INNOVATIVE SOLUTIONS

Portable Classroom HVAC Solution

Created by
Viconics Electronics, Inc.

June 2009

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Portable Classroom HVAC Solution

Problem

Portable Classrooms are outbuildings and not connected to the local area BMS system networks rendering time of day schedule useless leaving the HVAC running often 24 hours a day using costly energy and causing premature wear to the HVAC equipment.

Solution

Wireless communicating networks using reliable Zigbee (802.15.4) technology present an opportunity for government and school systems to connect these devices to an existing BACnet BMS system without running any new communication wiring. This allows for time and event scheduling in addition to equipment monitoring reducing energy and service costs dramatically.

This document presents the HVAC controls solution for such systems based on wireless communicating thermostats integrated into an existing BACnet network through a wireless gateway.

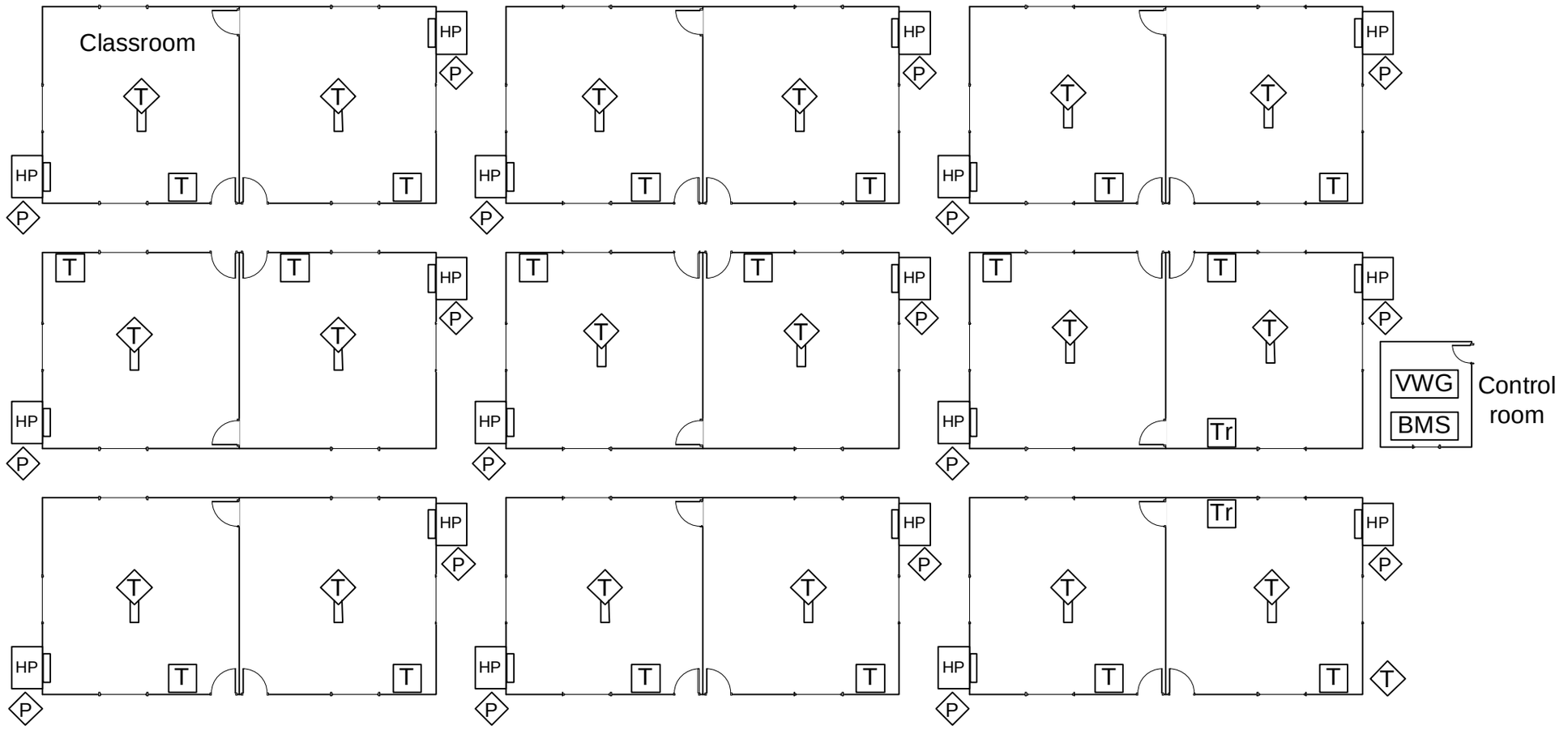
Notes

“Viconics wireless solution for portable classroom offers the comfort, reliability and redundancy of typical stand-alone thermostat operation.

Temporary loss of wireless connectivity will not degrade system operation or cause classroom to be uncomfortable.

However, wireless connectivity can be affected in some cases by portable classroom construction and the number of windows, their types and location.

Your authorized Viconics representative will be glad to assist with the review of the application, system architecture as well as a field survey using Viconics wireless field survey tool.”



Legend:

T	Thermostat	HP	Heat Pump	BMS	BACnet building management system
Tr	Thermostat acting as repeater	VWG	Viconics Wireless Gateway		Supply Temperature Sensor

T	Outdoor Temperature Sensor
P	Differential Pressure Sensor

Notes

1. Walls structure must respect the restrictions and considerations. Please refer to the VWG setup and installation manuals

Viconics Electronics Inc.

VICONICS Beyond Comfort

By Jimmy El-hajj

Drawing number D1

Drawing title

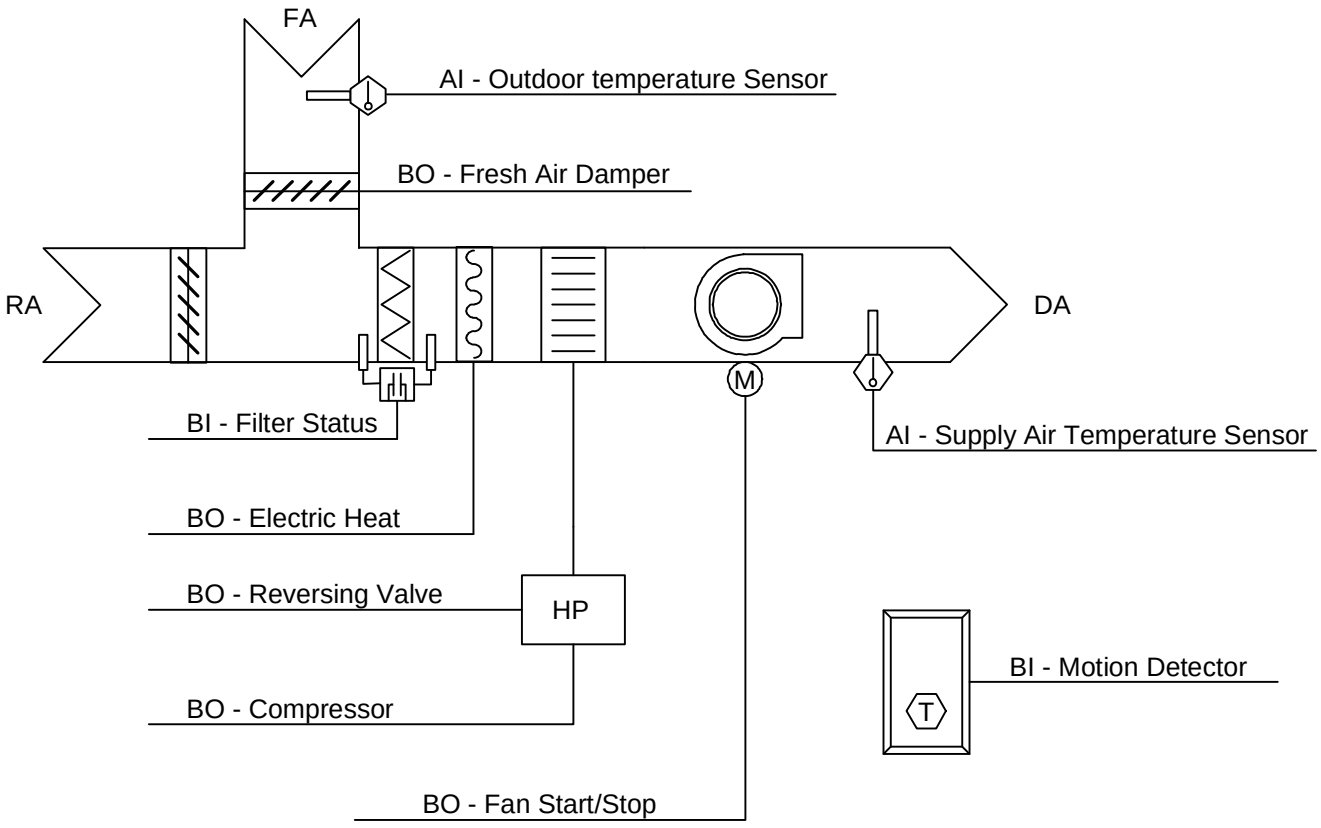
HVAC Controls Drawing

Network Site layout

Equipment Location

Date June 2009

Control Schematic



Controller Physical Inputs And Outputs

Inputs	
Binary Inputs	Motion Detector
	Filter Status
Analog Inputs	Supply Air Temperature Sensor
	Outdoor temperature Sensor

Outputs	
Binary Outputs	Compressor
	Reversing Valve
	Fan
	Electric Heat
	Fresh Air Damper

Sequence Of Operation

Occupied Mode

Thermostat shall use the Occupied setpoints. If the classroom temperature rises above 72°F (cooling setpoint), the thermostat shall activate the heat pump in cooling mode. If the classroom temperature drops below 70°F (heating setpoint), the thermostat shall activate the heat pump in heating mode. If the heat pump is not able to satisfy the heating demand, the thermostat shall activate the auxiliary heat. The thermostat shall de-activate the heat pump when the classroom temperature is back into the deadband (between 70°F and 72°F)

Unoccupied Mode

Thermostat shall use the Unoccupied setpoints. If the classroom temperature rises above 78°F (cooling setpoint), the thermostat shall activate the heat pump in cooling mode. If the classroom temperature drops below 64°F (heating setpoint), the thermostat shall activate the heat pump in heating mode. If the heat pump is not able to satisfy the heating demand, the thermostat shall activate the auxiliary heat. The thermostat shall de-activate the heat pump when the classroom temperature is back into the deadband (between 64°F and 78°F)

Fan Mode

Thermostat shall turn the fan on continuously during Occupied periods. During unoccupied periods, the thermostat shall turn the fan on only if there’s a heating or cooling demand.

Occupancy

Thermostat shall go to Unoccupied mode during unoccupied periods. The occupancy shall be determined either with a 7-day schedule (done through the front-end system) or by using the integrated motion detector, or both.

Motion Detector Function (if used)

After the last motion detected by the thermostat, If no motion is detected for the « Unocc Time » period (Unoccupied time parameter is adjustable between 0.5 and 24 hours), the thermostat goes to Unoccupied and stays in Unoccupied mode until the next motion detected.

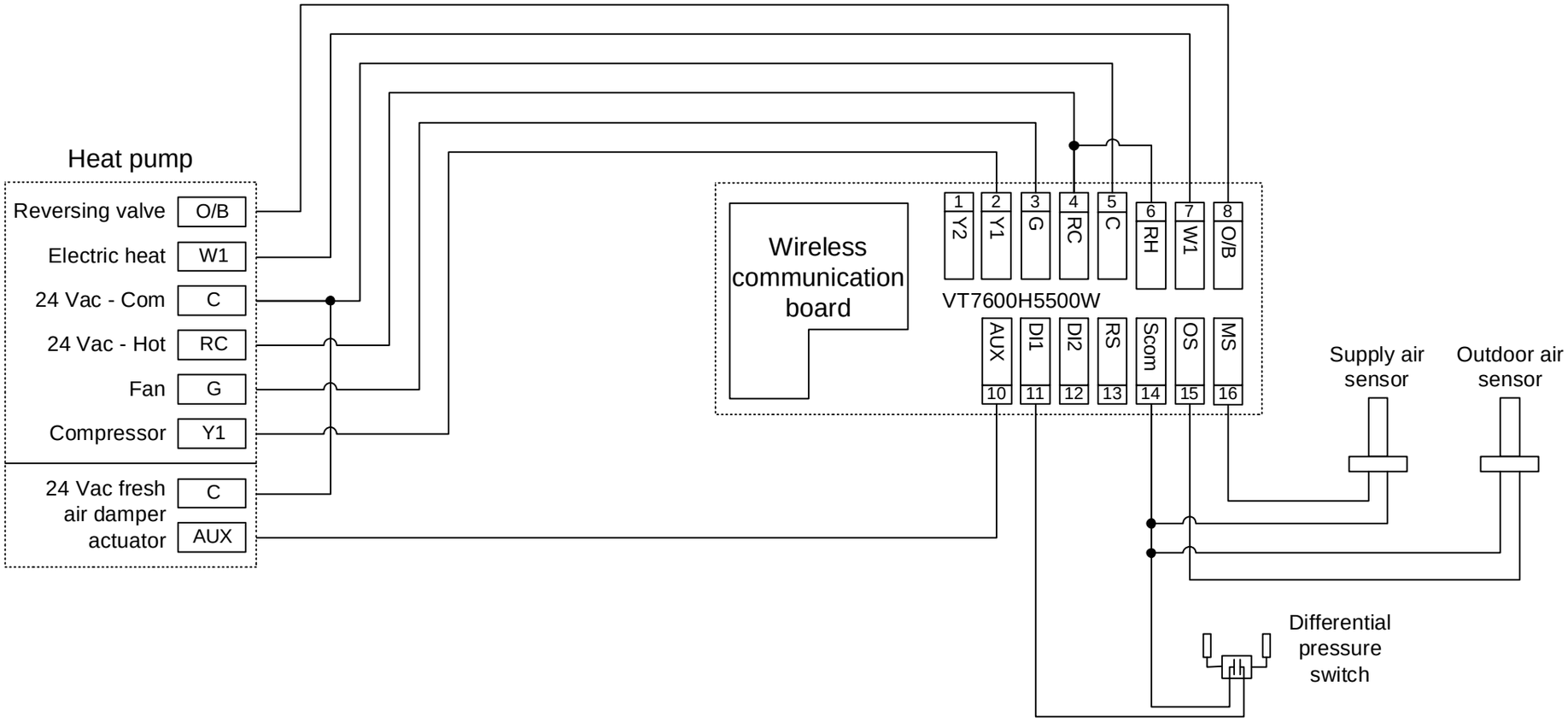
Indoor Air Quality

Thermostat shall keep the fresh air damper at a minimum opening position during Occupied periods. During Unoccupied periods, the fresh air damper is completely closed by the thermostat.
A filter alarm shall be displayed on the thermostat and at the front end when the filter should be cleaned.

Bill Of Materials

Model Number	By	Description	Quantity
VWG-40-IP-1000 or VWG-40-MSTP-1000	**Viconics**	**Wireless gateway / Handles up to 30 thermostats BACnet IP or MS/TP**	**1**
VT7600H5500W	**Viconics**	**Heat pump thermostat / Wireless communication / Integrated motion detector**	**20**
S2020E1000	**Viconics**	**Outdoor temperature sensor (10Kohms type 2 thermistor)**	**1**
S2000D1000*	**Viconics**	**Duct mount temperature sensor (10Kohms type 2 thermistor)**	**18**
Differencial pressure switch*	**Others**	**Differential pressure switch (contact closure)**	**18**

*** Optional**



Notes

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By Jimmy El-hajj	*Drawing number* D2
Drawing title HVAC Controls Drawing Equipment Wiring Diagram	
	Date June 2009

Configuration Parameters Available On The Local Thermostat

To enter the user menu press the Menu button
To enter the Configuration menu, press and hold the Menu button for 8 seconds

User Parameter Name	**Local settings**
Occupied Cooling and Heating setpoints	Heating setpoint: 70°F - Cooling setpoint: 72°F
Unoccupied Cooling and Heating setpoints	Heating setpoint: 64°F - Cooling setpoint: 78°F
System Mode	Auto
Temperature scale	As per user: °F or °C
Fan Mode	Smart
Configuration Parameter Name	**Local settings**
Com Addr	Between 1 and 127 – Should be unique on the network
PAN ID	Between 0 and 500
Channel	Between 10 and 26
DI1	**Filter**
DI2	**None**
Lockout	**0** is factory set, range is: 0, 1 or 2 (0 is full access)
pwr del	**10 seconds** is factory set, range is: 10 to 120 seconds
Frost pr	**ON**
Heat max	**90 °F (32 °C)** is factory set, range is: 40 to 90 °F (4.5 to 32.0 °C)
Cool min	**54 °F (12 °C)** is factory set, range is: 54 to 100 °F (12.0 to 37.5 °C)
Pband	**2.0 °F (0.6 °C)** is factory set, range is: 2 to 8 °F (0.6 to 3.9 °C)
anticycle	**2 minutes** is factory set range is: 0,1,2,3,4 & 5 minutes
Heat cph	**4 C.P.H** is factory set, range is: 3, 4, 5, 6,7 & 8 C.P.H.
Cool cph	**4 C.P.H.** is factory set, range is: 3 or 4 C.P.H.
deadband	**2.0 °F (1.1 °C)** is factory set, range is: 2, 3 or 4 °F (1.0 to 2.0 °C)
fan cont	**ON**
Fan del	**OFF**
ToccTime	**3 hours** is factory default, range is: 0 to 12 in one hour increments
cal RS	**0.0 °F or °C**
cal OS	**0.0 °F or °C**
H stage	**2 stages**
HP stage	**2 stages**
H lock	**120 °F (49 °C)** is factory default, range is: **-15 °F up to 120 °F (-26 °C up to 49 °C)**
C lock	**-40 °F (-40 °C)** is factory default, range is: **From -40 °F up to 95 °F (-40 °C up to 35 °C)**
Unocc Time	**0.5 to 24 hours**
2/4event	**2 events** is factory default, can also be set to 4 event
Aux cont	**N.O. normally open**
Prog rec	**ON**
high bp	**90 °F (32.0 °C)** is default value, range is:**34 to 90 °F (1.0 to 32.0 °C)**
low bp	**-12 °F (-24.0 °C)** is default value, range is:**-40 to 30 °F (-40.0 to –1.0 °C)**
comf/eco	**Comfort mode or Economy mode**
re valve	**O** when reversing valve energized in cooling **or B** when energized in heating

Virtual Control And Status Objects

Object Name	Object Type	Object Property
Local Temperature Status		
RoomTemp	Analog Value (AV)	Present Value (R/W)
OutdoorTemp	Analog Value (AV)	Present Value (R/W)
SupplyTemp	Analog Value (AV)	Present Value (R/W)
Setpoints		
OccCoolSetpoint	Analog Value (AV)	Present Value (R/W)
OccHeatSetpoint	Analog Value (AV)	Present Value (R/W)
UnoccCoolSetpoint	Analog Value (AV)	Present Value (R/W)
UnoccHeatSetpoint	Analog Value (AV)	Present Value (R/W)
Main Commands		
OccupancyCommand	Multi-State Value (MV)	Present Value (R/W)
SystemModeHPU	Multi-State Value (MV)	Present Value (R/W)
FanMode	Multi-State Value (MV)	Present Value (R/W)
KeypadLockout	Multi-State Value (MV)	Present Value (R/W)
Main Status		
PIHeatingDemand	Analog Value (AV)	Present Value (R)
PICoolingDemand	Analog Value (AV)	Present Value (R)
EffectiveOccupancy	Multi-State Value (MV)	Present Value (R)
Alarms	Multi-State Value (MV)	Present Value (R)
HeartbeatDelay	Analog Value (AV)	Present Value (R)
Output Status		
GFanStatus	Binary Value (BV)	Present Value (R)
W2Stratus	Binary Value (BV)	Present Value (R)
W1Status	Binary Value (BV)	Present Value (R)
Y1Status	Binary Value (BV)	Present Value (R)
Y2Status	Binary Value (BV)	Present Value (R)
ReversingValveStatus	Binary Value (BV)	Present Value (R)
AuxStatus	Binary Value (BV)	Present Value (R)
DI1Status	Binary Value (BV)	Present Value (R)
DI2Status	Binary Value (BV)	Present Value (R)

Quick Start-up Guide

1. Install and wire the thermostats following drawing D2 - Wiring Diagram

2. Set the configuration parameters at the local thermostat following the configuration parameters table. Com Addresses have to be unique on the network. All the thermostats connecting to the same wireless gateway must have the same PAN ID and Channel.

3. Install the Wireless Gateway Configuration Tool on your PC. Attach one end of a standard category-5 Ethernet unshielded twisted pair (UTP) patch cable to the RJ-45 Ethernet connector on the VWG (LAN1). Attach the other end of the patch cable to a network port or directly to an Ethernet hub. Power up the VWG.

4. For this initial connection to a factory-shipped VWG, configure your PC to use an IP address in the same subnet as the VWG, as well as a matching subnet mask. Set the IP address in the range: 192.168.1.1 to 192.168.1.254 with a subnet mask of: 255.255.255.0
Note: Do not assign your PC the identical IP address as the VWG factory-assigned IP address. The VWG IP address is 192.168.1.12x , x being the last digit of the VWG serial number written under the cover.

5. Open the Wireless Gateway Configuration Tool and wait for the end of the Auto-Discovery process. Double click the found VWG and login using « admin » as the user name with a blank password.
Note: If not auto-discovered, proceed manually to the login by manually entering the IP address of the VWG.

6. On the Gateway Settings page, set the PAN ID and Channel of the VWG and click Save Zigbee Settings. These should be identical to the thermostats PAN ID and Channel.

7. On the Database Tools page, discover the thermostats and add them to the database by selecting the thermostats and clicking the Add/remove selected thermostats button. The status of the « Added to network » column should become True. The thermostats are now added to the VWG database.

8. To configure the VWG BACnet settings, go to the BACnet network page and do the following:
a- Set the BACnet Object ID to any number other than -1.
b- Set the network number of the wireless network, between 1 and 65534.
c- If using a BACnet IP gateway, leave the other parameters to default and jump to step 9. If using an MS/TP gateway, continue to « d ».
d- Set the MS/TP address and the Baud Rate of the VWG. Leave the other parameters to default.

9. The wireless network is now ready to be integrated to the BACnet network.

References And Support Documents

The following documents are available on the Viconics website www.viconics.com and are needed during the installation or maintenance of the Viconics parts.

VT7600H5500W:

VT7600 series technical manual

Click here to visit the VT7600 series webpage
Click here to open the VT7600 series technical manual

VWG Wireless gateway:

Installation Guide
Design Consideration and Setup Guide
BACnet Integration Manual

Click here to visit the VWG webpage

S2020W1000 and S2000D1000 sensors:

S1000-2000-3000 series technical manual

Click here to open the S1000-2000-3000 series technical manual