

# Wireless Mesh Network

## A Guide to Field Installation



Wireless Mesh  
Indoor Sensor 042



Mesh Network  
Extender 041



Smart Boiler Control 294



Wireless Mesh  
Outdoor Sensor 043

### ⚠ WARNING



Please read carefully before proceeding with installation. Your failure to follow any attached instructions or operating parameters may lead to the product's failure.



Keep this Manual for future reference.

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## Glossary

**Mesh Network Extender (041)** – A routing device that strengthens the network by relaying messages and creating redundant paths.

**Nexa™ Platform** – The cloud-based system used for device registration, monitoring, and management.

**Node** – Any device participating in the mesh network (sensor, extender, or system control).

**Range** – The maximum distance a wireless signal can travel under specific conditions. Measured in a sphere.

**Sensor (Indoor 042/Outdoor 043)** – Low-power devices that transmit environmental data (such as temperature) to the system control.

**System Control** – The endpoint device that connects the mesh network to the internet and manages data from sensors.

**Thread** – An IPv6-based networking protocol designed for low-power IoT devices, offering secure and scalable communication. The tekmar Wireless Mesh Network is built on Thread.

**Wireless Mesh Network** – A network topology in which devices (nodes) connect dynamically to provide seamless coverage and redundancy.

# Overview of Wireless Mesh Network







A wireless mesh network is a communication system consisting of interconnected devices that provide seamless coverage across a broad area. The tekmar® Wireless Mesh Network incorporates Thread, an IPv6-based protocol with no single point of failure. By leveraging standard Internet Protocol (IP), Thread offers a dependable, scalable, and secure framework for linking low-power devices. The mesh network supports the installation of boiler and steam control systems in multifamily, commercial, and residential buildings.

This document presents mesh networking from a field-installer's perspective, outlining what a mesh network is, how it operates, and why it behaves the way it does. It connects those behaviors to practical considerations in planning, device placement, commissioning, and troubleshooting. The aim is to equip installers with the context needed to make informed onsite decisions, minimize callbacks, and ensure reliable long-term system performance.

## Wireless Devices in the Network

Three types of devices make up the mesh network: sensor, extender, system control. Each sensor in the network is linked to a system control either directly or through an extender. Extender count is one of the key factors that determine network performance. Fewer or more affects robustness and signal quality.

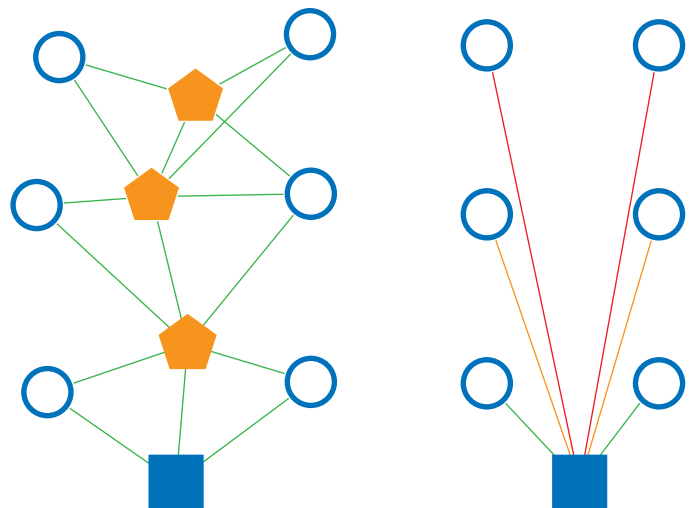
Call customer support if you need assistance with technical details.

Product	Description	Symbol
 <p>Wireless Mesh Indoor Sensor 042 Wireless Mesh Outdoor Sensor 043</p>	Battery-run, low-power device. Stays sleeping and wakes up every 2 to 10 minutes to transmit data to system control.	Sensor 
 <p>Mesh Network Extender 041</p>	Backbone of the network, routing and repeating messages to build the mesh. More extenders boost reliability and eliminate weak signal areas.	Extender 
 <p>Smart Boiler Control 294 Smart Steam Control 289</p>	Endpoint for data and single connection to the internet. These devices receive sensor data through the wireless mesh network.	System Control 

## Benefits of Mesh vs. Point to Point

A wireless mesh network is great for making sure you have strong, reliable wireless signal everywhere you need it. Multiple devices work together to spread the signal. Contrast this with a point-to-point connection, the opposite of mesh networking. In point-to-point, the wireless sensor signal must be strong enough to reach the endpoint device.

A wireless mesh network means fewer dead zones and better coverage in places like basements, mechanical rooms, or faraway rooms. Wireless mesh networks are also smart: They automatically connect your device by selecting the most optimized route based on a complex algorithm. That behind-the-scenes operation means you don't have to switch networks or deal with slow speeds. If one device stops working, the others keep the network running by following a new path for the signal. Plus, you can widen coverage by adding an extender, enabling your wireless signal to reach farther.



*A wireless mesh network versus a point-to-point network*

## Self-Healing Mesh Topology

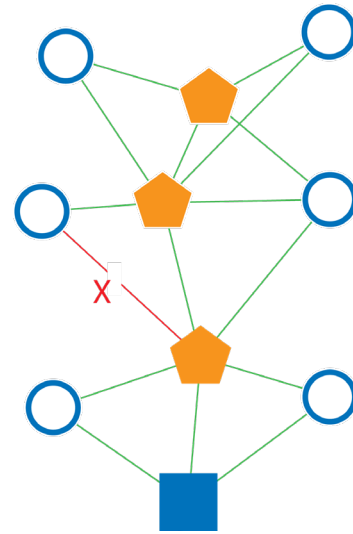
In a wireless mesh network, self-healing means the system can automatically fix itself when something goes wrong. Each device is connected to several others, forming a web-like structure. If one device stops working because of a power outage or technical issue, the network doesn't break. Instead, the other devices quickly find a new path to send data, keeping everything running smoothly. This rerouting happens instantly and without human intervention, so users stay connected without noticing any disruption. Self-healing makes wireless mesh networks more reliable and resilient.

## Robust Network

Wireless mesh networks are considered robust because the design allows problems to be handled without causing the system to fall apart. The built-in redundancy means the network can keep functioning even when parts of it go down.

Wireless mesh networks are also adaptive. Devices can join or leave the network without causing major disruptions. This makes wireless mesh networks ideal for places where conditions change often, like large buildings. The more extenders you add, the stronger and more flexible the network becomes. (The extender is a type of routing device.)

In short, the mesh network mitigates different obstacles in the building and provides a robust and reliable wireless network.



*A break between nodes leads to the rerouting of signals through other nodes*

## Setting Up a Wireless Mesh Network

Knowing the benefits of a wireless mesh network is important, but knowing the constraints is just as important. Always keep in mind these two: obstacles and interference. When you understand what and where the barriers are, you can work around them.

## Avoid Obstacles

Wireless signals can run into quite a few obstacles in apartment buildings, which can weaken or block your wireless signal. Here are the most common ones:

- **Below street grade.** Basements and areas below the street level reduce signal range.
- **Concrete walls and floors.** These are especially tough for signals to pass through, and many apartment buildings use them for fireproofing and sound insulation.
- **Metal structures.** Steel beams, pipes, and even metal doors can reflect or absorb signals.
- **Glass with metal coating.** Some windows have a metallic tint that interferes with wireless signals.
- **Long hallways or odd angles.** Signals travel best in straight lines. Twists and turns in the layout can reduce strength.
- **Multiple floors.** Wireless signals have a harder time traveling vertically through thick ceilings.
- **Large furniture.** Bookshelves, cabinets, and even fish tanks (water absorbs signals) can block or weaken wireless signals.
- **Appliances.** Refrigerators, washing machines, and other large electronics can disrupt signals, especially when located between your device and the router.

## Avoid Interference

Interference happens when other signals disrupt or weaken a wireless connection, making it harder for devices to communicate smoothly. Wireless mesh mitigates interference by selecting preferred channels that avoid overlapping with existing networks. Wireless mesh includes technology that checks the channel for conflicting signals and communicates when other devices are silent, a network protocol that improves coexistence with Wi-Fi and other 2.4 GHz technologies. Still, keep these categories of interference in mind.

- **Wi-Fi devices.** These devices can use the same 2.4 GHz band and can interfere with the wireless mesh sensors.
- **Bluetooth devices.** While usually low-power, these devices can still add noise to the wireless environment.
- **Microwave ovens and cordless phones.** These devices often use the same 2.4 GHz band as Wi-Fi and can interfere with your signal.
- **Other wireless devices.** In densely packed buildings, dozens of routers might be operating on the same frequency, causing congestion.

## Planning

When it comes to system limitations, some recommendations, such as horizontal range, can be based on industry standards. Real-world performance may be better or worse, depending on specific environmental factors at the site.

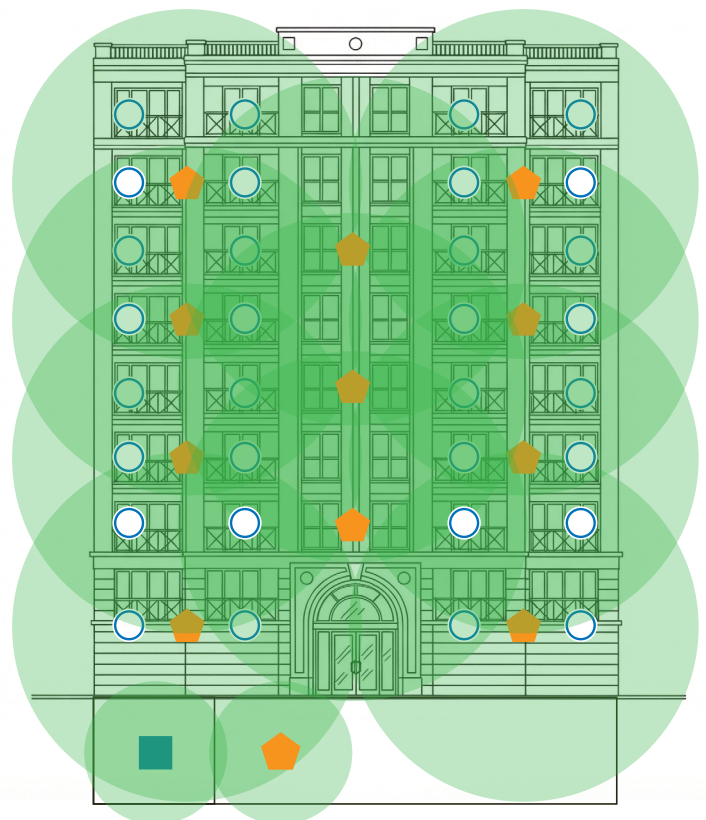
## Range

Ground-level obstacles can reduce wireless signal strength. Installing devices above the ground surface (at elevated heights) generally improves signal distance and overall performance.

Environment	Radius With Overlap Included
Typical wireless range in an unobstructed environment	100 feet
Typical wireless range inside buildings	50 feet
Typical wireless range inside buildings below street grade or buildings with high interference	25 feet

Different materials dampen the wireless signal. In general, the more obstacles (for example, walls, stairwells, doors), the lower the wireless range. Vertical range is 1 to 2 floors depending on building construction.

Material	Range	Floors
Plywood, drywall, and glass	High	2
Lumber, brick, and masonry block	Medium	1
Concrete and reinforced concrete	Low	1



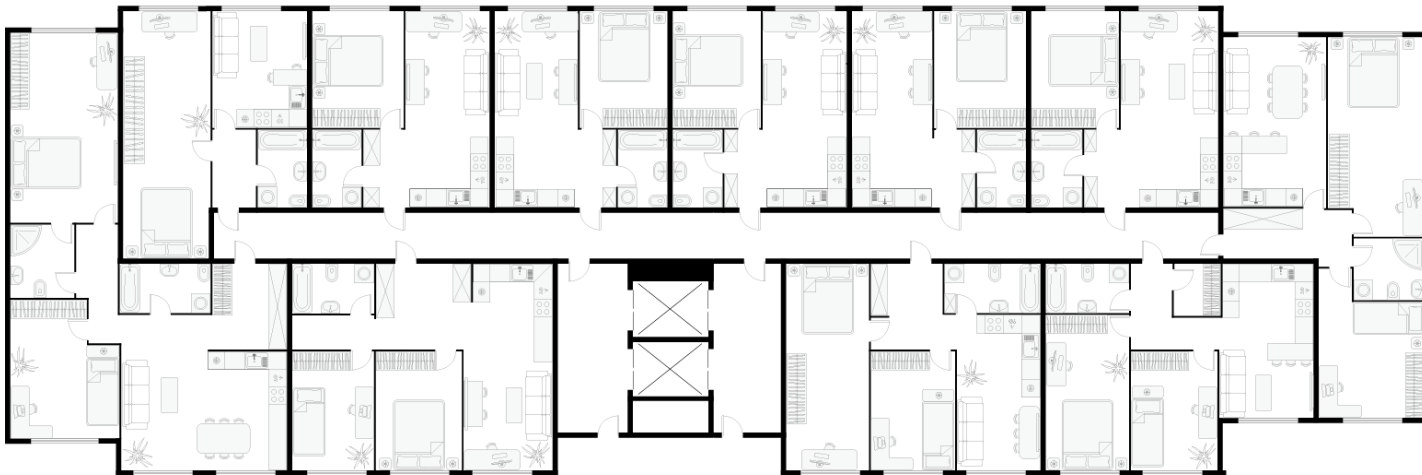
*Placement of nodes in a multistory building; control and extender below street grade have a shorter signal distance, whereas sensors and extenders above street grade have a longer signal distance*

## Network Design Limitations

The wireless mesh network supports up to 10 wireless device connections per system control and 32 connections per extender with a total system limit of 100 devices. The following techniques—building a floor plan, performing a site survey, planning extender and sensor locations, and adding extenders—help installers work effectively within these limitations.

## Building a Floor Plan

The building floor plan may be available with the architecture plans. If not, an emergency exit plan for each floor is usually posted inside the building. Take a photo of the emergency floor plan.



*Begin with a floor plan to estimate the required number of nodes and identify ideal placement*

### Perform a site survey

Conducting a site survey before installing a wireless mesh network is essential to understand the layout, identify potential obstacles, and plan the best placement of your devices.

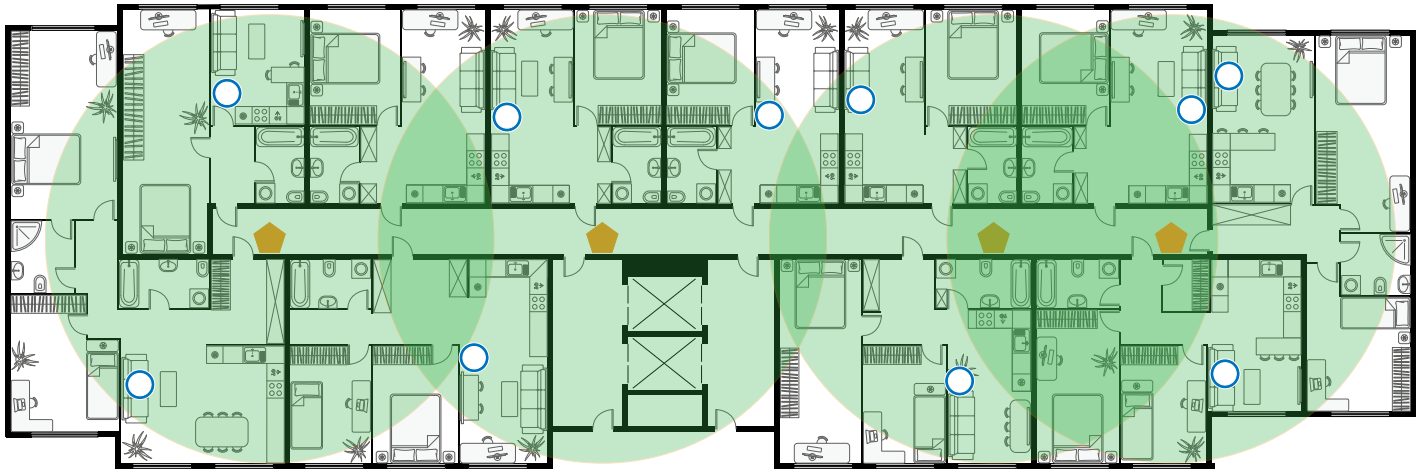
- **Size and construction.** Use online tools such as Google Maps™ Street View™ to determine the size of the building, the number of floors, and the general construction of the building. The Street View tape measure can provide a rough dimension of the building.
- **Get a floor plan.** Use a blueprint or sketch of the area to mark key rooms, hallways, and outdoor zones. If blueprints are unavailable, check for fire exit maps that can be used.
- **Locate power source.** Find receptacle locations so you can start to lay out the backbone of the wireless mesh network. Bring a 100-foot (30-meter) measuring tape to determine the distance between electrical outlets in public hallways.
- **Spot Physical obstacles.**
  - Walls and materials. Note thick concrete, brick, or metal walls that can dampen signals.
  - Appliances and furniture. Large items such as fridges, bookshelves, and fish tanks can interfere with signal strength.
  - Floors and ceilings. Wireless signals struggle to travel vertically through dense materials.

### Lay out mesh network extender locations

The extender sends out its signal in all directions, like a sphere. To get the best coverage, place each device where there is access to electrical power. It is best to put one device in the center of each floor. In larger buildings, you may need more than one device per floor to cover the space.

Mechanical rooms have a large amount of metal equipment, pipes, duct work, concrete, cinder block, and metal doors that reduce wireless signal range. To boost signal strength, given the construction of mechanical rooms, place an extender outside the wall of the mechanical room.

When below street grade, the earth and concrete foundations reduce the signal range. In multilevel buildings, the signals from the first floor may be able to span to the third floor; however, adding at least one extender to every floor enhances signal overlap and improves wireless mesh reliability.



*Position extenders to form the backbone of the mesh network across both vertical and horizontal planes*

To plan your layout, use the preceding range guidelines. With a compass scribe, draw circles on your floor plan to show how far the signal of each device signal can reach. This helps you see where coverage overlaps and where you might need extra devices. In addition, the wireless mesh needs to have overlap between two other mesh extenders. (These extenders may be on different floors.) This allows the wireless mesh to have redundant paths to improve reliability. In general, each extender can cover approximately 8,000 square feet in a typical office environment with drywall construction, assuming a radius of 50 feet in a circular pattern.

### Lay out sensor locations

Lay out the sensors on the floor plan, ensuring each one is located within network coverage. Consider the following for locations of the sensors.

#### **Wireless Indoor Sensor 042**

- Mount the sensor on an inside wall, about 5 feet (1.5 meters) above the floor.
- Keep the sensor away from drafts, direct sunlight, or anything that could affect temperature readings.
- Avoid placing the sensor near appliances or electronics that might cause interference.
- Avoid placing the sensor near metal doors and sheet metal that interfere with radio signals.
- Do not install the sensor above radiators or air vents.
- Do not install inside a metal enclosure.
- Install the sensor inside a thermostat lock box if security is a concern.

#### **Wireless Outdoor Sensor 043**

- Install the sensor on a north-facing outside wall, away from direct sunlight.
- To prevent heat from the wall affecting readings, add insulation behind the sensor.
- Keep the sensor away from heat sources such as vents or open windows.
- Mount the sensor above ground level to avoid damage or tampering.
- Do not place the sensor on metal or other conductive surfaces.

### Add mesh network extenders

If the initial set of extenders fails to fully cover the area, add more. It is better to have extra extenders than not. These devices improve coverage, add backup paths, and make your network stronger and more reliable.

# Installation and Commissioning

Contact technical support for any issues during installation and commissioning. Refer to the installation manual of a specific product for mounting instructions.

An internet connection and an account on the Nexa platform are required for installation and commissioning. Use a desktop or mobile web browser to access Nexa. Or, use the Nexa mobile app as an alternative to either web browser. Download the Nexa mobile app from App Store® or Google Play™.

## Preparing Nexa for Installation

Before starting, gather all the information you need to (1) set up your organization (property name and address), (2) register equipment (type and name to use), and (3) input locations established in your building floor plan.



1. Scan the QR code to log in to your Nexa account or enter <https://app.nexaplatform.com> in a web browser. (If you do not have a Nexa account, you can sign up then immediately proceed with the preparation for installation.)
2. Follow the prompts to set up the organization for each property and register the equipment (system control) for that location.
3. Select Locations in the navigation pane (left), click Create New (upper right), and enter a name for the location.

Create a separate location for each floor or area where the wireless mesh network will be deployed. For example, 1st Floor, 2nd Floor, or Mechanical Room. During device commissioning, you will select the appropriate area from the Location drop-down menu to keep devices organized.

Selecting or creating an organization is the first step in registering equipment (wireless mesh network devices) on the Nexa platform

ID	Location Name	Parent Location	Equipment	Sensors	
285d34a8-55a4-f0...	2nd Floor		0	2	...
c8c86130-0ac0-f0...	3rd Floor		0	2	...
d619b73c-0ac0-f0...	4th Floor		0	2	...
06f7bc-a9c0-f01...	5th Floor		0	1	...
01d90743-0ac0-f0...	Main Floor		0	2	...
efaa3c89-54a4-f01...	Mechanical Room		1	1	...

Use the Locations page to view and create equipment locations

## Installation Process

Here are two common installation methods, and the building environment often determines which is more practical. Option 1 involves installing all devices of a single type across the entire site, then commissioning them before moving to the next device type. Option 2 is often more time efficient, allowing installers to work floor by floor—installing and commissioning each device type before proceeding to the next.

### Option 1


1. Confirm that your version of system control has the Thread capability. Check by accessing Menu > About > Thread.
2. Install all the network extenders for your system. Follow the commissioning instructions to connect them to Nexa.
3. Check the link quality of your extenders. (See the Network Acceptance Testing section.) All extenders must have an Excellent signal.
4. Install all the sensors for the system, then follow the commissioning instructions to connect them to Nexa.

### Option 2

1. Confirm that your version of system control has the Thread capability. Check by accessing Menu > About > Thread.
2. Starting from the mechanical room, install all extenders and sensors on your current floor. Follow the commissioning instructions to connect them to Nexa.
3. Proceed to the next floor and install all extenders and sensors. Follow the commissioning instructions to connect them to Nexa.
4. Repeat until all floors have been completed.

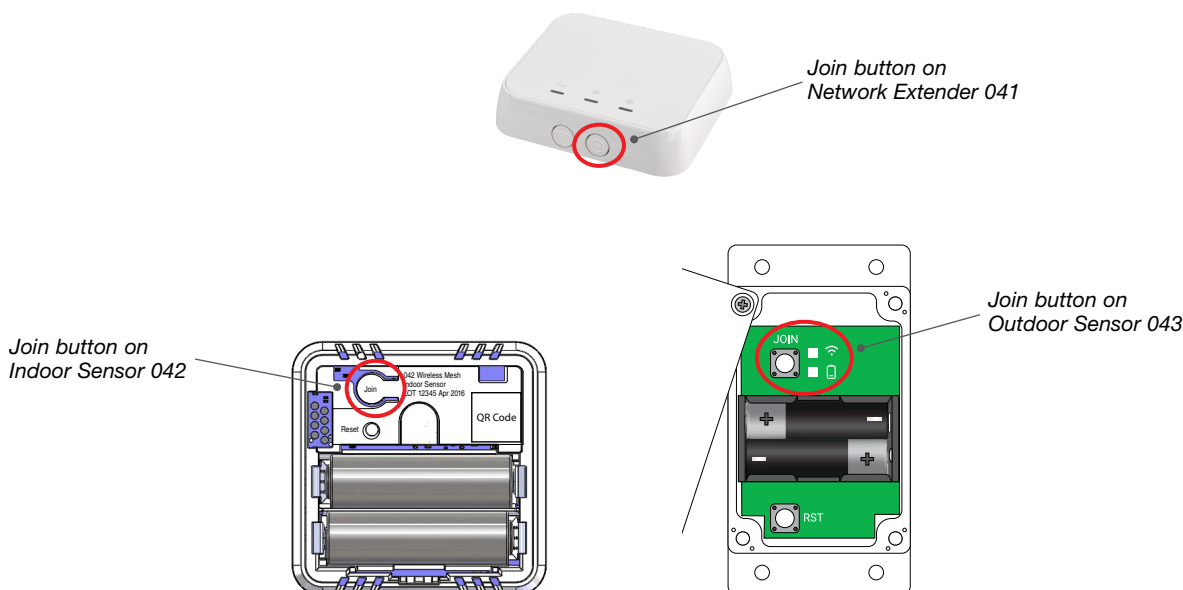
## Commissioning

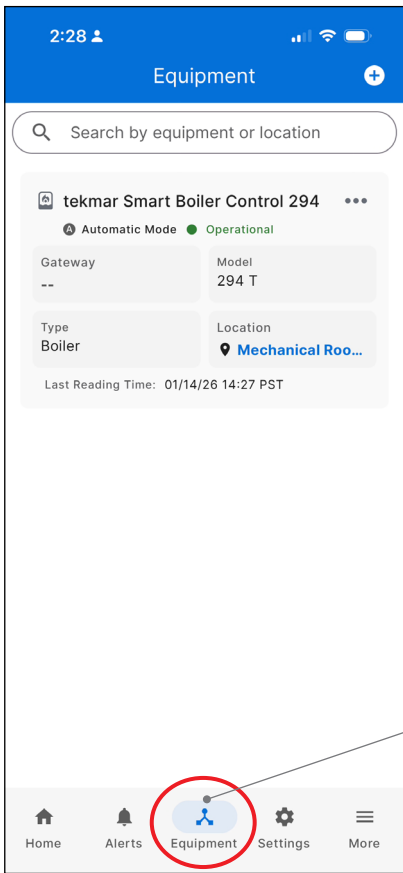
Before commissioning the devices, ensure that your organization and all designated locations within the building are configured in Nexa.

1. Open the Nexa app.
2. Click Equipment and find the system control. (If your device is not registered, follow the directions in the product manual to register. Or, scan the QR code to start the registration process.)
3. Click Connected Devices.
4. Click the + Add button to add a device.
5. Scan the QR code inside the cover of the device, then input the device name, and select a location for it. (Each location must be set up before commissioning to ensure it is included on the list.)
6. When prompted, press the Join button when adding a sensor. Press  when adding an extender. A message confirms when the device has been paired.



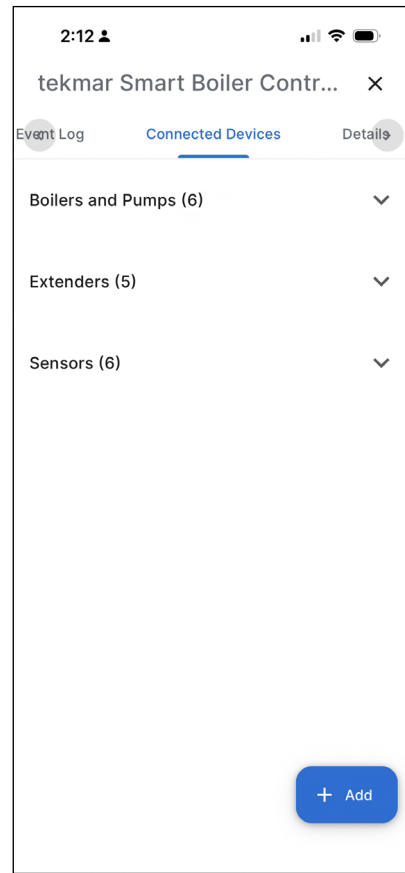
If the joining process fails repeatedly, installing another extender may be necessary to improve connectivity.



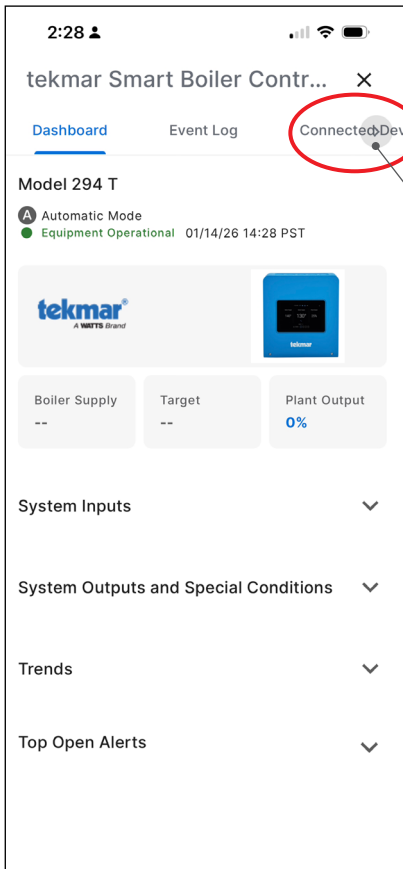


Equipment screen

On the menu, click Equipment to view all system controls

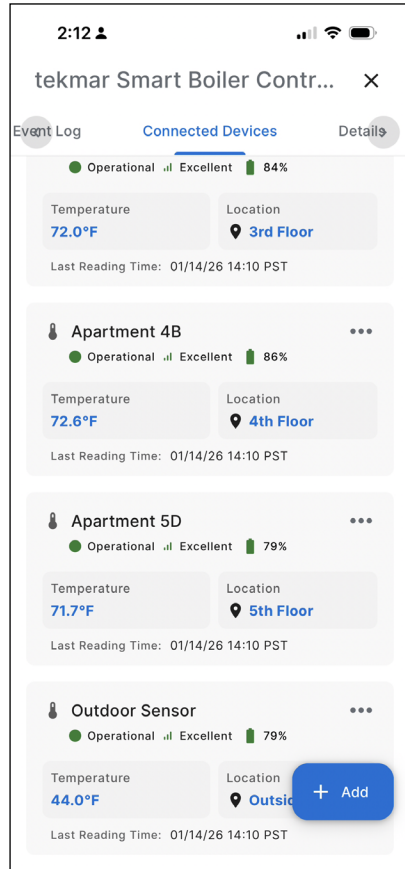


Click the item categories to navigate or view various connected devices



Connected Devices tab

Click the Connected Devices tab to find sensors and extenders



Click the + Add button to start the commissioning and pairing of devices

# Network Acceptance Testing

View all the devices on the Nexa platform. Each device indicates signal strength to the next available extender or the system control. If you cannot connect the extender, you may need to add more extenders to increase the range of the wireless mesh network. For best performance all signal strength must carry an Excellent rating.

BOILERS & PUMPS (6)		SENSORS (6)		EXTENDERS (5)	
Name	Location	Type	Status	Signal Strength	
<a href="#">1st Floor</a>	<a href="#">Main Floor</a>	Hub	<span style="color: green;">●</span> Operational	Excellent	...
<a href="#">4th Floor</a>	<a href="#">4th Floor</a>	Hub	<span style="color: green;">●</span> Operational	Excellent	...
<a href="#">Boiler Room</a>	<a href="#">Mechanical Room</a>	Hub	<span style="color: green;">●</span> Operational	Excellent	...
<a href="#">Floor 2</a>	<a href="#">2nd Floor</a>	Hub	<span style="color: green;">●</span> Operational	Excellent	...
<a href="#">Floor 3</a>	<a href="#">3rd Floor</a>	Hub	<span style="color: green;">●</span> Operational	Excellent	...

*On the Nexa platform, at-a-glance view of extenders at a facility, showing location, operating status, and signal strength of each extender*

# Sequence of Sensor Operation

The system control uses the lowest temperature reported by any indoor sensor on the wireless mesh network. This value, combined with the Room Occupied/Room Unoccupied setting on the system control, determines the boiler water temperature (or cycle length for steam systems).

The system control automatically excludes any sensor reading that falls significantly outside the range of the other sensors. This safeguard prevents occupants from manipulating the heating system by artificially lowering the temperature of a sensor such as by opening a window during cold weather.

## Disconnected Sensors

If a sensor is disconnected from the wireless network, the following provisions take place.

Wireless Mesh  
Indoor Sensor 042

The indoor temperature reading is taken from the remaining connected indoor sensors.

If all sensors are offline, then the control defaults to its outdoor reset settings.

Wireless Mesh  
Outdoor Sensor 043

The system uses the outdoor temperature from the internet. If this is unavailable, the system defaults the outdoor temperature to 32°F (0°C).



## Temperature Alerts

Temperature alerts can be configured in the system control settings to notify you when any indoor sensor rises above or falls below a specified threshold. Alerts are delivered by email or SMS and can also be viewed within Nexa.

## Over-the-Air Updates

Sensor firmware requires periodic updates, which are applied automatically. These updates enhance the security of the sensor network and improve overall sensor performance.


## Troubleshooting

Issue	Possible Solution
Device dropped out or lost	<p>If devices are dropping out frequently or have lost communications, add extenders to increase the robustness of the network.</p> <p>Take your floor plan and check the location of the dropped-out device. There may be obstacles that are reducing the range of the wireless signal.</p> <p>Add an extender between the dropped-out device and the nearest extender to increase the robustness of the wireless mesh network.</p>
Sensor location and labeling	<p>Each device may be beacons from the Nexa platform. Find the device you want to beacon on the equipment page then click Beacon on the device settings. The beacon emits an LED pulse of Orange-Green flashes for 2 minutes to help identify the device.</p>
Determining signal quality at a given point in a building	<p>While installing the system you can use a sensor that has been commissioned to the wireless mesh network to test the wireless quality at any given point of the building. Keep the sensor at hand and press the Join button to get the link quality. (Press  on the extender.) Indicators: Green flash – Excellent; Yellow flash – Fair; Red flash – Poor. A long red flash followed by short red flashes indicates a disconnected device.</p>
Device cannot connect	<p>The device could already be connected to a different wireless mesh network. Before joining a new network, the device MUST be factory reset. Do this by pressing and holding the Reset button  (Wi-Fi on the extender) for 20 seconds.</p>

## Maintenance

**Battery Life and Replacement.** Sensors installed with excellent signal strength can operate for up to 3 years. Those with fair or poor signal strength experience reduced battery life.

RECOMMENDATION: Replace indoor sensor batteries annually rather than waiting for full depletion. Low-battery email or SMS alerts typically provide 1 to 2 months of advance notice before the batteries are depleted and the sensor drops from the wireless mesh network.

**Secure Disposal.** When permanently removing the sensor from a building, with batteries installed, press and hold the Reset button  (Wi-Fi on the extender) for 20 seconds. This resets the sensor to factory default and permanently deletes its access to the wireless mesh network. The sensor can then be safely recycled.



A WATTS Brand

