temperature can be allowed to drift even more.

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## ***Network Infrastructure***

The door and motion sensors are associated with the thermostat through the Room Area Network(RAN). The room thermostats are associated with one Ethernet Coordinator(EC) which is connected to the EMS server through the hotel's Ethernet network.

## ***Energy Management System (EMS)***

The core of the EMS system is the EMS Server. The EMS Server receives room information through its connection to the Ethernet Coordinators(ECs). The EMS Server also sends information to the room devices. In addition, check-in and check-out signals are received from the hotel's reservation system. Access to the EMS server is made using the Centralite EMS client software which connects to the EMS Server Database.

The conditions that the system uses to maximize energy savings under either heating or cooling conditions for guest rooms are:

- Room Unrented, Room Unoccupied
- Room Unrented, Room Occupied by Housekeeping or Engineering, etc
- Room Rented, Room Occupied
- Room Rented, Room Occupied, guest manually sets thermostat temperature
- Room Rented, Room Unoccupied

Before a guest is checked-in and the room is not occupied, the thermostat SETPOINT temperature is set to the VACANT Cooling/Heating setting to maximize energy savings. The EMS will allow the room temperature by the DEEP SETBACK differential above or below the SETPOINT temperature before the HVAC system is activated.

If the room becomes occupied before a guest is checked-in such as when housekeeping or engineering is working in the room, the thermostat holds to the standard differential around the SETPOINT as long as the room is occupied. The EMS uses these settings as long as the room remains occupied. When the room is no longer occupied after 15 minutes, the thermostat SETPOINT temperature" is automatically set back to the Unrented Default SETPOINT.

When a guest is checked-in through the registration system the thermostat SETPOINT temperature is set to the "Occupied" Default Setpoint. The EMS will turn on the HVAC system to bring the room to the selected temperature before the guest arrives at the room. Once the SETPOINT temperature is achieved, the HVAC system is turned off and the temperature is allowed to drift (up or down) by the number of degrees in the Standard Differential setting before the HVAC system is again turned on.

If the thermostat setting is changed manually after a guest has checked-in the new temperature becomes the SETPOINT temperature and the room temperature is allowed to fluctuate by the number of degrees in the occupied Standard Differential setting. A manually set SETPOINT temperature is automatically kept within the range of the "SETPOINT Upper and Lower Limits" set in the Room Thermostat Settings. This setting remains in effect until the guest checks out.

When a guest leaves the room, after 15 minutes, the SETPOINT temperature is adjusted (up or down) the number of degrees in the Unoccupied Setback setting. Once the room achieves the new SETPOINT temperature the HVAC system is turned off. Afterwards the temperature is allowed to drift (up or down) by the number of degrees in the Standard Differential setting before the HVAC system is again turned on.

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When a guest is checked-out the room SETPOINT temperature is automatically reset to the Unrented Default SETPOINT setting and the temperature is allowed to change (up or down) by the Deep Setback Variance.

The Energy Control System will automatically ensure that the temperature in a room will not go outside of the Upper or Lower Limit Safety Range settings.

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<b>Default Thermostat Settings</b>		
<b>Room Conditions</b>	<b>System Pre Sets</b>	<b>Change Requirement</b>
<b>Guest checked-in /Room Occupied or Guest not checked-in/Room Occupied Settings</b>		
RENTED DEFAULT TEMP	72	
Standard Differential	+/- 2	
<b>Occupant Override Limits</b>		
Occupant Setting Upper Limit	80	
Occupant Setting Lower Limit	60	
<b>Guest checked-in / Room not Occupied for at least 15 minutes</b>		
SETBACK	+/- 3	
<b>Guest not checked-in/Room not occupied Settings – Vacant(Deep Setback)</b>		
UNRENTED DEFAULT TEMP	74	
DEEP SETBACK	+/- 6	
<b>Standard Thermostat Settings (reset upon guest check-in)</b>		
Status	ON	
Mode	AUTO	
Fan	AUTO	
Upper Limit Safety Range	80	
Lower Limit Safety Range	60	

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## EMS Client Installation

The EMS Client is installed locally on the windows PC you wish to view the system on. To download the latest version of the software go to: [www.centralite.com/emsmanager](http://www.centralite.com/emsmanager) then click in **Install**.

The EMS Client software requires Microsoft .NET 3.5 so the installer may have to load this first if it is not currently installed on your machine.

Once the software installation is complete just double click on the EMS shortcut on the Desktop.

You should see the following login screen:



Before you can login you must specify the Datasource information. Once you do this successfully it will be saved and you will not have to do this for that property unless their connection information changes. You can also set Datasource information for multiple properties.

Click on Set Datasource to get to the next screen:



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The screenshot shows a 'Data Connection' dialog box for an SQL Server. It is divided into three sections: 'Data Source', 'Initial Catalog', and 'User Credentials'. In the 'Data Source' section, the 'Server Name' is set to '10.245.26.11, 1961' in a dropdown menu, and the text box below it also contains '10.245.26.11, 1961'. The 'Initial Catalog' section has a text box containing 'EMS\_PRD'. The 'User Credentials' section has a 'User ID' text box with 'sa' and a 'Password' text box with '\*\*\*\*\*'. There is an unchecked checkbox for 'Use Integrated Security'. At the bottom are 'Cancel', 'Test', and 'OK' buttons.

The IT source at the property will provide you with the following Datasource information:

Server Name:

SQL Server Initial Catalog:

User ID: (This will not be the same as your login username to the EMS Client)

Password: (This will not be the same as your login password to the EMS Client)

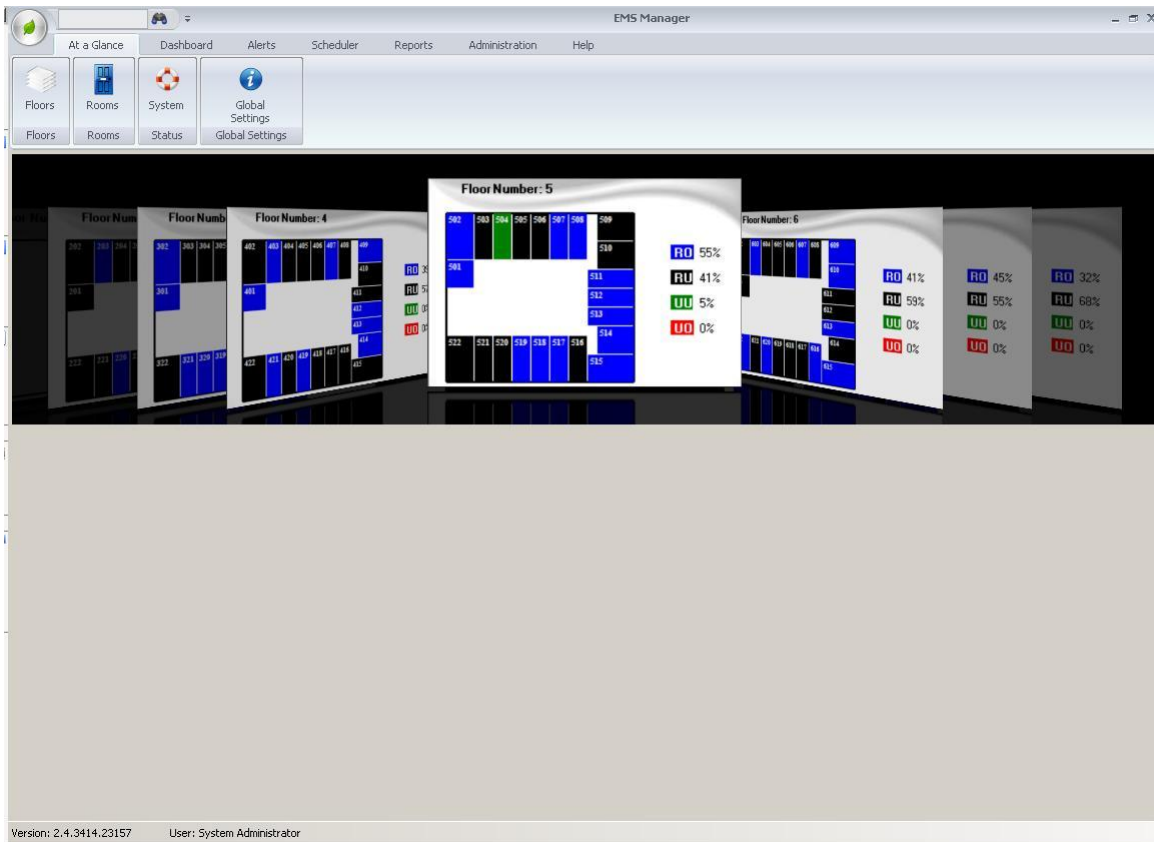
After entering the information press Test to make sure the connection is being made. If the connection fails double check the spelling and capitalization of the fields entered.

Click OK to go back to the EMS login screen.

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You can now enter your EMS username and password. If the username or password entered are not valid you will receive an Invalid Login message.

If the login is successful you will see the floor layout for the property.



This is the floor layout screen. You can view the layout for each floor and the color coded status for each room on the floor. The color codes mean:

**BLACK** – Room Unoccupied and Rented

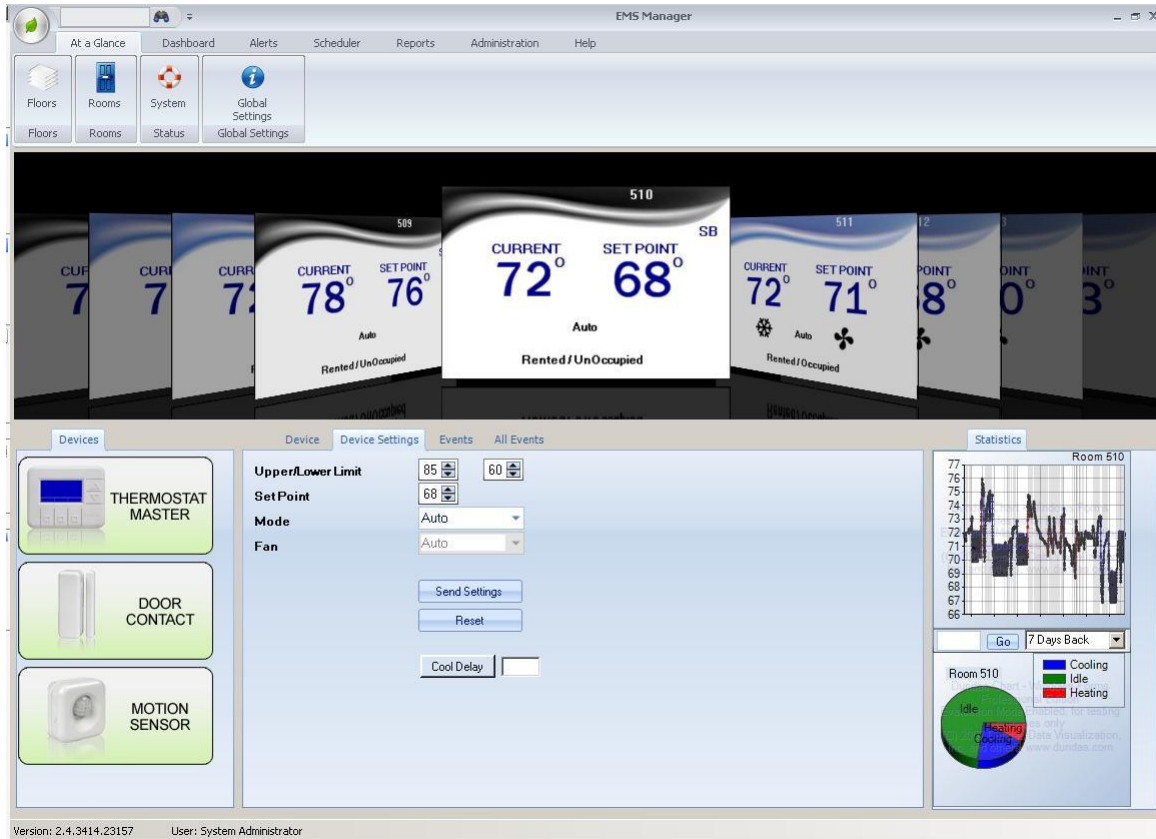
**BLUE** – Room Occupied and Rented

**GREEN** – Room Unoccupied and Unrented

**RED** – Room Occupied and Unrented

To view details of rooms on a floor just click on the floor while it is the center card.

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The rooms screen shows all rooms on the selected floor arrayed in the cover flow cards. Each card shows several key pieces of information:

Current Room Temperature

SETPOINT Temperature

Mode(AUTO/OFF)

Current Fan Activity(Fan Symbol means fan is running)

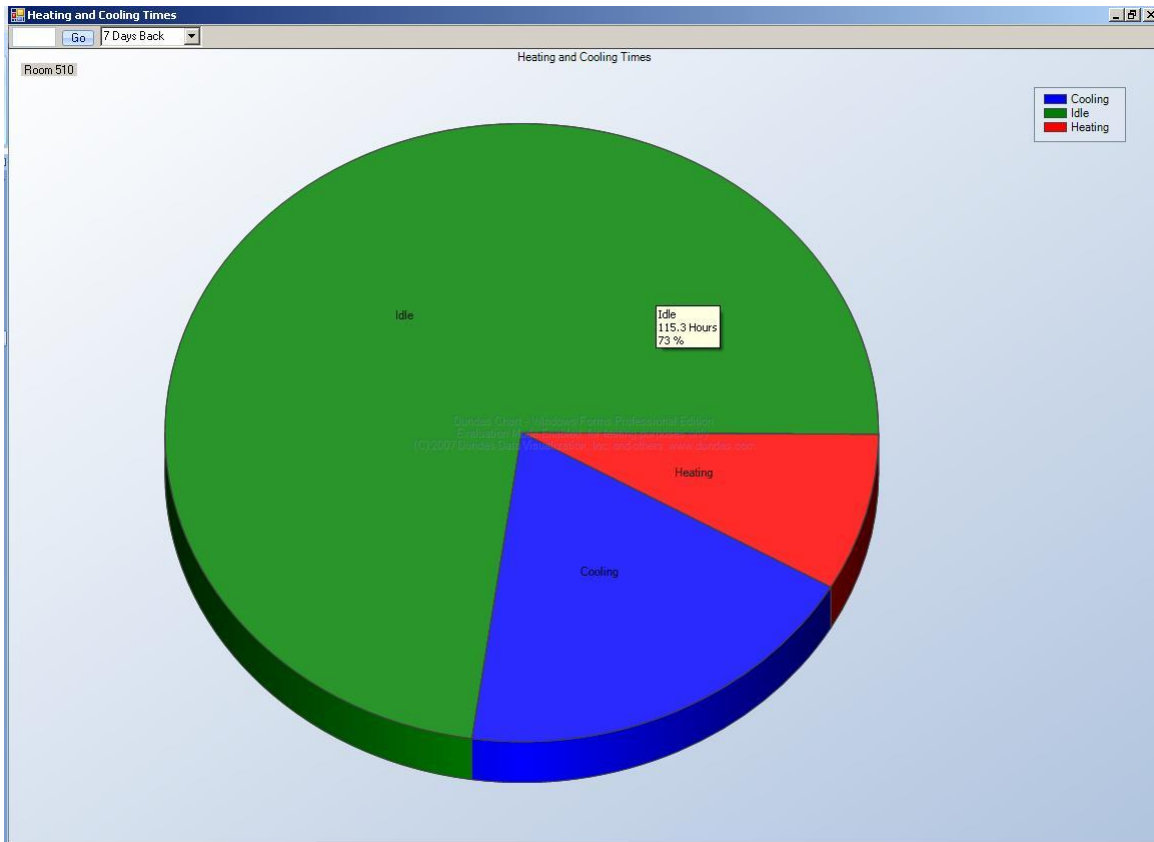
Current Compressor Activity(Snowflake means calling for cool, Flame means calling for heat)

Current Occupied/Rented Status(Color codes at top of card and text at bottom)

To see all details of a room just click on its card while it is the center card.

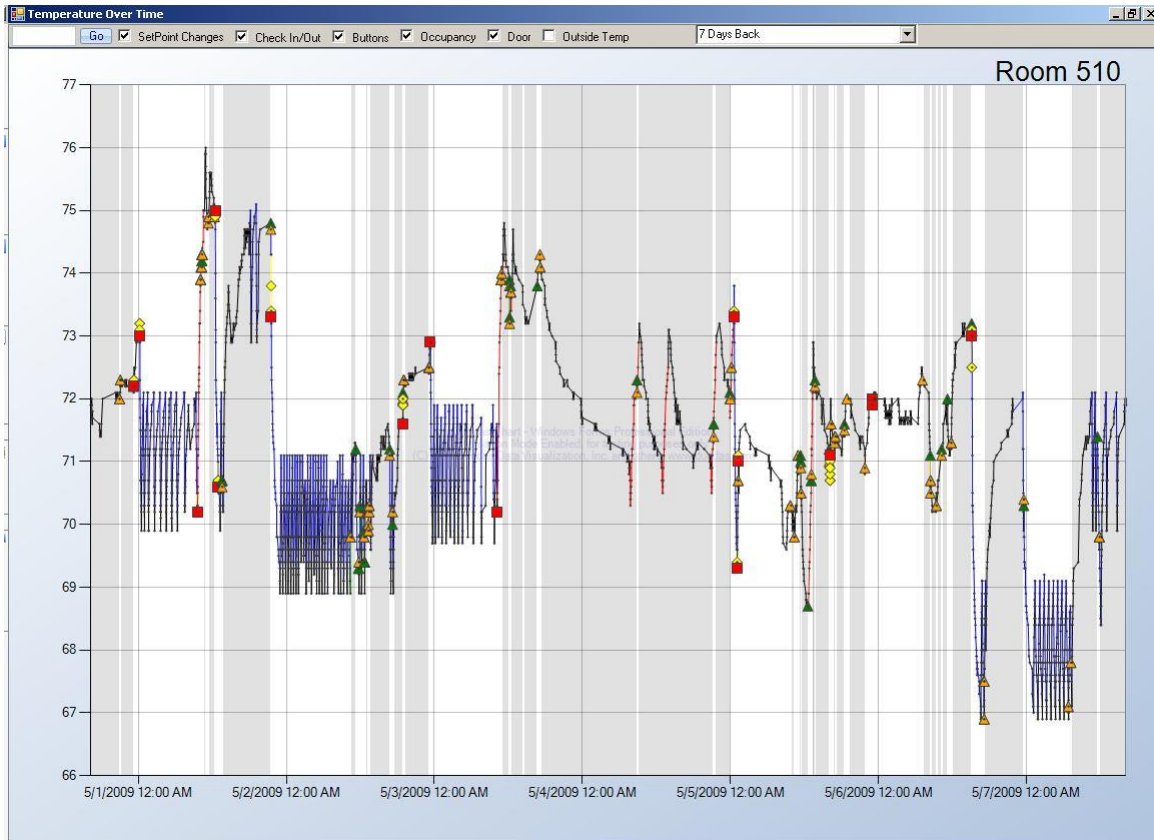
Details of the room will be populated at the bottom of the screen. The list of devices in the room appear in the window to left. Graphical information appears at right. Event and device setting information appear in the center.

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If you click on the Heating and Cooling Pie chart it will expand to fill the entire screen. This graph shows the percentage of Heating, Cooling, or Idle time for the selected thermostat for the time period that can be selected at the top of the screen.

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The Temperature Over Time chart shows a rich selection of data presented graphically. The data shown includes the following for the time period selected at the top of the screen.

Room Temperature – the line represents the room temperature over the time period

Current Heating/Cooling mode:

- Black Line – Idle
- Blue Line – Cooling
- Red Line – Heating

Door Open/Close Events:

- Yellow Triangle – Door Close
- Green Triangle – Door Open

SETPOINT Changes: Red Square

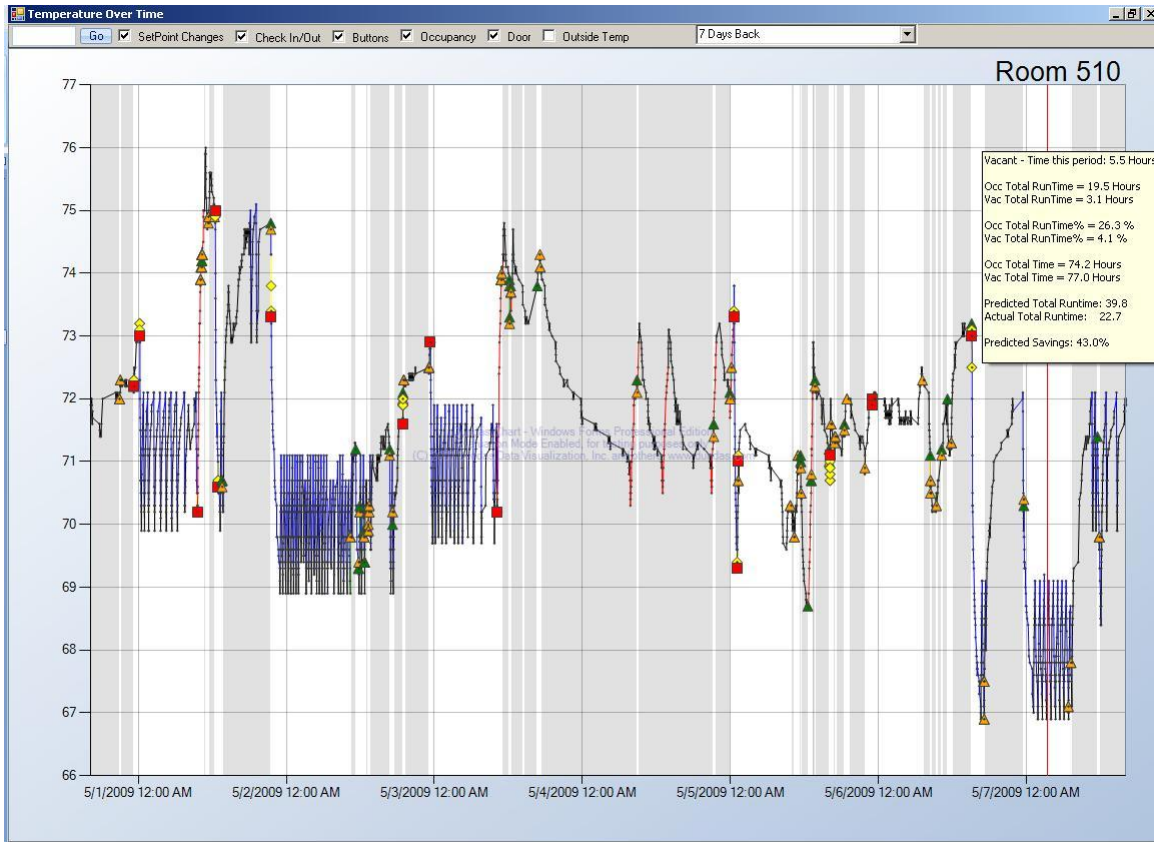
Occupied/Unoccupied/Deep Setback(Colored bands indicate mode):

- White – Occupied
- Grey – Unoccupied/Rented
- Green – Unoccupied Unrented(Deep Setback)

Outside Temperature – If outside temperature is selected these will show up as Green circles with new scale at the right.

Check boxes at the top of the screen allow different data to be made visible/invisible.

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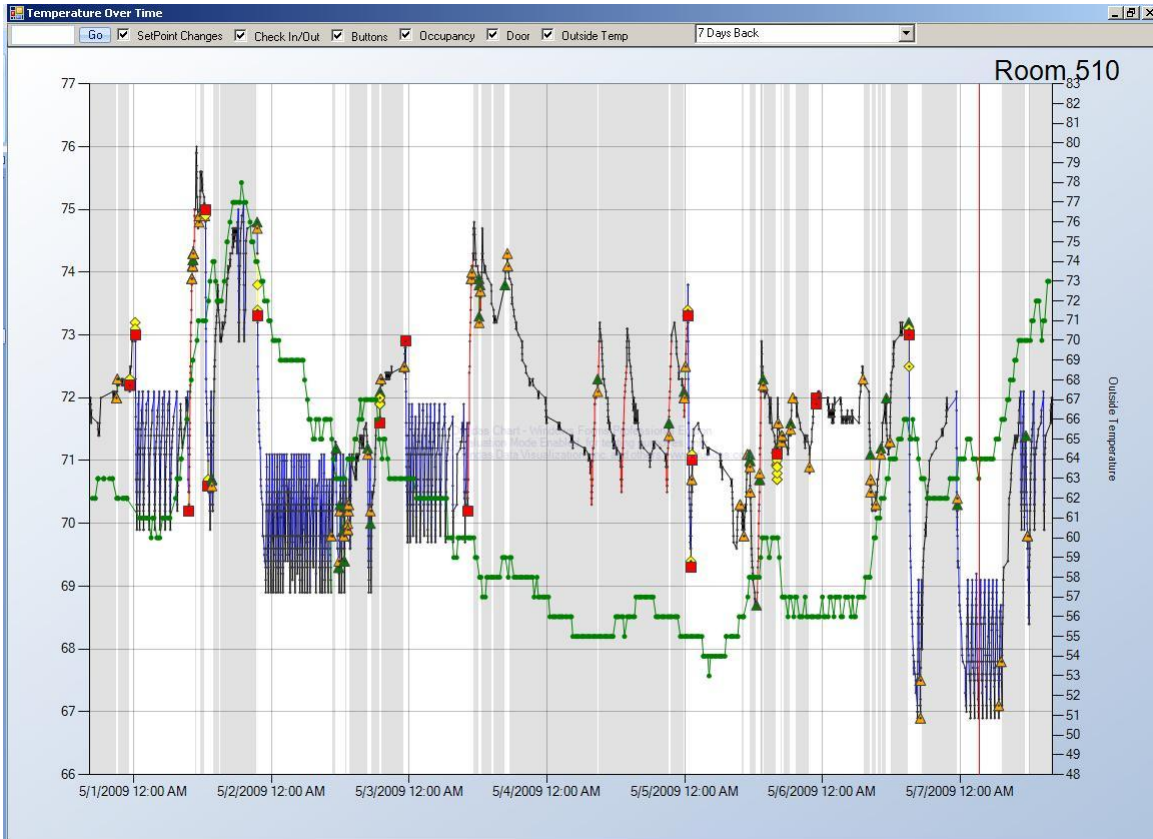


Extra data are available when hovering the mouse pointer over a piece of data.

When the mouse pointer is hovered over a band, it will show:

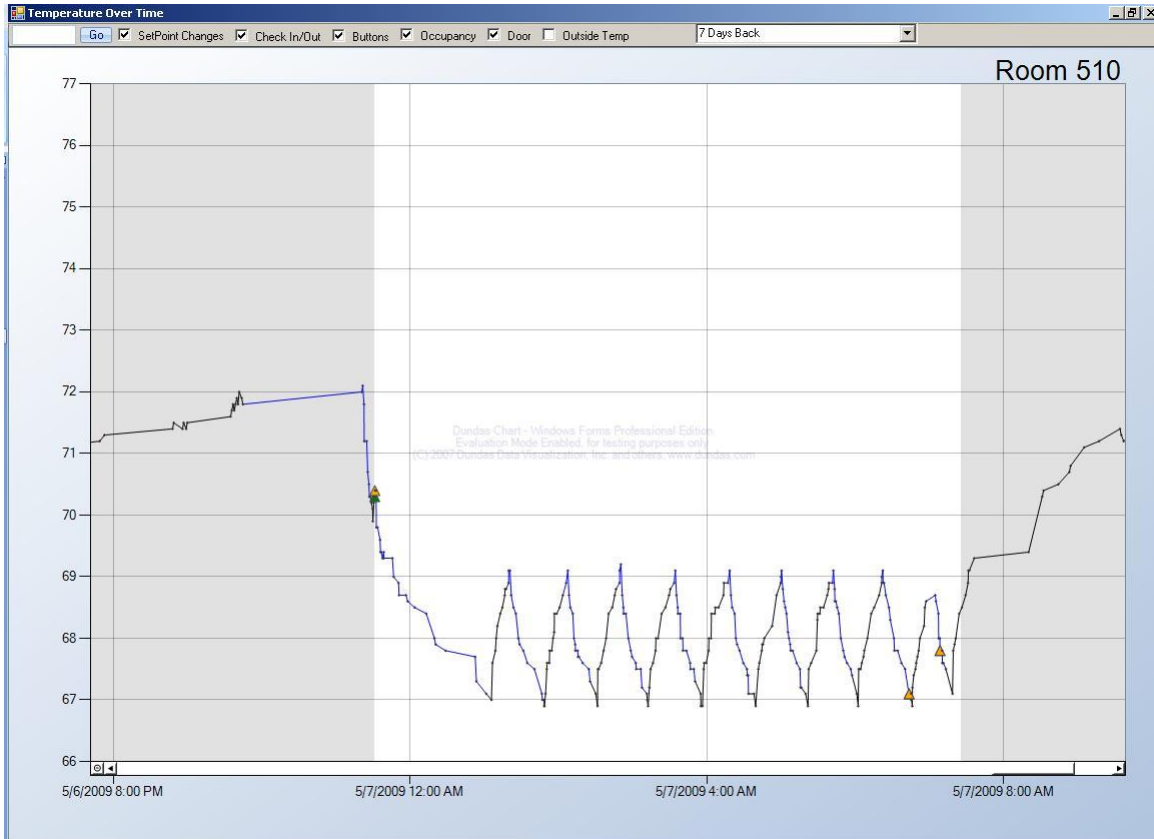
- Occupied/Vacant mode for that band
- Time period for the band
- Occupied total runtime for the graph time period up until the selected band
- Vacant total runtime for the graph time period up until the selected band
- Occupied runtime percentage up until the selected band
- Vacant runtime percentage up until the selected band
- Total time room has been occupied for the graph period up until the selected band
- Total time room has been vacant for the graph period up until the selected band
- Predicted total runtime
- Actual total runtime
- Predicted saving percentage for the graph period up until the selected band

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This shows the Temperature Over Time graph with all data visible.

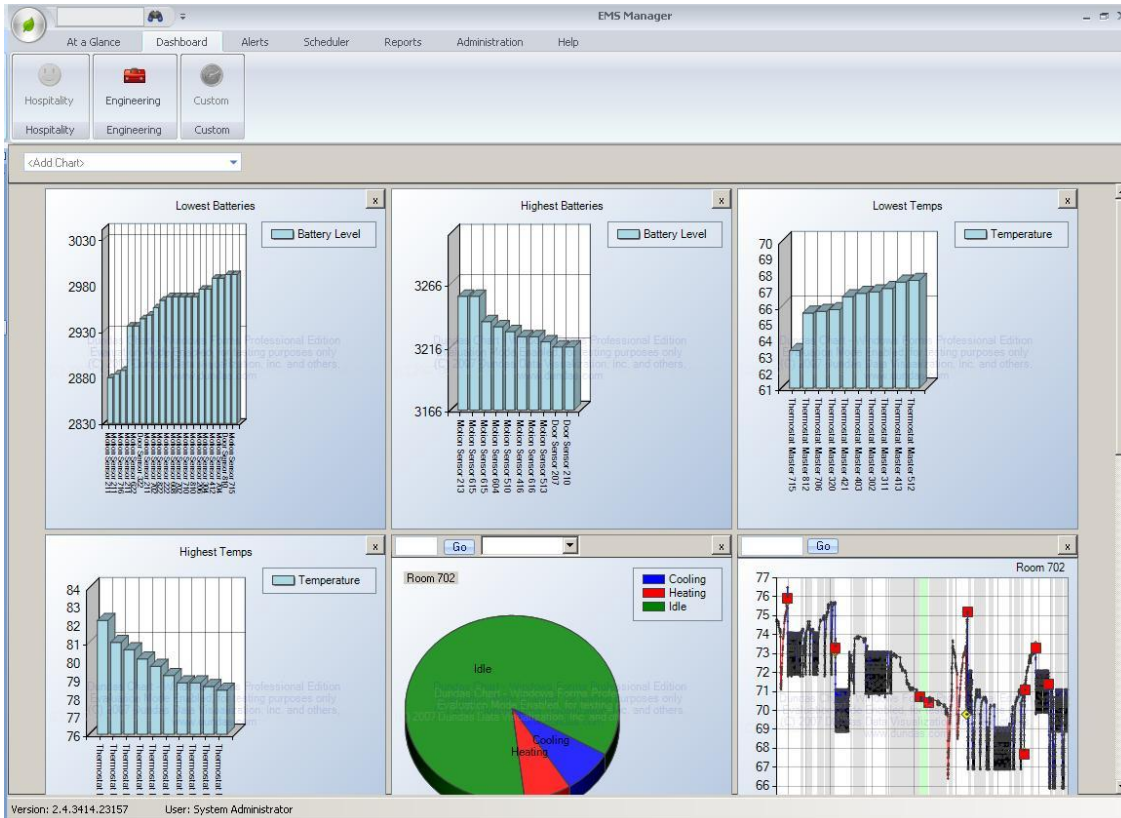
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The graph is capable of zooming in on data. Just hover the mouse pointer over the first part of the data to be zoomed and left click and drag over the desired zoom period. The graph will take a few seconds to load this zoomed view.



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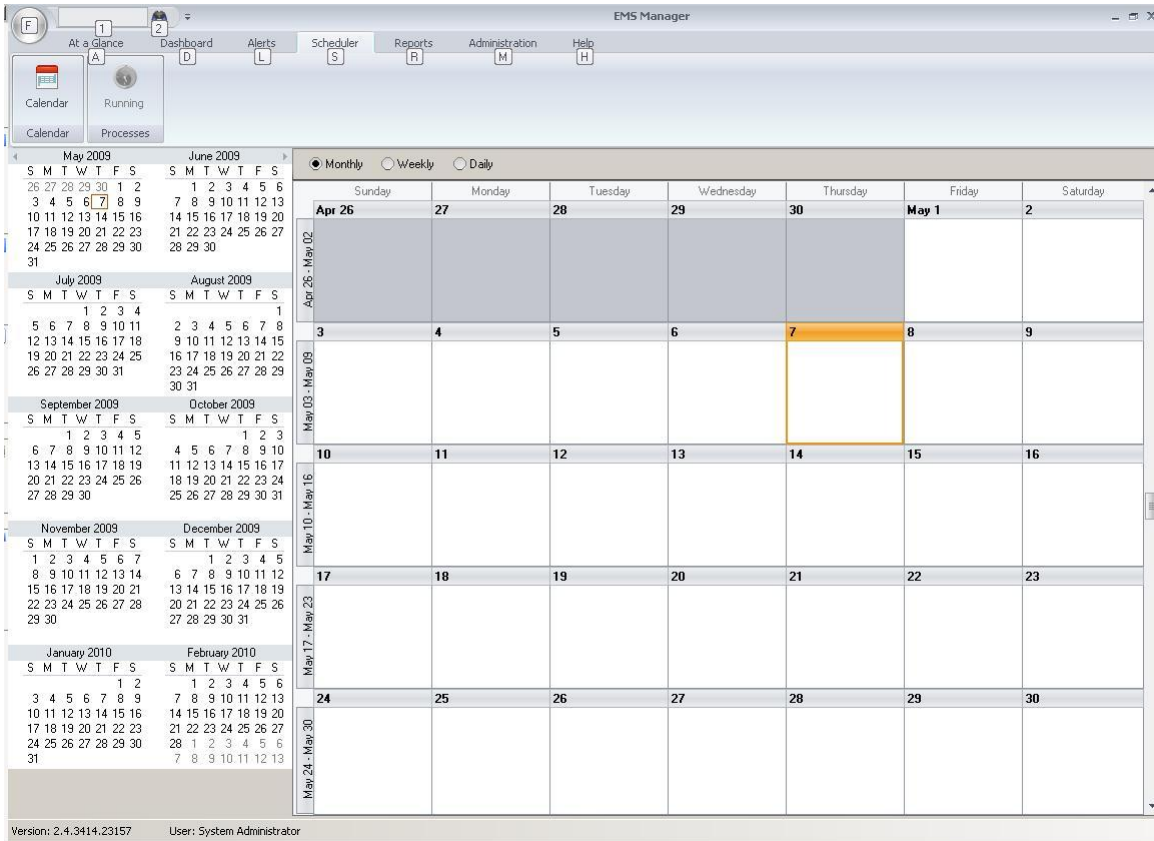


The dashboard presents several graphical reports for the entire property.

The following graphs are available:

- Highest Battery Levels
- Lowest Battery Levels
- Highest Room Temperatures
- Lowest Room Temperatures
- Individual Room Heating and Cooling Pie chart
- Individual Room Temperature Over Time chart
- Highest SETPOINTS
- Lowest SETPOINTS

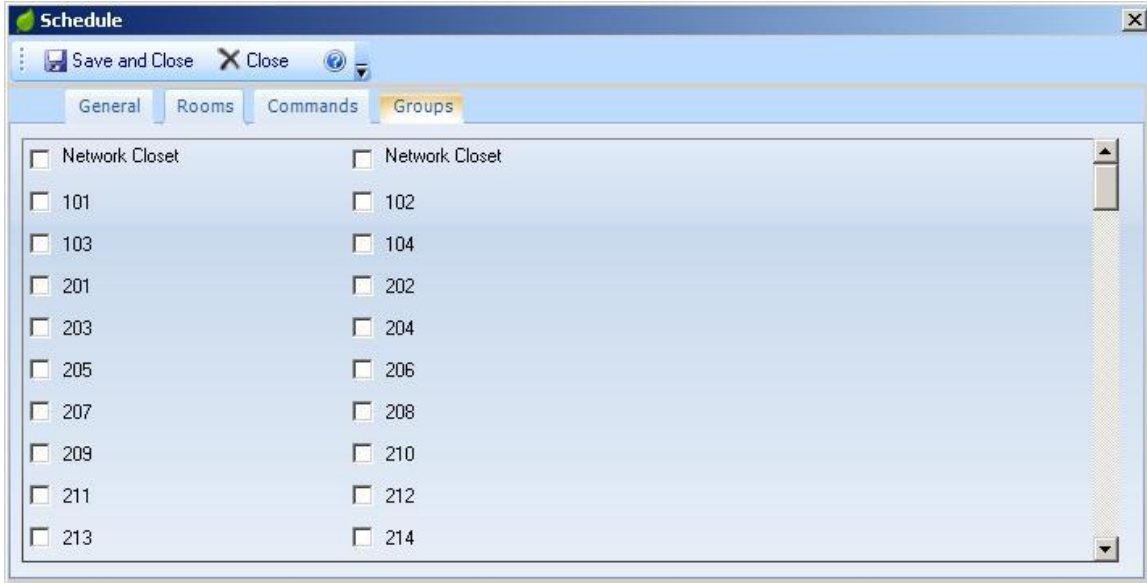
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The scheduler allows commands to be sent to one or more Thermostats at one scheduled time or at recurring times.

To add a new scheduled event just double click on the day for the event to occur.

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Rooms for which the event will occur can be selected individually or as a group.

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### Operation of the Thermostat

#### Buttons:

**AUTO/OFF** Toggles thermostat mode between AUTO mode and OFF:  
**AUTO** Thermostat controls the HVAC Unit automatically switching between Heating and Cooling.  
**OFF** Thermostat does not control the HVAC Unit.

#### FAN MODE(OPTIONAL)

**ON** The fan runs constantly.  
**AUTO** The thermostat will run the fan only when heating or cooling.

**C/F** Toggle between Fahrenheit and Celsius Temperature Display

#### Manually Change Thermostat SETPOINT Temperature

**+ (UP)** Press this button to raise the SETPOINT temperature.  
**- (Down)** Press this button to lower the SETPOINT temperature.

#### Notes:

1. The thermostat normally displays the current room (ambient) temperature.
2. Pressing the + (Up) or – (Down) buttons once will cause the SETPOINT temperature to be displayed along with the current ambient temperature. The backlight will also turn on. Pressing the Up or DOWN button again will change the SETPOINT temperature. While the SETPOINT temperature is displayed, pressing the Up or Down buttons will raise or lower the SETPOINT temperature.

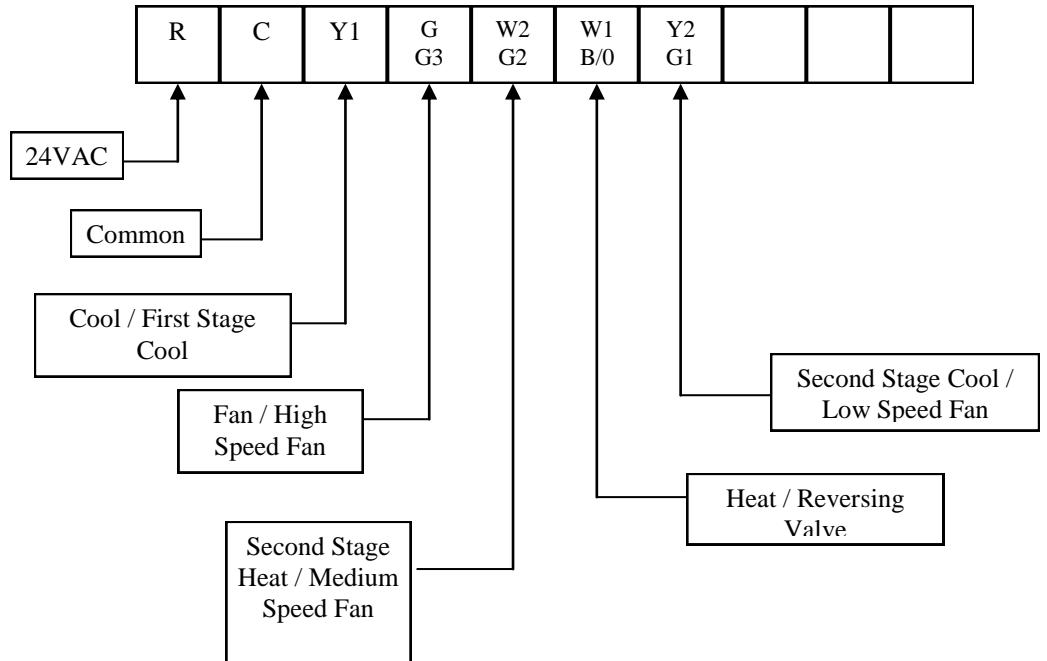
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## Replacement of the Thermostat:

Figure 4 shows the backplate for the Thermostat, with the terminals labeled:

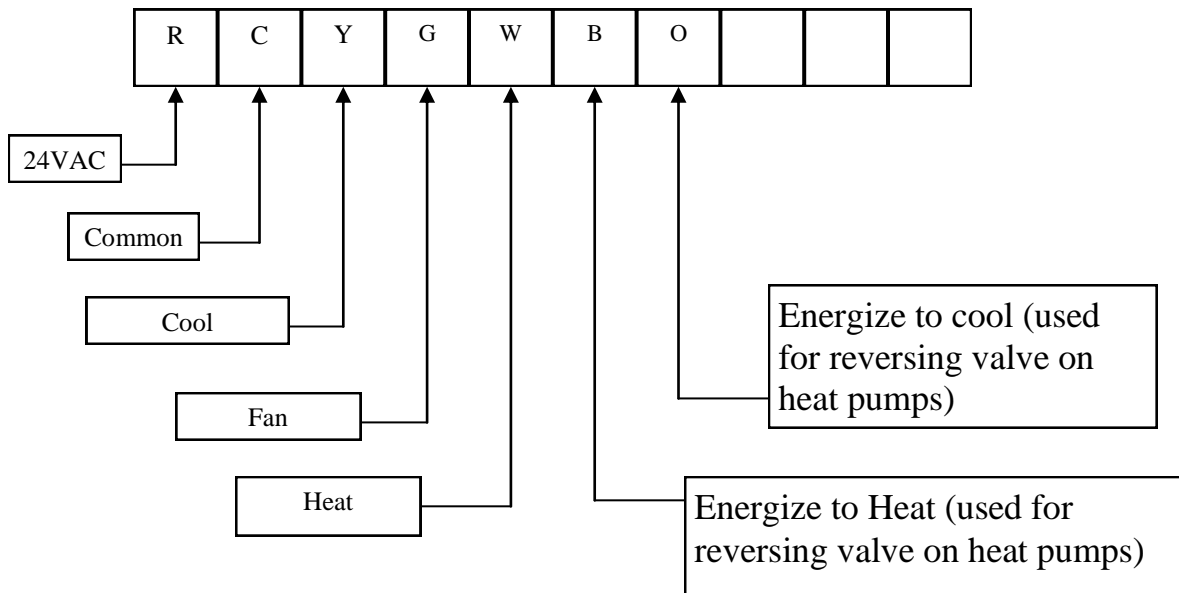
**Figure 4 - Thermostat Backplate and Terminal Labels**

Standard Universal Connection



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Standare 1 Cool, 1 Heat, 1 Fan Generic Heat Pump



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Make the connections as shown in Table 2 below:

Thermost Terminal	Function
R	24V AC Hot
C	24 V AC Common
Y1	First stage cooling
G G3	Fan (1-speed fan only) or Hi speed fan (2- or 3-speed fan)
W2 G2	Second stage heat or Medium Fan (3-speed fan only)
W1 B/O	First stage heat or Heat pump reversing valve
Y2 G1	Second stage cooling or Low speed fan (2- or 3-speed fan)



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### Thermostat Settings

All thermostats should be set as follows from the factory. Factory settings are used to establish a baseline for thermostat operations. These settings will be overridden by the EMS during automatic energy management processes. Newly replaced thermostats should be set to a SETPOINT temperature of 71 degrees F.

### Thermostat Default Settings:

Description	Setting
- Low SETPOINT Limit	60
- High SETPOINT Limit	80
- Setback Variance	3
- Deep Setback Variance	6

# **Online Energy Management Control System**

## ***Infrastructure Components***

### **Ethernet Coordinator**

Each Ethernet Coordinator can support up to 100 Thermostats. The number of Ethernet Coordinators is dependent on the layout and construction of property.

### **Ethernet Backbone**

The successful communication with Ethernet Coordinators is heavily dependent on the network they are attached to.

### **Server**

The EMS Server receives temperature, door events, motion events, and other data from the rooms. The data flows from the thermostats to the Ethernet Coordinators to the Ethernet backbone to the EMS Server. The EMS Server also sends commands back up to the thermostats.

## ***Software Components***

### **EMS Listener**

The EMS Listener is the communications software that runs on the EMS Server and writes data arriving from the rooms to the EMS Server Database.

### **PMS Interface**

The energy saving aspects of the EMS system are very dependent on utilizing information on when guests are checked in or out of the guest rooms. When the guest rooms are unrented larger setbacks are utilized to gain more energy savings. And as soon as a guest checks in, a command is sent from the EMS Server to the guestroom so that the HVAC unit begins conditioning the room before the guest arrives.

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## Service Information

### *Troubleshooting Guide*

#### **DO NOT MOVE THERMOSTATS – All thermostats are uniquely addressed**

##### ***Thermostat Problems***

The following trouble shooting techniques assume that the wiring between the HVAC and the Thermostat is correct and that the Thermostat has been controlling the HVAC properly in the past. If this is not the case, correct any wiring problems before presuming that the Thermostat is not working properly.

##### **Thermostat Display is Blank**

The display on the Thermostat is blank. Pressing buttons on the Thermostat does not cause the backlight to turn on or anything to display on the screen.

Remove the thermostat and either measure DC voltage between the R and C terminals(should read 24V) or replace with temporary Thermostat. If the new Thermostat powers up properly then the old one is defective and must be replaced. If the new Thermostat does not power up then either the HVAC unit is not supplying power or there is a wiring issue.

##### **Thermostat Doesn't Control Anything**

The Thermostat seems to provide no control of HVAC and temperature. Does the Thermostat screen respond to button presses? If not then check power to the Thermostat. Check to see if the Thermostat Mode is set to AUTO/COOL/HEAT and not OFF. If the display screen is showing a Snowflake or Flame symbol and the Fan symbol then it is calling for COOL/HEAT/FAN and the relays are closed. Check the wiring to the HVAC unit. You may wish to actually remove the compressor and fan wires and tie them directly to the 24V to see if they function.

##### **Thermostat Does Not Heat/Cool When You Move the SETPOINT Several Degrees**

If the thermostat is in AUTO mode it may be switching between Heat and Cool mode. By default the SETPOINT temperature will need to be 6 degrees. This feature is there to prevent the thermostat from constantly changing between Heat and Cool modes when the temperature is fluctuating up and down.

##### **Thermostat is Consistently Reading Temperature Too Low or Too High**

The thermostat has a field calibration setting. The default value is zero. Ex: If the stat is reading 3 degrees too low, then change the calibration setting to 3. If the stat is reading 4 degrees too high, then change the calibration setting to -4.

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## Preferred Procedure for Replacing Thermostat

BE SURE THE THERMOSTAT IS ACTUALLY AT FAULT. VERIFY THAT THERE IS 24VOLT POWER BETWEEN THE R AND C CONNECTIONS.

REMOVE FAULTY THERMOSTAT FROM THE BACKPLATE.

CAREFULLY REMOVE EACH ZIGBEE RADIO WHILE NOTING THEIR POSITION.

INSERT THE RADIOS INTO THE REPLACEMENT THERMOSTAT AGAIN NOTING THEIR POSITION AND MAKING SURE THEY ARE ORIENTED CORRECTLY AND ALL PINS MAKE CONTACT.

REINSERT THE THERMOSTAT INTO THE BACKPLATE.

THE REPLACEMENT THERMOSTAT SHOULD NOW SHOW UP IN THE EMS SOFTWARE AS THE OLD THERMOSTAT. TEST THE COMMUNICATIONS BY OPENING AND CLOSING THE DOOR SEVERAL TIMES AND MAKING SURE YOU ARE IN FRONT OF THE MOTION SENSOR FOR A FEW MINUTES.

CHECK IN THE EMS SOFTWARE EVENTS THAT THESE EVENTS ARE BEING RECORDED.

## Procedure to Form Room Network and Join Thermostat to an EC

If you are replacing an existing thermostat without using the Zigbee radios from the previous thermostat, you must default the door and motion sensors first using the procedure on the following page.

Enter the thermostat configuration mode by holding all 3 bottom buttons simultaneously and tapping the UP button.

You should see this screen:

1. Stat Config
2. Network Config
3. Diag/Test

Select 2.

Now you should see this screen:

1. Enter Room Number
2. Active Scan
3. Status
4. Permit Joining
5. No Joining
6. Leave Network

HAN/RAN

The center button is used to toggle between the Hotel Area Network(HAN) and the Room Area Network(RAN).

Make sure RAN is visible and Select 1.

Now enter the appropriate room number and press SELECT. Be sure to include preceding zeros.  
Ex.: 002021

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The thermostat RAN will now be open for joining. This allows us to join the door and motion sensor(s) to the thermostat.

Door sensors: remove the door sensor from the base. Be sure to default the sensor according to the procedure on the next page. Then press the button three times. The LED on the door sensor should begin to blink slowly. If it is successfully joined to the thermostat, then a message will appear on the stat that says "Device Joined". If it does not, then try the procedure again.

Motion sensors: remove the cover from the sensor. Be sure to default the sensor according to the procedure on the next page. Then press the button three times. The LED on the motion sensor should begin to blink slowly. If it is successfully joined to the thermostat, then a message will appear on the stat that says "Device Joined". If it does not, then try the procedure again. When finished, replace the cover for the motion sensor.

### **Procedure for Defaulting Door and Motion Sensors**

Remove the battery from the sensor.

While holding the button down firmly, reinsert the battery.

The LED will blink rapidly. When the LED stops blinking, release the button.

The sensor should now be factory defaulted and ready to be joined to a thermostat.

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### Glossary

#### SETPOINT

The temperature at which a room thermostat has been set. This is done either automatically by the EMS or manually by a guest.

#### Global Settings

Parameters established by a hotel to guide the automatic functions of the EMS.

#### Setback

A global setting for the number of degrees that the thermostat will be allowed to drift either up or down from the SETPOINT temperature while the room is Unoccupied and Rented.

#### Deep Setback

A global setting for the number of degrees that the thermostat will be allowed to drift either up or down from the SETPOINT temperature while the room is Unoccupied and Unrented.

#### Variance

A global setting for the number of degrees that the EMS will allow an occupied or unoccupied room temperature to change (up or down) from the SETPOINT temperature before the HVAC system is turned on.

#### Fluctuation

The number of degrees a room temperature is allowed to change before the EMS activates the HVAC.

#### Conditioning

The term used to describe the mode of the EMS when a guest is checked-in. At that time the EMS system immediately goes into "conditioning" mode and changes the room thermostat setting to the "occupied" SETPOINT temperature. The purpose is to ensure that the temperature is suitable for the guest by the time the room is occupied.

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Thermostat Notes:

FCC Caution:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.