

TEC Series Wireless Thermostat Controller for FX Supervisory Controllers with a Wireless TEC Option Card Technical Bulletin

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Document Introduction

This document describes how to commission and configure a TEC Wireless Thermostat Controller System on an FX Supervisory Controller (FX20, FX22, FX40, FX60, FX62, and FX70) network with a Wireless TEC option card. This includes how to:

- configure TEC Wireless Thermostat Controller addresses, which is explained in greater detail in the appropriate installation instructions
- map TEC Wireless Thermostat Controller objects into FX Supervisory Controller stations
- troubleshoot a TEC Wireless Thermostat Controller System application

This document does not describe how to install or program TEC Wireless Thermostat Controllers or how to install the FX Supervisory Controller with the Wireless TEC option card.

Related Documentation

See Table 1 to locate information in related documentation.

Table 1: TEC Wireless Thermostat Controller System Related Documentation (Part 1 of 2)

For Information On	See Document	LIT or Part Number
Applications, Features, Benefits, and an Overview of the TEC Wireless Thermostat Controller System	<i>TEC Wireless Thermostat Control System for Staged Equipment Product Bulletin</i>	LIT- 12011400
	<i>TEC Wireless Thermostat Control System for Fan Coil and Zoning Equipment Product Bulletin</i>	LIT- 12011401

Table 1: TEC Wireless Thermostat Controller System Related Documentation (Part 2 of 2)

For Information On	See Document	LIT or Part Number
Mounting, Wiring, and Programming TEC Wireless Thermostat Controllers	<i>TEC2001-3 Single-Stage Wireless Thermostat Controller Installation Instructions</i>	<i>Part No. 24-9890-714</i>
	<i>TEC2002-3 Heat Pump Wireless Thermostat Controller Installation Instructions</i>	<i>Part No. 24-9890-722</i>
	<i>TEC2003-3 Multi-Stage Wireless Network Thermostat Controller Installation Instructions</i>	<i>Part No. 24-9890-730</i>
	<i>TEC2004-3 Multi-Stage Economizer Wireless Thermostat Controller Installation Instructions</i>	<i>Part No. 24-9890-749</i>
	<i>TEC2045-2 Wireless Thermostat Controller with Single Proportional Output and One-Speed Fan Control Installation Instructions</i>	<i>Part No. 24-9890-757</i>
	<i>TEC20x6(H)-2 Series Wireless Network Thermostat Controllers with Two Outputs, Dehumidification Capability, and Three Speeds of Fan Control Installation Instructions</i>	<i>Part No. 24-9890-765</i>
	<i>TEC20x7-2 Series Wireless Thermostat Controllers with Two Outputs Installation Instructions</i>	<i>Part No. 24-9890-773</i>

Primer on Wireless Mesh Networks Using ZigBee™ Technology

Overview

The ZigBee standard is a global open networking standard that defines a low-cost, low-power, two-way wireless communication system. Its development comes from the ZigBee Alliance, an organization of manufacturers devoted to providing a cost-effective wireless networking technology for use in commercial and residential applications. The primary advantages that ZigBee technology brings to the marketplace include the following:

- high reliability and security
- low power with multiyear battery life
- low complexity at an economic cost

ZigBee Communications Technology

The ZigBee network is a Personal Area Network (PAN) based on the Institute of Electrical and Electronic Engineers (IEEE) 802.15.4 standard for low power, low-duty cycle wireless transmitting systems. Devices on the network use Direct Sequence Spread Spectrum (DSSS) wireless technology and operate on the 2.4 GHz Industrial, Science, Medical (ISM) band.

Devices on the ZigBee network are different from devices using Bluetooth® technology and wireless Universal System Bus (USB) devices because they form a mesh network between nodes. Mesh networks are a type of daisy chaining from one device to another. This technique expands the typically short range of an individual node into a much larger, widespread network consisting of multiple nodes.

The Medium Access Control (MAC) layer uses a Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) mechanism. This layer transmits beacon requests, synchronizations, and message retries. The physical layer of the ZigBee network uses the 2.4 GHz radio band. Channels 11 to 26 are available in this band. See Table 2.

Table 2: Physical Layer Frequencies for ZigBee Network

Channel	Radio Frequency	Overlaps with Wireless Fidelity (WiFi)?
11	2405 MHz	Yes
12	2410 MHz	Yes
13	2415 MHz	Yes
14	2420 MHz	Yes
15	2425 MHz	No
16	2430 MHz	Yes
17	2435 MHz	Yes
18	2440 MHz	Yes
19	2445 MHz	Yes
20	2450 MHz	No
21	2455 MHz	Yes
22	2460 MHz	Yes
23	2465 MHz	Yes
24	2470 MHz	Yes
25	2475 MHz	No
26	2480 MHz	No

ZigBee Device Types

The ZigBee specification defines three kinds of devices that can be part of a ZigBee network: a coordinator, one or more routers, and one or more end devices.

Coordinator

A coordinator is a required network component. One coordinator is permitted on each wireless network. It acts as a parent device, initiating network formation, which involves channel selection and network identification.

Router

A router is an optional network component. One or more routers are permitted on each wireless network. Routers act as parent devices, participating in multi-hop message routing. They relay messages between nodes and allow child nodes to connect to them. Routers can talk to other routers and to end devices.

End Device

An end device is an optional network component. One or more end devices are permitted on each wireless network. End devices may be low-power, child devices that are typically battery powered. They do not communicate directly with other devices but rely on their parent to forward and buffer messages for them.

ZigBee Network Topologies

A ZigBee network can adopt one of three topologies: star, tree, or mesh (Figure 1). The topology defines how a message is routed from one node to another. A star network has a central node through which all messages pass. A tree network has a top node with a branch and leaf structure below in which messages travel up and down the tree as necessary. A mesh network is a modified tree network in which some leaves are linked, enabling messages to travel across the tree when a suitable route is available. The TEC Series Wireless Thermostat Controller System uses a mesh network.

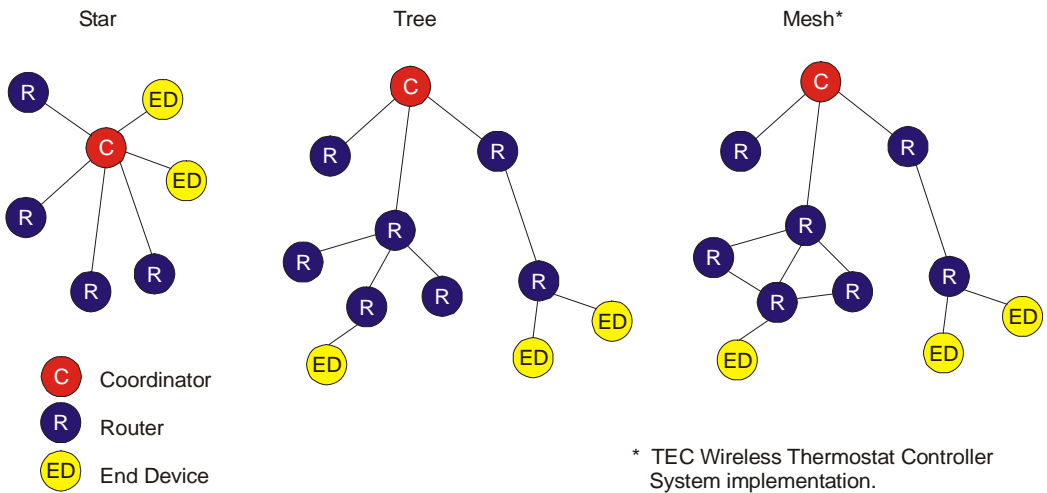


Figure 1: Topologies for Wireless Network

Parent and Child Devices

In a wireless ZigBee network, a parent is a device that assigns unique network addresses to other child nodes as they join the network. Any coordinator or router can be a parent to other routers and end devices, but the coordinator is always a parent device. When a router or end device joins the network, it selects a parent from a group of routers or the coordinator. The selected parent may not always be the closest node, since the router or end device selects a parent based on signal strength and its proximity to the coordinator. Once the router joins the network, it no longer relies on its parent for communication; however, once an end device joins, it continues to rely on its parent for all two-way communication.

Self-Healing, Multi-Hop Network

The ZigBee network is further characterized as a self-healing, multi-hop network. If a wireless communication path experiences interference or drops out, the network automatically reroutes the message through an alternate path to form a new wireless communication path. Each message is received, then retransmitted as it hops along from node to node until it reaches its final destination. Within a ZigBee network, a single message is allowed to hop 10 times between the source and destination node.

TEC Series Wireless Thermostat Controller System Implementation of ZigBee Technology

The TEC Series Wireless Thermostat Controller (WTC) system implements ZigBee technology as follows:

- The FX Supervisory Controller with the WTC is the ZigBee coordinator. The FX Supervisory Controller with the WTC is a parent to the TEC Wireless Thermostat Controllers.
- The TEC Wireless Thermostat Controllers are ZigBee routers. The TEC Wireless Thermostat Controllers serve as children to a FX Supervisory Controller with the WTC. The TEC Wireless Thermostat Controllers are also the ZigBee end devices.
- The system uses the ZigBee Home Automation Profile.

ZigBee Channels

A ZigBee network has 16 channels available for use. The TEC Series Wireless Thermostat Controller System uses only channels 15, 20, 25, and 26. These channels were selected for the TEC Series Wireless Thermostat Controller System because they do not overlap with channels used on a WiFi network. To illustrate, Figure 2 is a diagram showing the channel spacing of the ZigBee and WiFi networks. Notice that the TEC Series Wireless Thermostat Controller system does not interfere with the WiFi network.

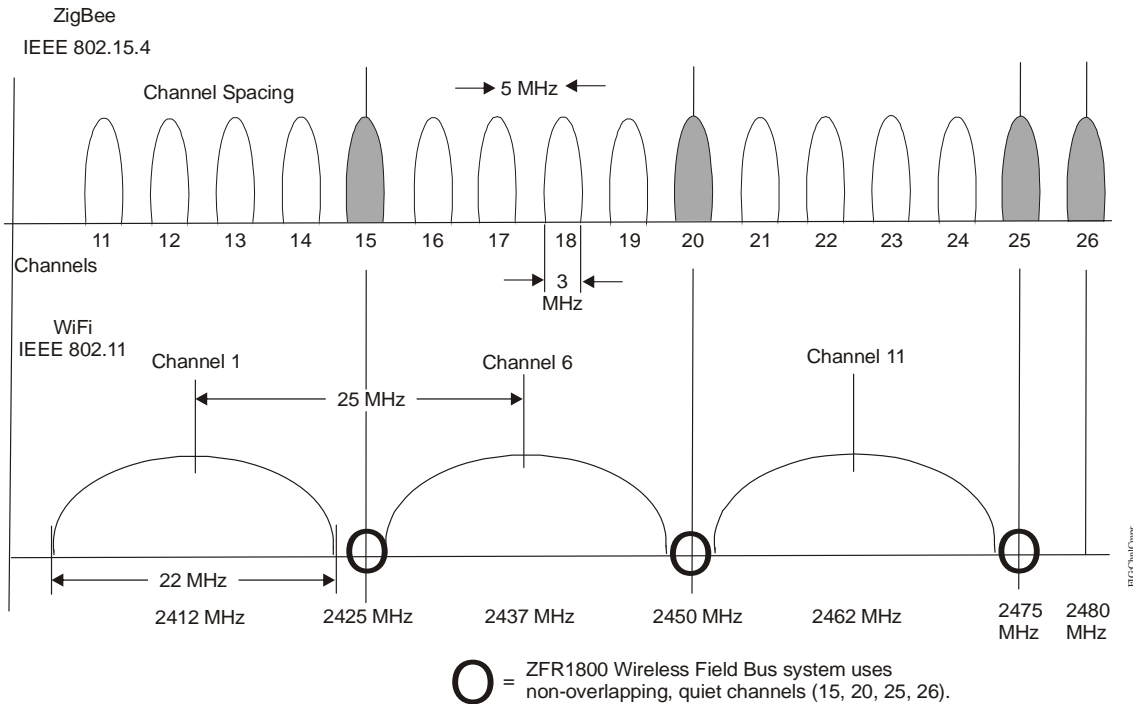


Figure 2: Comparing Channel Spacing of the ZigBee and WiFi Networks

TEC Wireless Thermostat Controller System Overview

TEC Wireless System Primer

A TEC Series Wireless Thermostat Controller System consists of:

- at least one FX Supervisory Controller with a WTC
- multiple TEC Wireless Thermostat Controllers

An FX Supervisory Controller with a WTC enables the TEC Wireless Thermostat Controllers to communicate with the supervisory controller, which schedules zone occupancy of the wireless system, collects trend data, overrides points, and monitors alarms. The TEC Series Wireless Thermostat Controller System confirms and synchronizes data transmissions between the TEC Wireless Thermostat Controllers and FX Supervisory Controllers with WTC.

Together, these components provide wireless monitoring and temperature control of building Heating, Ventilating, and Air Conditioning (HVAC) equipment.

Component Descriptions

Supervisory Controllers

FX Supervisory Controller are Web-enabled, Ethernet-based, supervisory controllers that connect BAS networks to IP networks and the Web. FX Supervisory Controller provide scheduling, alarm and event management, histories, energy management, data exchange, and password protection. With a computer running Microsoft® Internet Explorer® Web browser Version 6.0 (or later), you can browse to a configured FX Supervisory Controller and monitor and control BAS field devices.

Wireless TEC Option Card

The FX Supervisory Controller Wireless TEC Option Card provides communications capability between wireless TECs and the FX Supervisory Controllers. Only one Wireless TEC Option card is supported per FX Supervisory Controller.

TEC Wireless Thermostat Controllers

Depending on the model, the TEC Wireless Thermostat Controllers can communicate sensed temperature, setpoint temperature, and other data with an associated supervisory controller. TEC Wireless Thermostat Controllers can also control a variety of fan coil and zoning equipment. These controllers are designed for indoor, intra-building applications only.

Component Quantities

The maximum of number of TEC Series Wireless thermostats supported by a single FX Supervisory Controller is dependent on the resources available for the WirelessStatNetwork driver Jar file and the extent of integration added to the FX Supervisory Controller station. When additional functions and services are added to the FX Supervisory Controller station, the available resources for the driver are less. Once you configure the FX Supervisory Controller station for the wireless network and all other features (for example, graphics, services, histories, and alarms), you should monitor the FX Supervisory Controller's resources so that they do not exceed the recommended limits for each specific platform.

Wireless TEC Option Card Communication

The Wireless TEC Option Card and related WirelessStat driver jar file have been specifically designed to be used by Niagara^{AX} powered FX Supervisory Controller.

When used in conjunction with TEC Series wireless thermostats, the Wireless TEC Option Card provides simple integration to the FX Supervisory Controller.

Wireless Mesh Networks

The Wireless TEC Option Card and related wireless TEC thermostats operate using ZigBee/IEEE 802.15.4 physical layer for communication.

The general characteristics of the wireless physical communication layers are:

- uses a wireless physical layer of 2.4GHz with a data rates of 250 kbps
- yields high throughput and low latency
- uses automatic multiple topologies configuration: star, peer-to-peer, mesh
- uses a handshake protocol for transfer reliability
- uses a range of 30 feet (10 meters) typical (up to 100 feet [30 meters] based on environment)

IEEE 802.15.4 along with ZigBee Networks and Application Support Layer provide:

- low cost installation deployment
- ease of implementation
- reliable data transfer
- short range operation
- very low power consumption
- appropriate levels of security

The FX Supervisory Controller with the Wireless TEC Option Card acts as the network coordinator device for the IEEE 802.15.4/ZigBee network used with TEC wireless thermostats.

There are features necessary for the efficient operation of a ZigBee network. These features of the network physical layer include receiver energy detection, link quality indication, and clear channel assessment. Both contention-based and contention-free channel access methods are supported with a maximum packet size of 128 bytes, which includes a variable payload up to 104 bytes. Also employed are 64-bit IEEE and 16-bit short addressing, supporting over 65,000 nodes per network. All the properties of the physical layer are used by the mesh network. However, the properties are hidden to the user for ease of configuration and commissioning of the network database.

Wireless Signal Transmission Range

Line-of-sight transmission ranges between a Wireless TEC Option Card and a TEC Wireless Thermostat Controller (or between TEC Wireless Thermostat Controllers) can be less than the maximum distances shown in Table 3. The effective transmission range for indoor applications varies because of RF (wireless) signal absorption and reflection due to metal obstructions, walls (or floors), and furniture found in typical building interiors.

Table 3: Recommended Transmission Ranges between Two TEC Devices

Type	Distance
Through Walls	10 m (30 ft)
Open Space	30 m (100 ft)

RF Interference and Security in TEC Wireless System Applications

The TEC Series Wireless Thermostat Controller System is designed to virtually eliminate RF interference with other wireless applications. In most commercial environments, the TEC Series Wireless Thermostat Controller System does not encounter or generate RF interference, even in environments with cell phones and competing WiFi applications. ZigBee Wireless RF transmissions use different modulation schemes than WiFi applications and use frequencies between popular WiFi bands, enabling WiFi and ZigBee networks to exist in the same areas.

While using industry-standard frequencies for ZigBee Wireless transmissions, the Coordinators and Thermostat Controllers use a proprietary protocol that secures the RF data transmissions and inhibits the deciphering of any intercepted RF data.

In most commercial environments, the TEC Series Wireless Thermostat Controller System should not encounter or generate significant RF interference, even in environments that are saturated with competing WiFi applications and cell phones.

The TEC Series Wireless Thermostat Controller System should not interfere with other wireless systems for the following reasons:

- No common frequencies are between the cell phone bands and the 2.4 GHz ISM band where the TEC Series Wireless Thermostat Controller System operates; therefore, interference should not occur with cell phone transmissions.
- The 802.11 WiFi standard and the 802.15.4 standard used by the TEC Series Wireless Thermostat Controller System are both DSSS, and are specified and required by the Federal Communications Commission (FCC) to be simple noise sources to each other. This is a major advantage for DSSS technology, as each system's transmissions typically result in only a slight increase in background noise.

Other wireless systems should not interfere with the TEC Series Wireless Thermostat Controller System for the following reasons:

- Cell phones do not operate on the 2.4 GHz ISM band; therefore, cell phone transmissions should not interfere with the TEC Series Wireless Thermostat Controller System.

- When a TEC Series Wireless Thermostat Controller System encounters WiFi transmissions in the 2.4 GHz ISM band, most of the transmissions appear merely as noise, with insignificant or no impact on TEC Series Wireless Thermostat Controller System communication.
- RF interference and transmission failures are usually prevented by maintaining an adequate distance between RF transmitting devices. If an RF device (for example, WiFi access points) with a **standard antenna** is located at least 3 m (10 ft) from a TEC Series Wireless Thermostat Controller System, there should not be any interference. Likewise, if an RF device with a **high-gain antenna** is located at least 6 m (20 ft) from a TEC Series Wireless Thermostat Controller System, there should not be any interference.
- Tests indicate that WiFi channel 11 transmissions should not significantly interfere with a TEC Series Wireless Thermostat Controller System unless the WiFi access points are within 3 m (10 ft) of the FX Supervisory Controller with WTC and the access points are transmitting at full power almost continuously.
- Although the compatibility of WiFi and ZigBee products is based on standards and good design, other sources can interfere with both WiFi and the TEC Series Wireless Thermostat Controller System by overloading the bands with continuous transmissions at very high levels. 2.4 GHz cordless phones and some older phone headsets can cause RF interference, and they should not be used anywhere near a TEC Series Wireless Thermostat Controller System or other WiFi applications. Additionally, some camera and sound systems are continuous frequency modulation transmitters, and they must be kept out of the WiFi environment to ensure optimal operation.

Applications to Avoid

Locations or applications that prohibit cellular telephones or Wireless Fidelity (WiFi) systems are unsuitable for the wireless products. Examples include:

- operating rooms or radiation therapy rooms
- validated environments
- department of defense applications requiring DIACAP certification (for example, military bases and military hospitals)

Do not use the products in applications that cannot tolerate intermittent interference, or where:

- critical control features would impact life-safety or result in large monetary loss, including secondary (backup) life-safety applications
- data centers, production lines, or critical areas would be shut down
- loss of critical control would result from loss of data from humidity or temperature sensor communications
- operation of exhaust fans or Air Handling Units (AHUs) would impair a purge or pressurization mode

- missing data would invalidate reporting required by the customer security points being monitored

TEC Series Wireless Thermostat Controller System

Follow these steps to locate your TEC Series Wireless Thermostat Controller System products.

Note: The recommended maximum distance between every TEC wireless thermostat controller should be 10 m (30 ft) through walls, and 30 m (100 ft) in open spaces. Every TEC wireless thermostat controller should be within wireless transmission range of at least two other TEC wireless thermostat controllers. The FX Supervisory Controller with WTC should be within a wireless transmission range of at least two TEC wireless thermostat controllers. If a TEC wireless thermostat controller is not within a wireless transmission range of at least two TEC wireless thermostat controllers or an FX Supervisory Controller with WTC, then use TEC wireless thermostat controllers to function as repeaters to serve this purpose of providing multiple wireless data pathways.

To locate the products:

1. From the floor plan, locate the intended locations of all the TEC wireless thermostat controllers. See Figure 3.

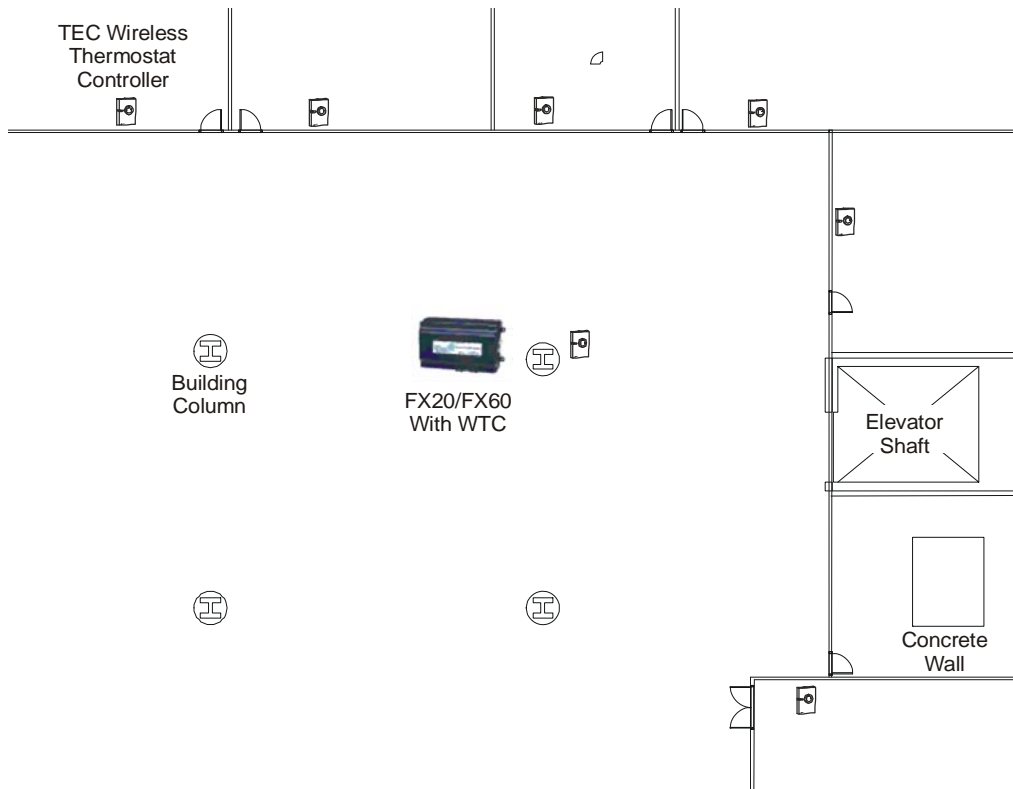


Figure 3: Building Floor Plan with TEC Wireless Thermostat Controller System

2. Highlight all of the obstructions on the building floor plans; for example, elevator shafts, metal equipment, equipment rooms, concrete block walls, and duct work. See Figure 3.
3. Try to locate the FX Supervisory Controller with WTC near the center of the space. See Figure 4. You must locate the FX Supervisory Controller with WTC on the same floor or building level as the associated TEC wireless thermostat controllers. The FX Supervisory Controller with WTC antenna should be in direct, unobstructed line of sight with a minimum of two wireless TECs. See Figure 4.
4. On your floor plans, draw a 30 m (100 ft) diameter (15 m [50 ft] radius) circle if transmitting in an open space (purple circle), or a 10 m (30 ft) diameter (5 m [15 ft] radius) circle if transmitting through walls (green circle) around each TEC wireless thermostat controller and FX Supervisory Controller with WTC, to help determine the wireless signal range. See Figure 4.

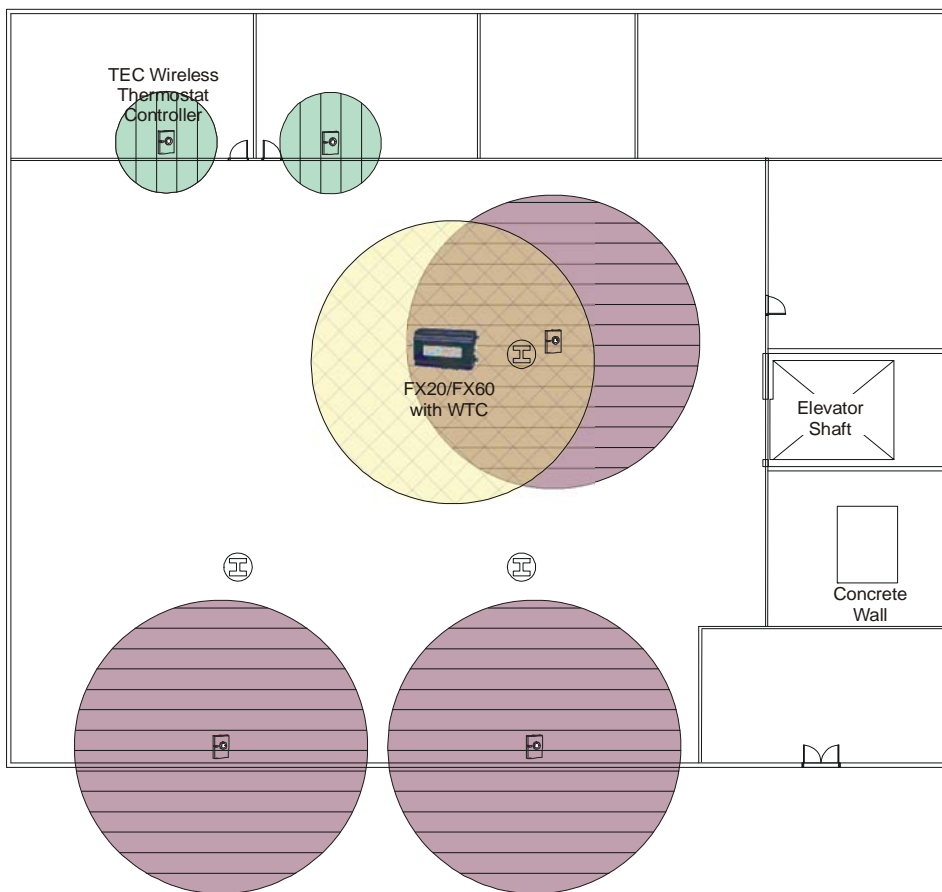


Figure 4: Building Floor Plan with TEC Series Wireless Thermostat Controllers and Circles Representing Wireless Signal Range

5. Add TEC Wireless Thermostat Controllers to serve as repeaters, to fill in gaps and provide multiple wireless transmission paths between wireless products in the network. See Figure 5.

Note: On your floor plan, if you have the circles that do not overlap with each other, add TEC wireless thermostat controllers to serve as repeaters to fill in the gaps so that every circle overlaps with at least two other circles.

The same transmission distances apply to TEC Wireless Thermostat Controllers serving as repeaters.

- 30 m (100 ft) diameter (15 m [50 ft] radius) for repeater wireless TECs transmitting in open space (orange circle).
- 10 m (30 ft) diameter (5 m [15 ft] radius) for repeater wireless TECs transmitting through walls (blue circle).

The dotted semi-circle represents the 30 m (100 ft) diameter (15 m [50 ft] radius) transmission in an open space.

Note: Typical job sites include a number of major and minor obstructions in the occupied space. The TEC quantity and locations are directly affected by the number and location of obstructions.

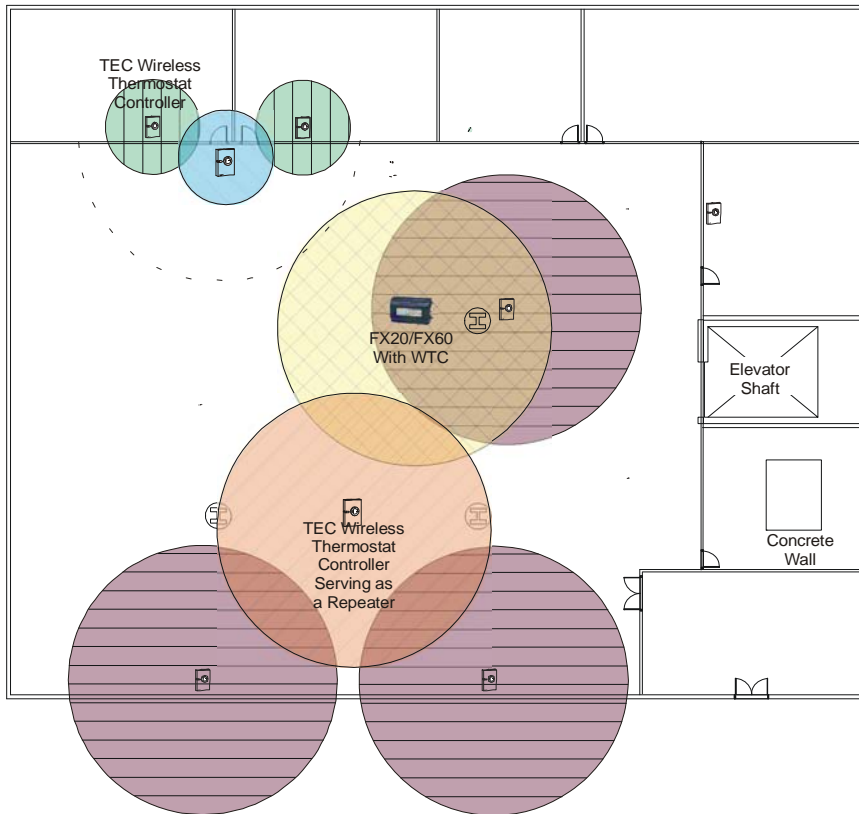


Figure 5: Building Floor Plan with TEC Series Wireless Thermostat Controller System, including Repeaters

6. Once the installation is complete, check the status LED on each wireless TEC to make certain the TEC controller has connected to the FX Supervisory Controller with WTC, to help validate a reliable mesh network is in place.

Detailed Procedures

Requirements

To commission and configure a TEC Series Wireless Thermostat Controller System application, you need the following:

- FX Supervisory Controller with WTC
- TEC Wireless Thermostat Controllers
- a computer (laptop preferred) with Microsoft Internet Explorer Web browser Version 6.x or Version 7.0
- an Ethernet crossover cable for direct connecting your laptop computer to the FX Supervisory Controller with WTC
- a copy of the job site building and HVAC plans and specifications

Overview

To install a TEC Wireless System, follow these steps:

1. Install the Wireless TEC Option Card as stipulated by the instructions provided by TEC Wireless Option Card. Refer to *FX Supervisory Controller Wireless TEC Option Card Installation Instructions (Part No. 24-9890-889)*.
2. Install each TEC Wireless Thermostat Controller and configure its wireless network settings (the PAN ID, CHANNEL, and COM ADDRESS). See *Install Each TEC Wireless Thermostat Controller and Configure Its Wireless Network Settings*.
3. Ensure that the **WirelessStat.jar** file is in your local FX Workbench modules folder.
4. Using the FX Workbench Software Manager, add the **WirelessStat.jar** file to the target FX Supervisory Controller with the TEC Option card already installed. See *Adding the WirelessStat.jar File to the Target FX Supervisory Controller*.
5. Using FX Workbench, add the Wireless driver and configure the driver properties. See *Adding and Configuring the Wireless Driver in the FX Supervisory Controller*.

Install Each TEC Wireless Thermostat Controller and Configure Its Wireless Network Settings

Install each TEC Wireless Thermostat Controller and configure its wireless network settings.

Installation

IMPORTANT: For local indication of wireless communication using the Status LED, install and configure TEC Wireless Thermostat Controllers, starting with locations closest to the FX Supervisory Controller with WTC and moving outward. Other installation procedures can be followed, but the Status LED only indicates wireless communications when the wireless mesh network is completed.

1. Install the TEC Wireless Thermostat Controllers.
2. Wire the TEC Wireless Thermostat Controller to the HVAC equipment.
3. Apply power to the TEC Wireless Thermostat Controller.
4. Remove the cover of the TEC Wireless Thermostat Controller to view the Status LED.

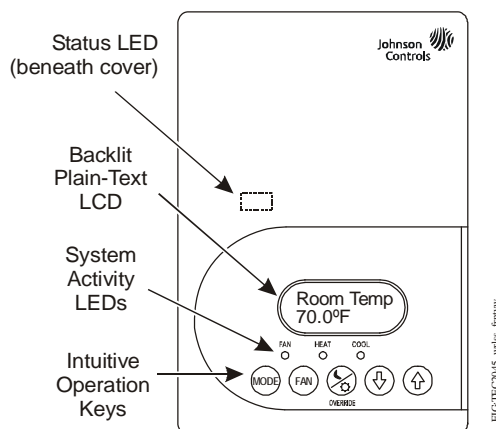


Figure 6: Front Cover of TEC2045 Thermostat Controller

Note: The Status LED should blink once to indicate power is on.

Note: Every 5 seconds, the Status LED should blink twice to indicate that self-test passed.

Configuring Wireless Network Settings

IMPORTANT: For every thermostat reporting to a FX Supervisory Controller with WTC, be sure you set the same **PAN ID** and **Channel** value on the FX Supervisory Controller with WTC and all associated TEC Wireless Thermostat Controllers. **Do not** reuse a **PAN ID** on this or any other wireless system in the same building.

Configure the TEC Wireless Thermostat Controllers as directed in the *Configuring the Thermostat Controller* section of the corresponding Installation Instructions document (Table 1) for the particular model TEC Wireless Thermostat Controller.

Use the following process to configure the wireless mesh network.

1. Scroll to the **Com Address** menu item and use the UP/Down Key to select a **Com Address** for each TEC Wireless Thermostat Controller (1 to 254). This address must be unique to each TEC Wireless Thermostat Controller on the same FX Supervisory Controller with WTC.
2. Scroll to the **PAN ID** menu item and use the UP/Down Key to select a **PAN ID** (1 to 500).
3. Scroll to the **Channel** menu item and use the UP/Down Key to select a **Channel** (11 to 26). Use only channel 15, 20, 25, or 26.

Note: Use these same **PAN ID** and **Channel** values for every TEC Wireless Thermostat Controller (and the associated FX Supervisory Controller with WTC) on the same wireless mesh network.

Note: Use the recommended installation procedure. Also configure the FX Supervisory Controller with WTC to the same **PAN ID** and **Channel**. The **Status** LED should blink then 4 times during each 5-second interval if the TEC Wireless Thermostat Controller can communicate with the FX Supervisory Controller with WTC.

You can locally set the rest of the parameters for each TEC Wireless Thermostat Controller now (see the corresponding Installation Instructions in Table 1).

Adding the WirelessStat.jar File to the Target FX Supervisory Controller

To add the WirelessStat.jar file to the target FX Supervisory Controller, you need to use the Software Manager in FX Workbench.

Note: Make sure the WirelessStat.jar is in the FX Workbench module folder before you perform this procedure.

To add the WirelessStat.jar file to the target FX Supervisory Controller:

1. In FX Workbench, connect to the desired device and open the Nav side bar.
2. Expand Platform for the FX Supervisory Controller.
3. Double-click Software Manager.

4. Select the WirelessStat.jar file from the Software Manager list.
5. Click Install and then click Commit. The FX Supervisory Controller reboots.

Adding and Configuring the Wireless Driver in the FX Supervisory Controller

To add the wireless driver to the local driver folder of the FX Supervisory Controller:

1. In FX Workbench, connect to the desired device and open the Palette side bar.
2. Open the WirelessStat palette.
3. Open the Nav side bar.
4. Expand Config and double-click Drivers. The Driver Manager appears.

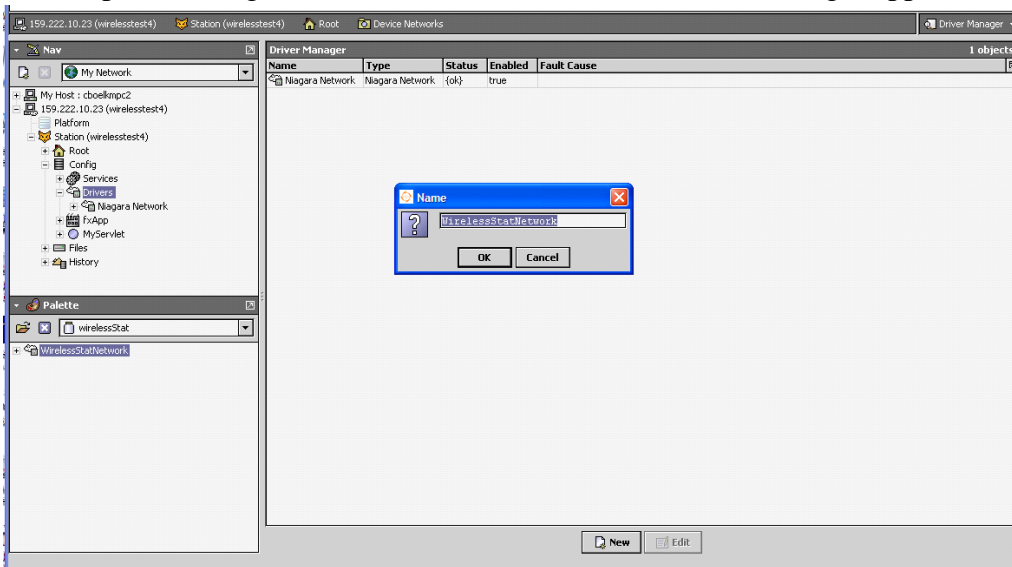


Figure 7: Adding the Wireless Driver

5. Drag WirelessStatNetwork to the Driver Manager.
6. If necessary, rename the driver and click OK. After adding the wireless driver to the FX Supervisory Controller, FX Workbench automatically locates and displays the wireless devices.

7. In the Driver Manager, right-click the wireless driver you added and select Property Sheet from the Views menu.

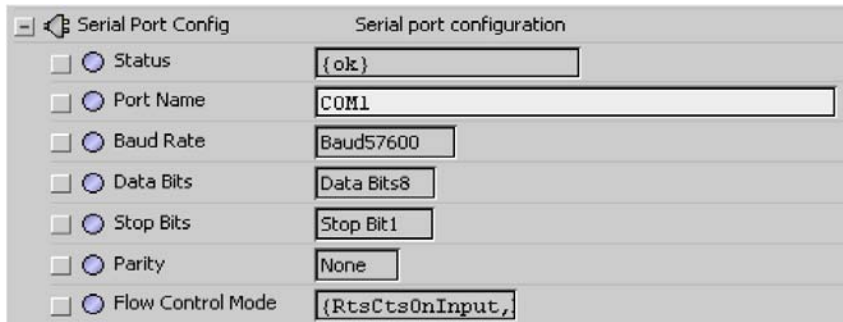


Figure 8: Serial Port - COM1

8. Expand Serial Port Config and enter COM1 in the Port Name field.
Note: You can only use COM1 in the Port Name field.
9. Expand Wireless Parameters Config.

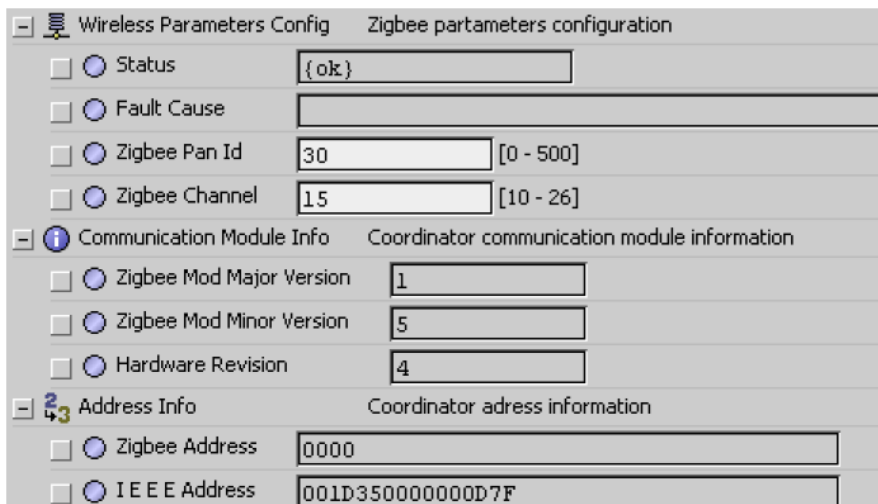


Figure 9: Zigbee Settings

10. Enter the values for the Zigbee Pan ID and Zigbee Channel fields. The values **must** match the values on the wireless TEC.
 - Gateway Zigbee Personal Area Network Identification (PAN ID) - This is where you set the PAN ID of the gateway. The range is from address 1 to 500. The default of 0 is not a valid PAN ID.
 - Channel Select - This is where you set the current channel frequency used by the gateway. The range is from 11 to 26 (2405 MHz to 2480 MHz, 5 MHz channel spacing).
Channel 26 is reduced by 4 db compared to the other channels. The default value of 10 is not a valid channel.

We recommend that you use the last two channels (25-2575MHz and 26-2580MHz). These upper channels are not affected and are out of the range of IEEE802.11x WiFi Channels spectrum.

Note: The communication module information and the assigned wireless address information is given for reference only.

11. From the File menu, click Save. The devices appear in the DiscoveredDevices folder of the WirelessStatNetwork (Figure 10).

Note: When properly configured, the issue of RF interference and lost data between the gateway and the thermostats can be avoided. Without proper care or proper software configuration, serious interference issues can happen.

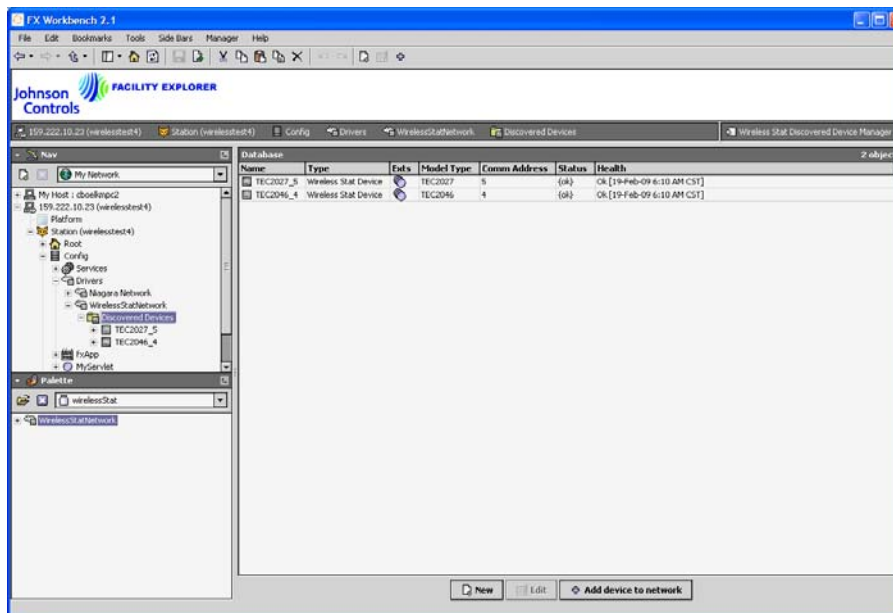


Figure 10: Discovered Devices

Viewing Discovered Wireless TEC Devices

The Wireless TEC Wireless Option Card and the wireless TEC Series family operate using Zigbee/IEEE 802.15.4 physical layer for communication.

This communication layer operates differently than most low level traditional wired communication bus. The heart of the network resides on the TEC option card found on the FX Supervisory Controller. This card is commonly referred to as the **coordinator** to the network.

As soon as a valid PAN ID and Channel are given to the Wireless TEC option card, any thermostat having the same configuration of PAN ID and Channel can be detected and registered to the wireless coordinator.

To view discovered devices:

1. From the Nav side bar, double-click DiscoveredDevices (Figure 10). This folder lists the thermostats with the same PAN ID and channel settings as the FX Supervisory Controller.

Note: It may take up to 2 minutes for a new thermostat device to be automatically discovered and appear under the DiscoveredDevice folder. If a properly configured thermostat (typically, the ones furthest from the FX Supervisory Controller) has issues joining the network and cannot be discovered by the FX Supervisory Controller, move the thermostat closer to the FX Supervisory Controller. This action enables the thermostat to have a Zigbee address assigned by the TEC Option card of the FX Supervisory Controller or another thermostat device. This process then enables the FX Supervisory Controller to discover the thermostat. Once the thermostat is discovered, reinstall the thermostat at the proper location.

2. Use Table 4 as a reference when you view the properties of the discovered devices.

Table 4: Discovered Device Properties

Name	Description
Name	Indicates the thermostat's name. The name is constructed of the thermostat model number and its current local MAC address. For example, a TEC2027 with a local MAC address of 21 has the name of TEC2027_21.
Model Type	Indicates thermostat model number.
Type	Identifies the type of wireless device.
Comm Address	Indicates the current physical MAC address set at each individual thermostat in its local configuration.
Status	Indicates if the current thermostat is online to the FX Supervisory Controller or not. If the thermostat is online, the status is {OK} and the thermostat line is all white. If the thermostat is offline, the status is {down} and the thermostat line is all yellow.
Health	Indicates the current status of each thermostat wireless node. <ul style="list-style-type: none">• OK means an online thermostat and the date and time represent the last time a communication event was received by the FX Supervisory Controller from a thermostat.• Fail means that a thermostat that stopped responding to its mandatory heartbeat.

Adding Discovered Wireless TEC Devices to the Network

After the FX Supervisory Controller device discovers the wireless TECs, you need to add the devices from the DiscoveredDevice folder to the WirelessStat network.

To add discovered wireless TEC devices to the network:

1. From the Nav side bar, double-click DiscoveredDevices (Figure 10). This folder lists the thermostats with the same PAN ID and channel settings as the FX Supervisory Controller.
2. Select the devices to add and click Add Device to Network. After you add the devices to the network, the devices move from the DiscoveredDevices folder to the WirelessStat folder.

You can now view points for the device you added by expanding the device and double-clicking Points.

Note: For wireless TEC devices, you cannot delete, edit, or add points.

Manually Adding New Wireless TEC Devices

To manually add new wireless TEC devices:

1. From the Nav side bar, double-click DiscoveredDevices (Figure 10).
2. Click New. The New dialog box appears (Figure 11).



Figure 11: New Wireless TEC Device

3. From the Type to Add list, select the type of wireless TEC device you want to add.
4. Enter the number of devices to add of the same type.
5. Enter the starting local MAC address.

6. Click OK. Another New dialog appears (Figure 12).

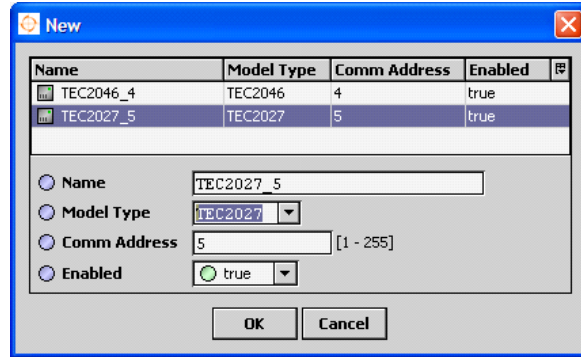


Figure 12: New Dialog Box

7. Select a device from the table at the top of the dialog box.
8. Enter a unique name for the device.
9. From the Model Type list, select the correct model type for the device.
10. Correct the Comm address if needed.
11. Repeat steps 7-10 for each device in the dialog.
12. Click OK.
13. Add the devices to the WirelessStat network by selecting them and clicking the Add Device to Network Button.

Appendix 1: TEC Wireless Thermostat Controller Objects Tables

See Table 5 for information on objects used by TEC Wireless Thermostat Controllers for fan coil and zoning equipment control. See Table 6 for information on objects used by TEC Wireless Thermostat Controllers for staged equipment control.

Table 5: Supported Objects Used by TEC Wireless Thermostat Controllers for Fan Coil and Zoning Equipment Control (Part 1 of 2)

Object Name	Read/Write Capability ¹	TEC2045-2	TEC2016-2	TEC2016H-2	TEC2026-2	TEC2026H-2	TEC2036-2	TEC2036H-2	TEC2046-2	TEC2046H-2	TEC2056-2	TEC2056H-2	TEC2027-2	TEC2047-2
Temperature Status														
RoomTemp	R/W	x	x	x	x	x	x	x	x	x	x	x	x	x
OutdoorTemp	R/W	x	x	x	x	x	x	x	x	x	x	x	x	x
RoomHumidity	R/W						x	x			x	x		
SupplyTemp	R	x	x	x	x	x	x	x	x	x	x	x	x	x
Setpoints														
OccCoolSetpoint	R/W	x	x	x	x	x	x	x	x	x	x	x	x	x
OccHeatSetpoint	R/W	x	x	x	x	x	x	x	x	x	x	x	x	x
StandByCoolSetpoint	R/W	x		x	x	x	x	x	x	x	x	x	x	x
StandByHeatSetpoint	R/W	x		x	x	x	x	x	x	x	x	x	x	x
UnOccCoolSetpoint	R/W	x	x	x	x	x	x	x	x	x	x	x	x	x
UnOccHeatSetpoint	R/W	x	x	x	x	x	x	x	x	x	x	x	x	x
DehumidRHSetpoint	R/W						x	x			x	x		
Main Commands														
OccupancyCommand	R/W	x	x	x	x	x	x	x	x	x	x	x	x	x
EffectiveOccupancy	R	x	x	x	x	x	x	x	x	x	x	x	x	x
SequenceOfOperation	R/W	x		x	x	x	x	x	x	x	x	x	x	x
SystemMode	R/W	x		x	x	x	x	x	x	x	x	x	x	x
FanMode	R/W	x		x	x	x	x	x	x	x	x	x		
KeypadLockout	R/W	x		x	x	x	x	x	x	x	x	x	x	x
DehumidLockout	R/W						x	x			x	x		
Main Status														
PIHeatingDemand	R	x		x	x	x	x	x	x	x	x	x	x	x
PICoolingDemand	R	x		x	x	x	x	x	x	x	x	x	x	x
DehumidStatus	R						x	x			x	x		
Alarms	R	x	x	x	x	x	x	x	x	x	x	x	x	x
HeartbeatDelay	R	x	x	x	x	x	x	x	x	x	x	x	x	x

Table 5: Supported Objects Used by TEC Wireless Thermostat Controllers for Fan Coil and Zoning Equipment Control (Part 2 of 2)

Object Name	Read/Write Capability ¹														
		TEC2045-2	TEC2016-2	TEC2016H-2	TEC2026-2	TEC2026H-2	TEC2036-2	TEC2036H-2	TEC2046-2	TEC2046H-2	TEC2056-2	TEC2056H-2	TEC2027-2	TEC2047-2	
Output Status															
FanStatus	R	x	x	x	x	x	x	x	x	x	x	x			
AuxStatus	R	x	x	x	x	x	x	x	x	x	x	x	x	x	
AuxCommand	R/W	x	x	x	x	x	x	x	x	x	x	x	x	x	
BI1Status	R	x	x	x	x	x	x	x	x	x	x	x	x	x	
BI2Status	R	x	x	x	x	x	x	x	x	x	x	x	x	x	

1. R = Read Only
R/W = Read/Write

Table 6: Supported Objects used by TEC Wireless Thermostat Controllers for Staged Equipment Control (Part 1 of 2)

Object Name	Read/Write Capability ¹				
		TEC2001-3	TEC2002-3	TEC2003-3	TEC2004-3
Temperature Status					
RoomTemp	R/W	x	x	x	x
OutdoorTemp	R/W	x	x	x	x
SupplyTemp	R	x	x	x	x
Setpoints					
OccCoolSetpoint	R/W	x	x	x	x
OccHeatSetpoint	R/W	x	x	x	x
UnOccCoolSetpoint	R/W	x	x	x	x
UnOccHeatSetpoint	R/W	x	x	x	x
Main Commands					
OccupancyCommand	R/W	x	x	x	x
EffectiveOccupancy	R	x	x	x	x
SystemModeRTU	R/W	x		x	x
SystemModeHPU	R/W		x		
FanMode	R/W	x	x	x	x
KeypadLockout	R/W	x	x	x	x
Main Status					

Table 6: Supported Objects used by TEC Wireless Thermostat Controllers for Staged Equipment Control (Part 2 of 2)

Object Name	Read/Write Capability ¹	TEC2001-3	TEC2002-3	TEC2003-3	TEC2004-3
PIHeatingDemand	R	x	x	x	x
PICoolingDemand	R	x	x	x	x
EconomizerOutput	R				x
Alarms	R	x	x	x	x
HeartbeatDelay	R	x	x	x	x
Output Status					
GFanStatus	R	x	x	x	x
W2 Status	R	x	x	x	x
W1 Status	R			x	x
Y1 Status	R	x	x	x	x
Y2 Status	R		x	x	x
ReversingValveStatus	R		x		
AuxStatus	R	x	x	x	x
BI1Status	R	x	x	x	x
BI2Status	R	x	x	x	x

1. R = Read Only
R/W = Read/Write

Supported Thermostat Objects

The list of points available for each thermostat model is different and has been optimized to best suit typical applications used by every single typical thermostat model.

Note that the wired BACnet Master-Slave/Token-Protocol (MS/TP) or LON models offer all possible objects supported by the thermostats (user, status, and configuration objects). The wireless versions only support the points which are of relevance for typical Building Automated System (BAS) interaction. As such, most configuration properties of the Wireless TECs are not available through the FX Supervisory Controller and need to be changed locally at the thermostat.

You cannot change or edit the object list supported by each model of wireless thermostat.

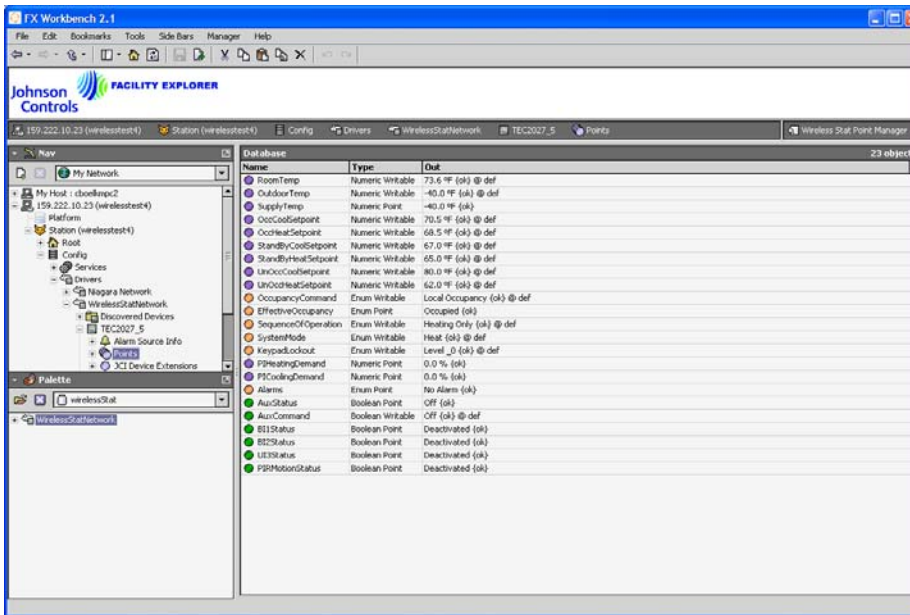


Figure 13: Points

Appendix 2: Troubleshooting

Use Table 7 to identify symptoms and their possible causes. After you determine the possible causes, use Table 8 to take corrective action.

Table 7: Identifying Symptoms and Possible Causes (Part 1 of 2)

Symptom	Identification	Possible Cause
TEC Wireless Thermostat Controller Cannot Communicate with FX Supervisory Controller with WTC	Communications LED does show two (or more) blink codes.	Communications board became loose during shipping.
		Defective TEC Wireless Thermostat Controller
No Power to TEC Wireless Thermostat Controller	Communications LED does not Flash.	Communications module became loose during shipping.
		TEC Wireless Thermostat Controller is not powered.
		Defective TEC Wireless Thermostat Controller
TEC Wireless Thermostat Controller Cannot Find Wireless Network	Communications LED does show two (or more) blink code.	FX Supervisory Controller with WTC was not installed following guidelines.
		FX Supervisory Controller with WTC is not powered.
		TEC Wireless Thermostat Controller is too far from another TEC Wireless Thermostat Controller or FX Supervisory Controller with WTC.
		TEC Wireless Thermostat Controller was not installed following guidelines.
		PAN ID mismatch
		Channel mismatch
FX Supervisory Controller with WTC Is Unable to Communicate with TEC Wireless Thermostat Controllers	None of the TEC Wireless Thermostat Controller LEDs indicate that the wireless network is found.	FX Supervisory Controller with WTC is mounted in a metal enclosure.
		PAN ID mismatch between FX Supervisory Controller with WTC and TEC Wireless Thermostat Controllers
		Channel mismatch between FX Supervisory Controller with WTC and TEC Wireless Thermostat Controllers
		An RF interference source is installed near the FX Supervisory Controller with WTC.
		Another FX Supervisory Controller with WTC (in range) has a duplicate PAN ID and Channel.
None of the WTC LEDs Are On	All WTC LEDs are OFF.	FX Supervisory Controller with WTC is not powered.
		Loose Power connection on FX Supervisory Controller with WTC.
		Defective FX Supervisory Controller with WTC.
		Incorrect voltage (AC) supplied to FX Supervisory Controller with WTC.

Table 7: Identifying Symptoms and Possible Causes (Part 2 of 2)

Symptom	Identification	Possible Cause
TEC Wireless Thermostat Controller Is Not Discovered by the FX Supervisory Controller with WTC	TEC Wireless Thermostat Controller does not show up in the DiscoveredDevices folder.	TEC Wireless Thermostat Controller has Duplicate Com Address.
		PAN ID mismatch
		Channel mismatch
FX Supervisory Controller with WTC Sees Fewer TEC Wireless Thermostat Controllers Than Installed on System	FX Supervisory Controller with WTC sees fewer TEC Wireless Thermostat Controllers in DiscoveredDevices folder than installed on system.	TEC Wireless Thermostat Controller has Duplicate Com Address.
		PAN ID mismatch
		Channel mismatch
Wireless Parameters Are Not Accessible in TEC Wireless Thermostat Controller Menu	Com Address, PAN ID, and Channel are not menu items in TEC Thermostat Controller Configuration menu.	TEC Thermostat Controller being configured is not a wireless version of the product.
		Wireless communications card was field added to a non-wireless TEC Thermostat Controller.

Table 8: Taking Corrective Action (Part 1 of 2)

Cause	Troubleshooting Step	Remedy
TEC Wireless Thermostat Controller Is Not Powered	Ensure 24 VAC is connected to 24-HOT and 24+ COM connector on TEC Wireless Thermostat Controller.	Connect +24 VAC to TEC Wireless Thermostat Controller terminals.
	Ensure 24 VAC measured across the 24- HOT and 24+ COM connector on TEC Wireless Thermostat Controller.	Troubleshoot mechanical equipment to determine why 24 VAC is not being supplied.
FX Supervisory Controller with WTC Is Not Powered	Ensure that the power module is tightly plugged into the FX Supervisory Controller.	
	Ensure that the low or line voltage power is properly wired to the power module.	
TEC Wireless Thermostat Controller Is Too Far from Another TEC Wireless Thermostat Controller or FX Supervisory Controller	Check TEC Wireless Thermostat Controller communications LED. If LED indicates that No Network was found.	Add a TEC Wireless Thermostat Controller as a repeater between the low signal TEC Wireless Thermostat Controller and the next closest TEC Wireless Thermostat Controller.
		Additional repeaters may be needed if TEC Wireless Thermostat Controllers are still not communicating effectively.
PAN ID Mismatch	Ensure that the PAN ID on the TEC Wireless Thermostat Controllers match the PAN ID of the FX Supervisory Controller.	Change the PAN ID on all devices within the same wireless network to match.
Channel Mismatch	Ensure that the Channel on the TEC Wireless Thermostat Controllers match the Channel of the FX Supervisory Controller.	Change the Channel on all devices within the same wireless network to match.

Table 8: Taking Corrective Action (Part 2 of 2)

Cause	Troubleshooting Step	Remedy
<p>Too Many TEC Wireless Thermostat Controllers Are Mapped to the FX Supervisory Controller</p>	<ol style="list-style-type: none"> 1. Identify all TEC Wireless Thermostat Controllers associated with this wireless network. 2. Remove a TEC Wireless Thermostat Controller farthest from FX Supervisory Controller. 3. Repeat removing TEC Wireless Thermostat Controllers until system is stable. 	
<p>An RF Interference Source Is Installed Near the FX Supervisory Controller</p>	<p>Identify sources of RF interferences. These sources can include, radio antennae, microwave ovens, ZFR1800 Seires Wireless Field Bus System devices, wireless security devices, wireless LAN access points, paging systems, and cordless phones.</p>	<p>Move the FX Supervisory Controller with WTC antenna at least 2 ft away from any RF noise source.</p>
<p>Another FX Supervisory Controller with WTC (in Range) Has a Duplicate PAN ID and Channel</p>	<ol style="list-style-type: none"> 1. Find any FX Supervisory Controller that is within a 100 ft radius of any TEC Wireless Thermostat Controller or FX Supervisory Controller in the network. 2. Ensure PAN ID and Channel on the FX Supervisory Controllers are unique. 	<p>Change PAN ID and Channel of all the TEC Wireless Thermostat Controllers or FX Supervisory Controller with WTC in one of the wireless networks.</p>
	<ol style="list-style-type: none"> 1. Find any FX Supervisory Controller that is within a floor above and below of any TEC Wireless Thermostat Controller or FX Supervisory Controller in the network. 2. Ensure PAN ID and Channel on the FX Supervisory Controller are unique. 	<p>Change PAN ID and Channel of all the TEC Wireless Thermostat Controllers or FX Supervisory Controllers in one of the wireless networks.</p>
<p>TEC Wireless Thermostat Controller Has Duplicate COM Address</p>	<ol style="list-style-type: none"> 1. Check FX Workbench to find device(s) that are offline. 2. Find the TEC Wireless Thermostat Controller that is offline. Enter its configuration menu. 	<ol style="list-style-type: none"> 1. Change PAN ID to an unused number. Wait 10 seconds. 2. Change PAN ID to correct number. Wait 10 seconds. 3. Ensure TEC Wireless Thermostat Controller Communications LED shows that it reconnects to the wireless network.

Appendix 3: Tips and Things You Need to Know

The following includes tips and things you need to know when you use TEC devices for FX Supervisory Controllers with WTC:

- Make sure all TEC devices connected to a FX Supervisory Controller are using the same PAN ID and Channel as the FX Supervisory Controller wireless TEC option card.
- Each thermostat connected to a wireless network reports to the FX Supervisory Controller with an automatic heartbeat for the local online-offline sanity. See the health status **Last Ok Time** value for the total amount of time a single thermostat has not updated its mandatory 3-minute heartbeat update to the FX Supervisory Controller.

LEDs

One LED is visible on the side of the Wireless TEC Option Card and indicates the following status:

- **1 short blink:** power on
- **2 short blinks:** power on and card memory properly initialized
- **3 short blinks:** power on, card memory properly initialized, and active communication with the FX Supervisory Controller
- **4 short blinks:** power on, card memory properly initialized, active communication with the FX Supervisory Controller, and wireless network successfully started
- **4 short blinks and 1 long blink:** power on, card memory properly initialized, active communication with the FX Supervisory Controller, wireless network successfully started, and active communication with TECs



Building Efficiency

507 E. Michigan Street, Milwaukee, WI 53202

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