Wireless Pneumatic Thermostat- WPT Series

1 Overview

The Cypress Envirosystems Wireless Pneumatic Thermostat (WPT) retrofits an existing pneumatic thermostat to provide Direct Digital Control (DDC) like zone control functionality at a fraction of the time and cost without disturbing occupants.

The WPT enables remote monitoring of zone temperature, branch pressure, remote control of setpoints, and programmable setback or setup of the pneumatic HVAC systems. It also enables integration with utility Demand Response programs.

The WPT can be integrated with an existing Building Management System via BACnet/IP. As a result, the WPT helps a building owner and tenants save energy by implementing indoor temperature policies, improve comfort, and reduce the maintenance cost of the legacy pneumatic HVAC systems.

1.1 Components

The WPT Series kit includes the following components:

- WPT
- Universal Wall Bracket
- Mounting screws, #6 x 1” self-tapping (x2)
- Wall Anchors
- Tadiran TL-5920 lithium battery

1.2 Prerequisites for Installation

The WPT relies on a wireless network for communication. Before installing the WPT, the wireless network must be set up. The following tasks must be completed before proceeding to WPT installation:

- Installation of WPT Green Box Server and Blue Box Gateway
- Assignment of a unique node ID for each WPT (to be programmed during installation)
- LoRa gateway must be configured with for each WPT. (Please refer to the LoRa WPT Gateway and Server Installation Manual, Document number 910-00031-01).

1.3 Tools Required for Installation

- # 1 Philips-head screwdriver
- 1/16” hex Allen wrench
- 3/16” Drill (for setting Wall Anchor, if required)

2 WPT Installation

The overall WPT installation procedure includes:

- Mounting the WPT on the wall
- Configuring the WPT
- Calibrating the WPT

2.1 Mounting the WPT

2.1.1 Remove the Existing Thermostat

Remove the external cover of the existing thermostat, if any.

Locate and remove the mounting screws and carefully remove the unit from the wall along with the attached pneumatic tubes.

Detach the old thermostat unit from the air tubes carefully. The air tubes may not have a lot of slack – be careful that the tubes do not retract into the wall. In a 2-pipe system, note the positions of branch and main tubes.

2.1.2 Installing the WPT

The WPT is installed in the existing thermostat location using the Universal Wall Bracket provided with the WPT kit. Care must be taken when opening and calibrating the WPT.

ESD Handling Precautions

Warning!

- The WPT contains ESD sensitive circuit cards and components.
- Great care must be exercised while handling the WPT with the cover open.
- Do not touch any of the circuit boards with fingers or any part of the body.
- Touching the circuit boards may cause the unit to fail due to electrostatic discharge.
- Hold and handle the unit as shown in Figure 1, using the external bottom plastic cover as the support.

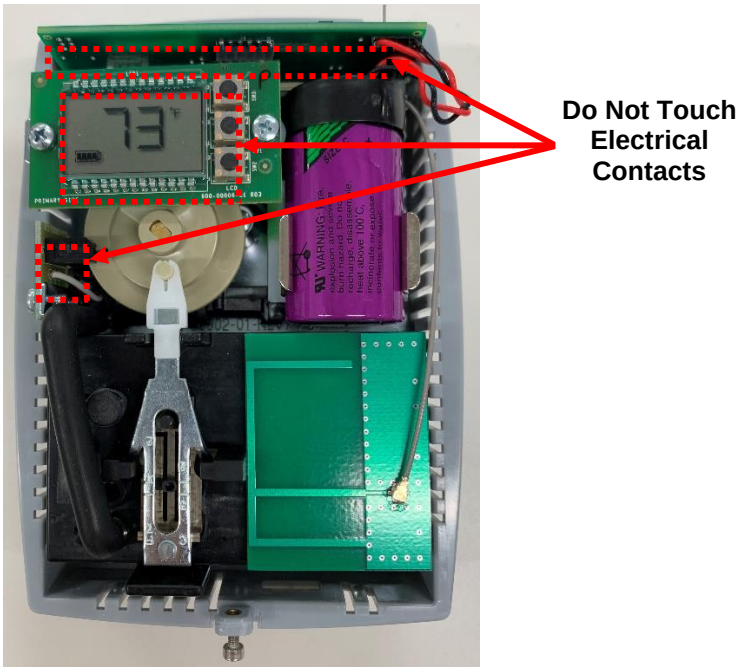


Figure 1. Handling the WPT

Thermostat Lever Handling Precautions

Warning!

- Great care must be exercised while calibrating the WPT.
- Handle the thermostat lever as little as possible.
- Use extreme caution not to allow the lever to rotate sideways while adjusting the setscrew.
- Damage to the bi-metallic spring can result if the end of the lever is allowed to move left or right by more than 1/16”.

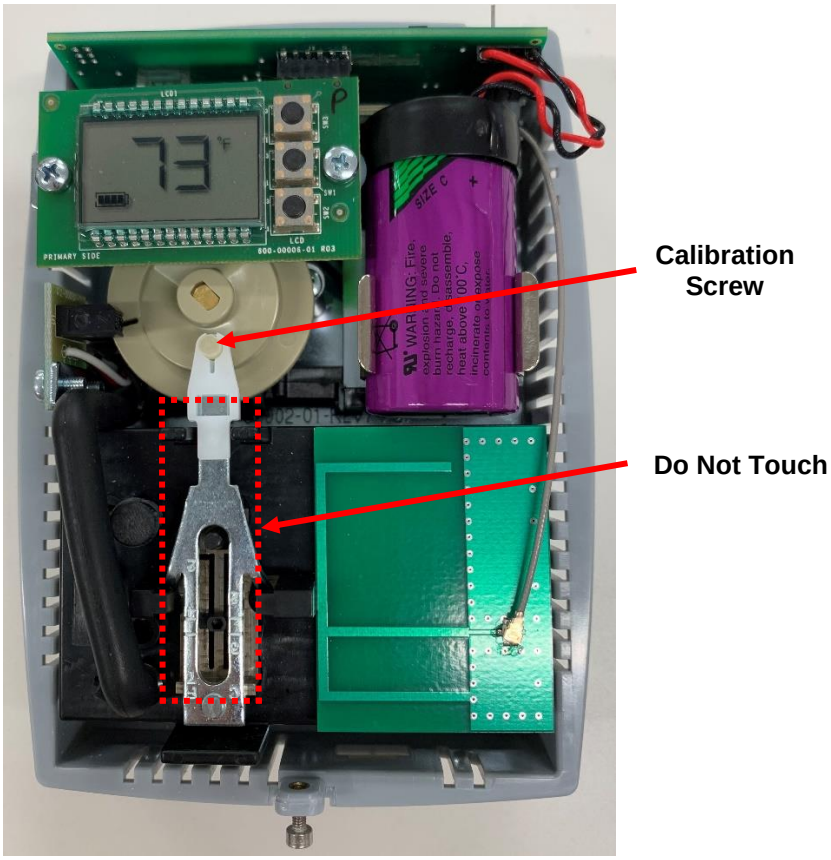


Figure 2. WPT Lever

To install the WPT:

Remove the plastic cover of the WPT using a 1/16" Allen wrench on the bottom screw.

If the Universal Wall-mounting Bracket is attached to WPT, remove it by unscrewing the two captive screws on the bottom of the WPT, as shown in Figure 3.

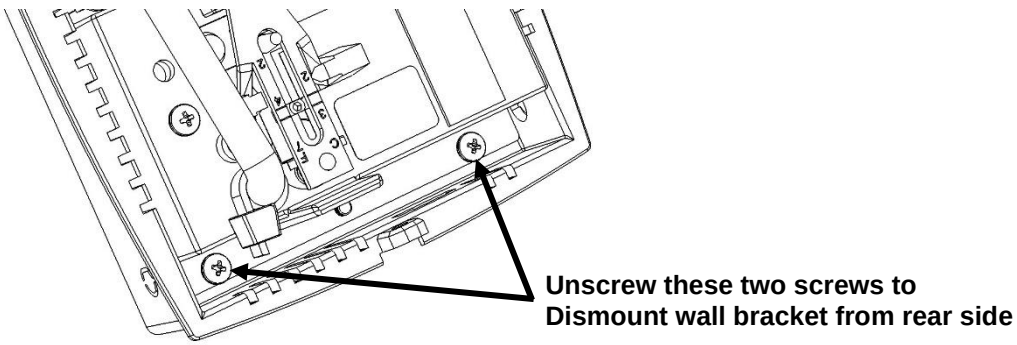


Figure 3. Removing the Universal Wall Bracket

Adjust the Universal Wall Bracket against the old thermostat position, such that any two slots on the wall bracket match the existing two screw holes on the wall, and the large center opening is aligned with the air tube(s). The Universal Wall Bracket is shown in Figure 4.

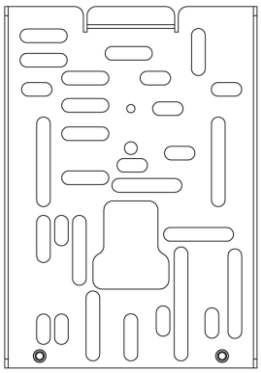


Figure 4. Universal Wall Bracket

Pull the air tubes through the central opening of the Universal Wall Bracket.

Affix the Universal Wall Bracket to the wall with two screws, as shown in Figure 5.

Note: The provided Wall Anchors can be used if existing receptacles are not in the correct location, or if they are damaged.

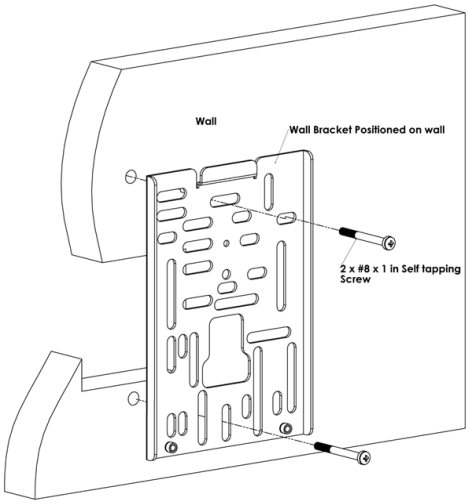


Figure 5. Mounting the Universal Wall Bracket

Connect the branch and main tubes to the air tubes marked B and M on the rear of the WPT, as shown in Figure 6.

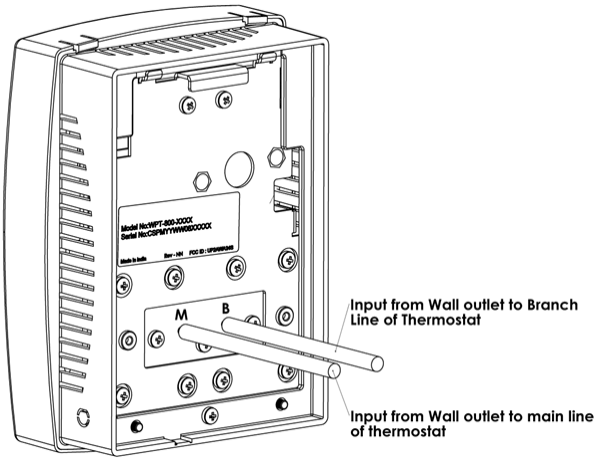


Figure 6. Connecting Main and Branch Tubes to M and B Ports

Attach the WPT to the Universal Wall Bracket using the captive screws.

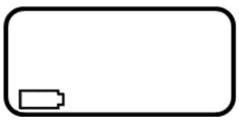
Connect the battery and close the top cover. The battery connector is keyed to prevent miswiring. Connect as shown in Figure 7.

Figure 7. WPT Battery

2.1.3 Installing/Replacing Battery

The WPT has a battery icon on the LCD display which indicates the current state of the batteries. Batteries must be replaced anytime the battery icon displays fewer than 4 bars as shown in the images below.

When the batteries are too low to function normally, the WPT will enter a fail-safe mode until batteries are replaced. The fail-safe mode shuts down all functions of the WPT except for temperature control which continues to operate at a setpoint of 72 ºF. The WPT will display the following screen during this mode.



When replacing the battery, press and hold the center button while plugging in the new battery connector. This will reset the battery gauge. When the display appears, release the button.

The following tasks must be performed after replacing batteries:

- Press any button to power on the WPT.
- Perform an OTAA bind. Refer to Figure 8 for the menu structure.
- Confirm calibration and if needed, perform a manual calibration, see section 2.3.
- (Optional) Resend temperature setpoints, setpoint limits and auto calibration values from the WPT Green Box Controller. Refer to the appropriate WPT Green Box manual for instructions.

Note: If any of the steps above fail, refer to the Additional Troubleshooting section at the end of this manual for further details.

2.1.4 Battery Handling Precautions

Warning!

Replace battery only with the approved Tadiran TL-5920 lithium metal battery. This battery meets UL-1642, as evidenced by UL component listing. Use of any other battery may present a risk of fire or explosion. See Figure 7 for correct polarity of connector.

- Underwriters Laboratories Recognition Mark:
- Caution: The battery used in this device may present a fire or chemical burn hazard if mis-treated. Keep away from children and/or other untrained personnel. Do not recharge, disassemble, heat above 100 ºC (212 ºF), or dispose of in fire.
- Dispose of used battery promptly in accordance with local regulations (place in plastic bag and recycle if possible).
- Do not insert batteries with the ⊕ and ⊙ polarities reversed.
- Do not short-circuit.
- Be sure to wrap each battery when disposing or storing to avoid short circuit.

Caution!

- If leaked liquid gets in the eyes, wash them with clean water and consult a physician immediately.
- Do not apply strong pressure to the battery nor handle roughly.
- Do not use or leave the battery in direct sunlight or in high-temperature areas.

2.2 Configuring the WPT

The WPT can be configured using the LCD display and the 3 front buttons. The menu structure is displayed below. Please refer to this diagram while calibrating and configuring the WPT.

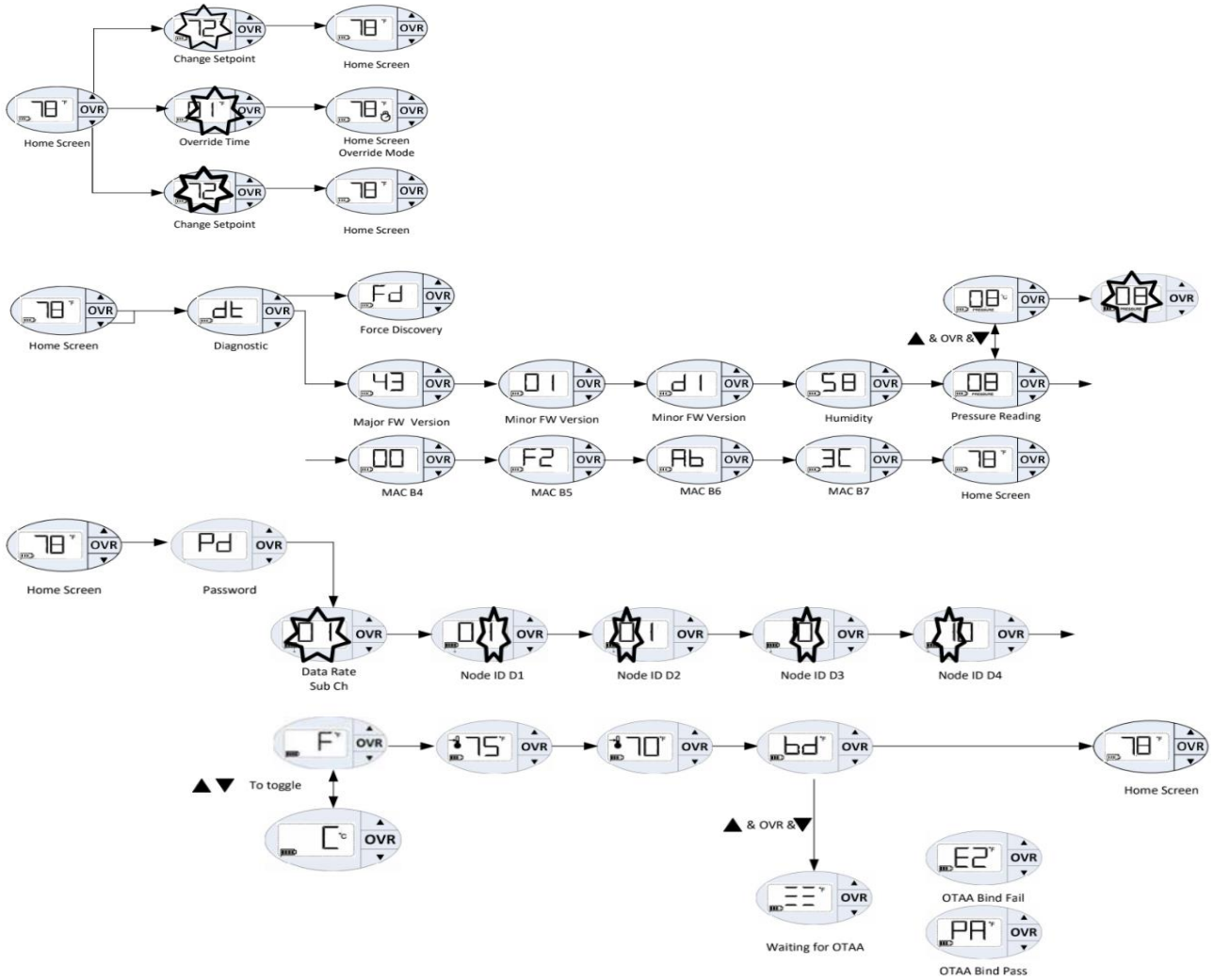


Figure 8. WPT Menu Structure

2.2.1 Programming Mode Password

A password is required to enter the Programming Mode. After pressing all three buttons simultaneously, the following screen will appear:

The password is a series of button presses: contact support@cypressenvirosystems.com for password

2.2.2 Configuring the Frequency Sub-band and Node ID

The WPT must be configured with a valid frequency sub-band and node ID. The frequency sub-band is a single digit number, from 1-9. Sub-bands 1-8 select the LoRa sub-band channel set as show in Figure 9 below. Setting the frequency sub-band to 9 allows the WPT to broadcast on all channels.

LoRa uplink sub-bands	Frequency range (MHz)	Channels
Sub-Band 1	902.3 - 903.7	0-7
Sub-Band 2	903.9 - 905.3	8-15
Sub-Band 3	905.5 - 906.9	16-23
Sub-Band 4	907.1 - 908.5	24-31
Sub-Band 5	908.7 - 910.1	32-39
Sub-Band 6	910.3 - 911.7	40-47
Sub-Band 7	911.9 - 913.3	48-55
Sub-Band 8	915.5 - 914.9	56-63

Figure 9. WPT Node ID Digits

The node ID is a four-digit number. The four digit node ID is displayed in groups of two (D2, D1 together and D4, D3 together).

Figure 10. WPT Node ID Digits

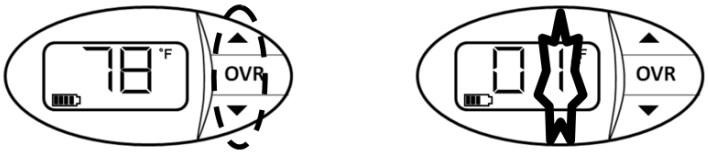
Before programming the WPT, connect the battery and then, press any button. The system will turn on and initialize. During initialization and whenever the WPT starts a

discovery process, “dy” is displayed on the LCD. During this period, the WPT will turn the motor and calibrate the position of the cam. This process should not be disturbed. Wait for the “dy” to disappear from the LCD before performing any additional operations. After initialization, the LCD displays either the current temperature or an error code. See troubleshooting section for a description of display codes. The WPT is now ready for the configuration of the frequency sub-band and the node ID.

To configure the Frequency Sub-band and the node IDs, perform the following:

Press all three buttons simultaneously, then release. The WPT enters “Programming Mode” and requires a password to continue (see section 2.2.1). After the password is successfully entered, the screen will show the current or default Frequency Sub-band.

NOTE: °F icon is displayed, indicating that the frequency sub-band is being programmed.



Press and release all three buttons simultaneously to enter Programming Mode

After entering a correct password, the frequency sub-band will flash signifying Programming Mode

Figure 11. Configuring Frequency Sub-band

Press the ▲ or ▼ button to change the Frequency Sub-band to the required value.

NOTE: The Frequency Sub-band cannot have a “0” value.

Press OVR to confirm the Frequency Sub-band. This completes the programming of the Frequency Sub-band and the LCD displays the first digit, D1, of the node ID.

NOTE: °C icon is displayed, indicating that the node ID is being programmed.

Press the ▲ or ▼ button to change D1 to the required value.

Press OVR to confirm D1.

Repeat above two steps to configure D2, D3, and D4 of the node ID.

NOTE: While the node ID is being configured, the corresponding bar of the battery indicator flashes.

NOTE: D1 and D4 cannot have a “0” value.

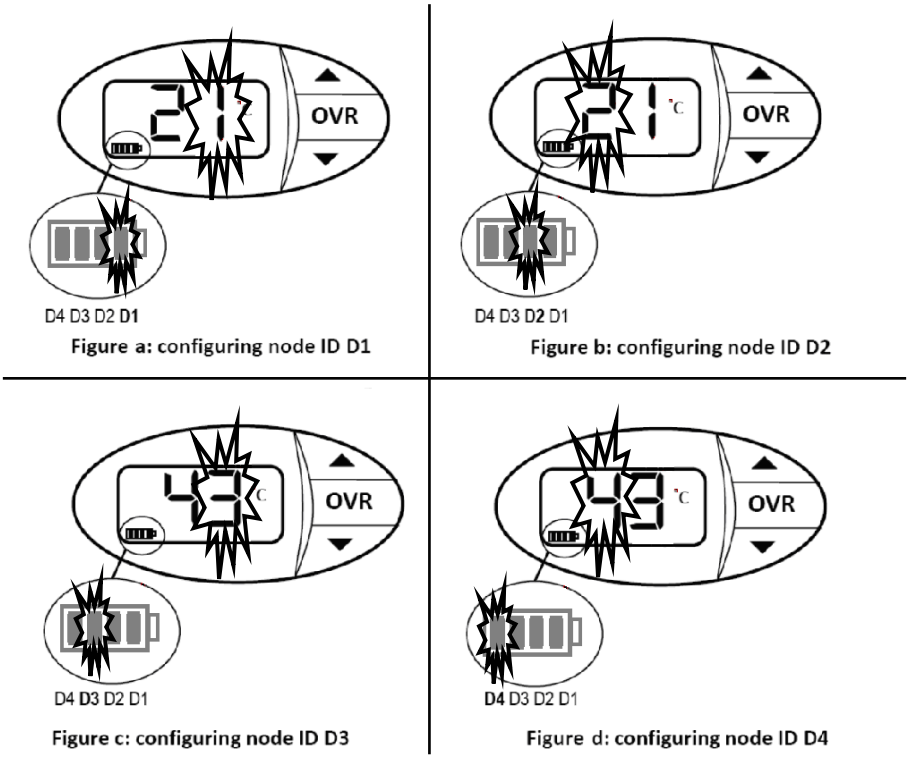


Figure 12. Configuring Node ID 4321

After D4 is configured and confirmed, continue to press OVR to exit the Programming Mode. Once Programming Mode is exited, the WPT will rebind to the LoRa network.

NOTE: The WPT will automatically exit the Programming Mode if no button is pressed for one minute.

The frequency sub-band and node IDs can be changed any time by completing steps 1 through 7.

2.2.3 Selecting between Celsius and Fahrenheit display

The WPT can display temperatures in Celsius or Fahrenheit. The default setting is for Fahrenheit. To toggle the setting:

- From the home screen, press all three buttons simultaneously to enter "Programming Mode" and enter the password (see section 2.2.1).
- Press the OVR button 5 times to navigate past the Frequency Sub-band and Node ID programming screen and into the Celsius/Fahrenheit screen.
- Press ▲ or ▼ to toggle between Celsius and Fahrenheit.
- Press OVR to accept the C/F change.
- Continue to press OVR to exit Programming Mode. Once Programming Mode is exited, the WPT will rebind to the LoRa network.
- Verify that the ambient temperature is displayed in the selected units (C or F).

2.3 Calibrating the WPT

Remove the front cover of the WPT and make sure that the WPT is acclimatized to the ambient temperature.

NOTE: This may take 5 to 10 minutes after attachment to the wall. The bi-metallic spring is very sensitive to body heat. Keep hands and breathe away from WPT to minimize calibration error.

NOTE: The black throttling range adjuster has been factory set to the location marked on the lever as shown in Figure 14. The factory setting provides a Throttling Range (TR) of 4°F. This TR adjuster MUST NOT BE MOVED in order to ensure proper operation and accuracy of the WPT.

To enter Calibration Mode, perform the following:

- Press the ▼ button and OVR button together for two seconds. The display will show 'dt'.
- Press OVR four times. The LCD displays the branch pressure in PSI along with PRESSURE indicator. The display shows "--" if the motor is in motion when trying to access branch pressure.
- Press all buttons simultaneously to enter Calibration Mode. The "C" icon will flash rapidly while in this mode.

Use a 1/16" hex Allen wrench and very carefully turn the calibration set screw on the thermostat lever, shown in Figure 14, until the branch pressure is equal to the desired control point. Use extreme caution not to allow the lever to rotate sideways while adjusting the setscrew. Damage to the bi-metallic spring can result if the end of the lever is allowed to move left or right by more than 1/16".

NOTE: Ensure that there is at least one thread of calibration screw adjustment above the top surface of the Friction Clip, or not less than one thread below the bottom surface of the Control Lever as depicted in Figure 15.

NOTE: Each battery segment on the LCD represents 0.25 PSI resolution, as shown in Figure 13. Pay special attention to this extra resolution while turning the set screw. It is critical this value precisely matches the control point for seamless operation.

8.00 PSI **8.25 PSI** **8.50 PSI** **8.75 PSI** **9.00 PSI**

Figure 13. Pressure Display Resolution

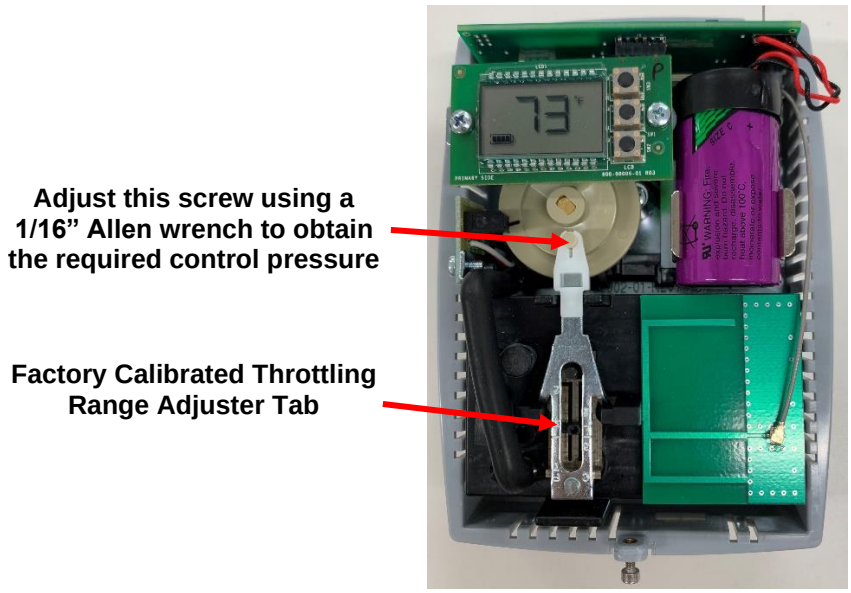


Figure 14. WPT Calibration

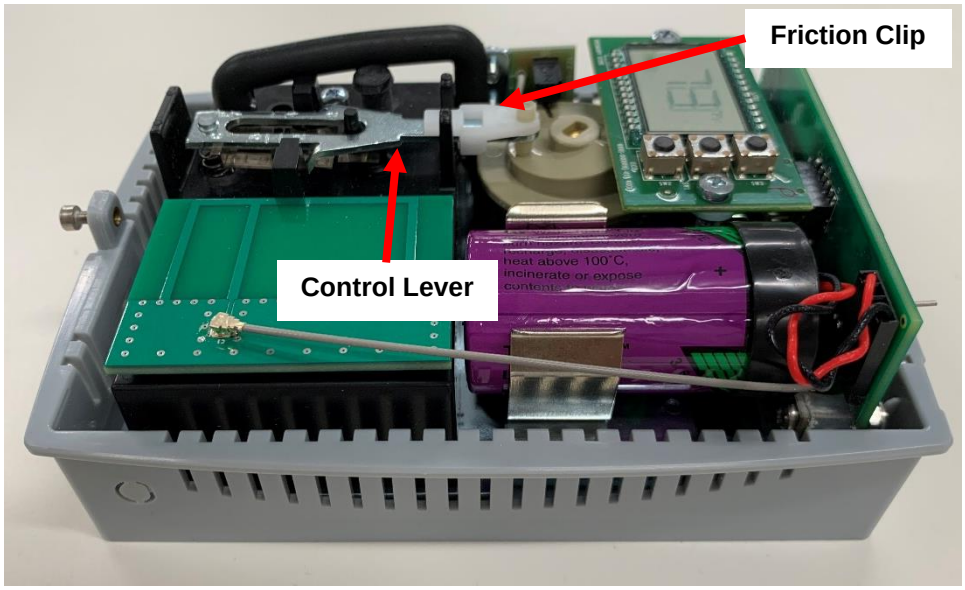


Figure 15. Friction Clip and Control Lever

When the desired control pressure is achieved, press the OVR button to exit and save the value.

- A confirmation screen will appear and flash the stored control pressure for 3 seconds. Repeat the calibration procedure if this value does not match the desired control pressure.

NOTE: The WPT will automatically exit Calibration Mode if OVR is not pressed after 3 minutes. The control pressure will NOT be saved and the WPT will return to the home screen.

Replace the WPT front cover.

3 Operation

The various indicators and characters that are displayed on the LCD display are shown in the Figure 16.

Figure 16. LCD Display

The front panel of the LCD display is used to perform the following functions:

- Adjusting the setpoint temperature
- Turning on/off the occupancy override
- Measuring the branch line pressure

3.1 Adjusting the Setpoint Temperature

The setpoint temperature may be shifted up or down using the ▲ or ▼ buttons. To change the setpoint temperature:

- Press the ▲ or ▼ button once to view the current setpoint along with the setpoint indicator.
- Press the ▲ or ▼ button to change the setpoint value.
- Once the desired value is reached, press the OVR button to accept the change. Leaving the display on the desired value for 5 seconds will also result in a setpoint change.

The LCD display will revert to the current temperature.

3.2 Turning ON/OFF the Occupancy Override

NOTE: This feature only works if the WPT is in “Unoccupied” mode as commanded by the scheduler.

To change the occupancy state from “Unoccupied” to “Override”:

- Press the OVR button to activate the occupancy override. The LCD display flashes the override duration in hours.
- Press the ▲ or ▼ button to change the override duration to desired value.
- Once the desired value is reached, press the OVR button to accept the change. Leaving the display on the desired value for 5 seconds will also result in a duration change.

During Occupancy Override, the setpoint will revert to the last “Occupied” value as commanded by the server. During the override duration, the LCD displays the OVR indicator.

3.3 Measuring the Branch Line Pressure

To measure the branch line pressure:

- Press the ▼ button and OVR button together for two seconds. **NOTE**: The display shows ‘dt’.
- Press OVR four times. The LCD displays the branch pressure in PSI along with PRESSURE indicator.

  NOTE: The display shows “--" if the motor is in motion when trying to access branch pressure. Press OVR to exit and try again.
- Press OVR to exit.

3.4 Checking the Control Pressure

Follow these steps to verify the control pressure:

- Press the ▼ button and OVR button together for two seconds. **NOTE**: The display shows ‘dt’.
- Press OVR four times. The LCD displays the branch pressure in PSI along with PRESSURE indicator.

  NOTE: The display shows “--" if the motor is in motion when trying to access branch pressure. Press OVR to exit and try again.
- Press the ▼ button. The LCD will flash the stored control pressure for 3 seconds and return to the home screen. The battery segments on the LCD represent 0.25 PSI resolution.

3.5 Locking and Unlocking WPT Controls

The WPT can be locked to prevent occupants from overriding setpoints. To lock or unlock the WPT, press the ▲ and ▼ buttons simultaneously. The display will show “LC” if the unit is locked, “UL” if the unit is unlocked. Press the ▲ and ▼ buttons simultaneously to reach the desired condition.

3.6 LoRa Over-The-Air Activation (OTAA)

The WPT uses LoRa OTAA to create a connection link to the network.

NOTE: Force discovery before a WPT is bound to the LoRa network will cause an error. A force discovery simply transmits a test data packet and verifies an acknowledge is received from the network to indicate the link is good.

NOTE: As mentioned in the prerequisites (Section 1.2), the LoRa gateway must be configured for each WPT **PRIOR** to binding.

Troubleshooting

The WPT is designed with diagnostic functions to detect and diagnose faults.

Code	Reason	Solution
dy	Discovery Status: This code indicates that the WPT is performing a discovery operation and it should not be disturbed.	• This indication disappears automatically after a few seconds.
dt	Diagnostic Status: This code indicates that the WPT is performing a diagnostic operation.	• This indication disappears automatically after a few seconds.
Fd	Force Discovery: This code indicates that the WPT is performing a force discovery operation.	• This indication disappears automatically after a few seconds.
UL	Keypad Unlocked: Indicates that the buttons were unlocked by the user.	• This indication disappears automatically after a few seconds.
LC	Keypad Locked: Indicates that the buttons are locked.	• This indication disappears automatically after a few seconds.
E0	Discovery Error: Not able to connect to the Gateway.	• Perform Force Discovery to retry (see Figure 8). • Verify the Frequency Sub-band has been properly configured in the WPT. • This error disappears automatically within 15 minutes or by any button press.
E1	Time Synchronization Error: Not able to synchronize the WPT time with the wireless network.	• The WPT automatically recovers from this error after a few refresh cycles.
E2	Radio Error: Not able to send/receive data.	• If the error persists, contact the original distributor for replacement.
E4	Optical Sensor Error: Not able to properly position the motor/cam.	• This error is an indication of a defective device. Contact the original distributor for replacement.

Additional Troubleshooting

Symptoms	Possible Solution
The WPT does not seem to build branch pressure.	For 2 pipe WPTs: 1. First check that the rubber cap is firmly bottomed into port stub as shown in Figure 17 below. 2. Remove the WPT from the Universal Wall Bracket. 3. Verify both main and branch lines are connected correctly. If they are not attached correctly, reattach the line and check the pressure again. 4. Remove the main line and verify that air is coming out. If possible, measure the main pressure – this requires an additional pressure gauge (not provided by Cypress) connected to the main line. 5. Reconnect the main and remove the branch line connection. 6. Cover the branch port on the WPT completely with a finger. 7. Adjust the setpoint so it is at least 5 degrees above the ambient temperature (for a direct acting stat) or 5 degrees below the ambient temperature (for a reverse acting stat). 8. Check the branch pressure as described in section 3.3 9. If the pressure in the WPT is the same as the main pressure, then there is a potential leak somewhere in the branch line and there is nothing wrong with the WPT. 10. If the pressure in the WPT is not the same as the main pressure, try swapping the WPT with another unit.
The WPT does not seem to be controlling correctly and/or is making a loud hissing sound	1. Check that the rubber cap is firmly bottomed into port stub as shown in Figure 17 below. 2. Check to see that the main and branch lines are connected properly to the WPT. Refer to Figure 6 for proper connection. 3. If the lines are not properly connected, reattach the lines and check the system again. 4. If the lines are properly connected, try swapping the WPT with another unit. 5. If the branch and main lines are swapped, the WPT was installed incorrectly and may be damaged.
The WPT exhibits incorrect or suspect behavior after battery replacement, perform the following steps. *Examples of such behavior could be: non-responsive buttons, erroneous setpoint limits, inaccurate ambient temperature or excessive motor movement.*	1. Disconnect the battery from the WPT thermostat. 2. Press and hold the OVR button until the segments on the LCD are no longer visible. 3. Let the thermostat sit for 30-45 minutes to fully discharge all components. This will default many of the operating parameters of the thermostat to factory defaults. 4. Reconnect the battery and follow the steps in section 2.1.3.

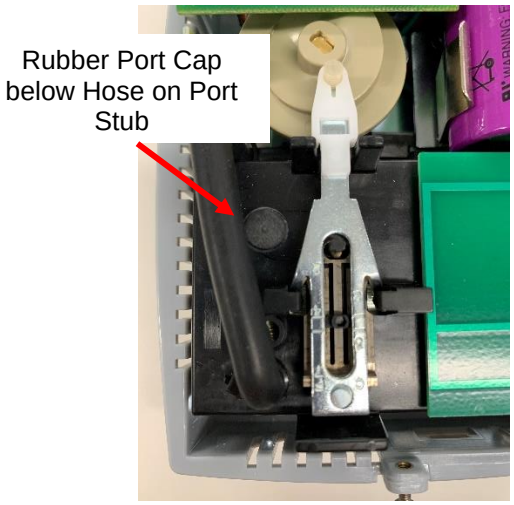


Figure 17. 2 Pipe Thermostat Port Cap

4 Repair

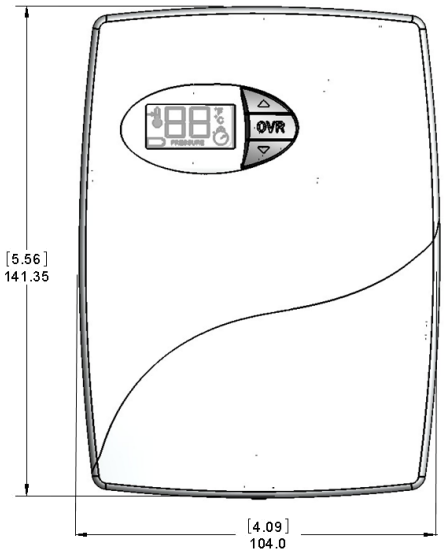
Except for the batteries, the WPT does not have any field replaceable or repairable parts. Contact the original distributor of the unit for repair or warranty service.

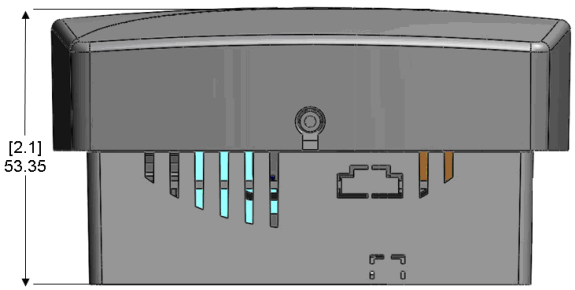
NOTE: Care should be taken to keep the unit dust-free during installation.

The WPT is designed to work reliably with a clean, dry-compressed air supply at the required pressure.

5 Technical Specification

Action	Direct / Reverse Acting
Number of pipes	Dual pipe
Setpoint Temperature Range	55ºF to 85ºF (13°C to 29°C)
Air connections	3/32 in (2.5 mm) ID tube fittings
Maximum Operating Pipe Pressure	25 psi (170 kPa)
Airflow Usage	0.011 scfm (5.2 mL/s)
Sensitivity	Factory Adjusted to 2.0 – 2.5 PSI/F
Operating Frequency Band	915 MHz LoRa Network Band
Battery Life	More than 2 years (with four setpoint changes per day)
Operating Conditions	32 to 122ºF (0 to 50ºC) 95%RH Max, Noncondensing
Storage Conditions	-40 to 122ºF (-40 to 50ºC) 95%RH Max, Noncondensing
Dimensions	Length: 5.6 in (141 mm) Width: 4.1 in (104 mm) Depth: 2.1 in (53 mm)





Cypress Envirosystems
5883 Rue Ferrari
San Jose, CA 95138, USA
support@cypressenvirosystems.com