

USING THE TOWER MONITORING SYSTEM

REALM
AGRICULTURE

Table of Contents

<i>Tower Monitor System</i>	4
1. Overview	4
1.1 Part Numbers	4
1.2 Features	4
1.3 Important FCC and IC Compliance Information	5
1.4 Installation Safety	5
1.4.1 Pivot Safety	5
1.4.2 Ladder Safety	5
1.5 User Information	6
1.5.1 Mounting	6
1.5.2 Wiring	6
1.6 Installation Packet Series	6
1.7 Indicator Description	6
1.8 Cloud Data Services	7
1.8.1 Points of Contact	7
1.8.1.1 Installation User Interface	7
1.8.1.2 Obtaining a Login	7
1.8.1.3 Obtaining Help	7
2. Tower Monitor Installation	8
2.1 Log In to App	8
2.2 Navigate	8
2.3 Add Pivot	9
2.4 Navigate Organization	10
2.5 Enter Information	11
2.6 Place Pivot	12
2.7 Check Progress	13
Field Install	13
2.8 Gather Tools	13
2.9 Connect Gateway	13
Tower Pivot Monitor Installation	14
2.10 Power Off Pivot	14

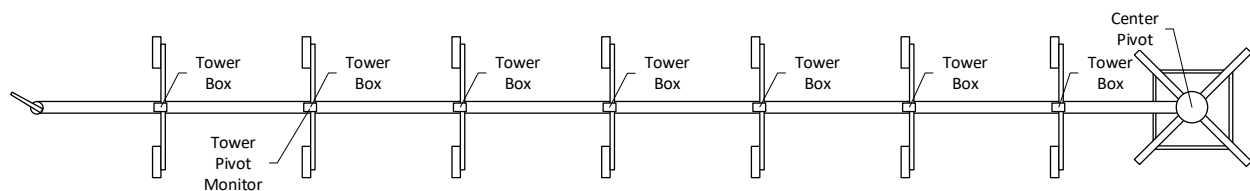


2.11	Add Tower Pivot Monitor	14
2.12	Turn Off Tower Box.....	15
2.13	Open Tower Box and Locate Alignment Fault Microswitch.....	15
2.14	Loosen Microswitch Screws	16
2.15	Inspect Microswitch Screws	17
2.16	Mount the Tower Pivot Monitor Board.....	17
2.17	Move Right Forked Terminal Wire	18
2.18	Tighten All Three Screws	19
2.19	Connect the Wires	19
2.20	Plug in the Connector	20
2.21	Secure the Wires and Replace the Lid	21
2.22	Turn on the Switch	21
2.23	Complete the Installation	22
2.24	Start the Pivot.....	23

TOWER MONITOR SYSTEM

1. OVERVIEW

The Tower Pivot Monitor (TPM) is an end device in the Internet of Things (IoT) for agriculture. It is installed on the electrical terminal screws of the fault alignment microswitch in the existing tower box on the center pivot used for field irrigation. It has three wire connections to the Forward, Reverse, and Neutral span cable control wires. Its job is to report position and direction of a pivot and monitor the fault alignment microswitch. It sends this information to a Gateway device. The Gateway listens for packets from end devices and periodically makes a cellular data connection to forward the accumulated end device packets to a server along with its own packets. The Gateway acknowledges packets from edge devices. The Gateway also holds downlink packets from the server for edge devices and sends them to the device after the next uplink packet from the device in lieu of an acknowledge.



With a tower monitoring system installed, you can:

- Tell which direction a pivot is running.
- Tell when it starts and stops.
- Tell approximately where the pivot is in the field using GPS.
- Tell when it has a safety stop and whether the stop was caused by alignment of the tower on which the TPM is installed.
- Tell when the TPM's microswitch is becoming faulty — before it fails completely.*
- Stop the pivot remotely, by interrupting the alignment fault detection control wire.*

1.1 Part Numbers

Tower Pivot Monitor Part Number 100-00528

1.2 Features

The TPM includes the following features:

- Low power microcontroller
- Mounts on the fault alignment microswitch wire connections
- 120 VAC powered from either the Forward or Reverse control wires
- Low power, long range radio for communication to Data Gateway
- GPS receiver for device location
- Non-volatile memory for configurable read intervals
- Non-volatile memory for data storage when a Gateway is not available
- Red-green-blue LED status indicator



1.3 Important FCC and IC Compliance Information

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

This product meets the applicable FCC Part 15 rules. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

To limit RF exposure, please ensure 8 inches (20 cm) of separation from the transmitter antennas at all times.

1.4 Installation Safety

- Only certified electricians should install the tower alignment monitors and tower pivot monitors.
- Wear appropriate safety gear.

1.4.1 Pivot Safety

- Read and follow your pivot manufacturer's safety instructions and guidelines.
- Do not part a vehicle in the path of the irrigation pivot towers.
- Before installing the TPM on a pivot, insure that power to the pivot is off.
- Use a harness to tether to a solid point that could hold your weight while working up high on a pivot.
- Only certified electricians should install the tower alignment monitors and tower pivot monitors.

1.4.2 Ladder Safety

- Read and follow all safety instructions from the ladder manufacturer.
- Do not use a ladder under overhead power wires.
- Do not exceed the weight rating of the ladder.
- Set the ladder on a firm surface with both legs touching the ground where they will not slip or sink.
- Set the ladder at the proper angle.
- Ensure that both sides of the top of the ladder rest firmly against a solid surface
- Have a second person hold the base of the ladder.
- Keep three points of contact with the ladder.
- Do not overreach when working on a ladder.

1.5 User Information

1.5.1 Mounting

The TPM is a circuit board that mounts on the fault alignment microswitch inside the tower box on the next to the last tower. **The board can be damaged by static discharge.** Even discharge that you cannot feel can potentially damage sensitive circuits. The TPM board should be kept in its anti-static bag until the tower box cover has been removed and it is ready to be installed on fault alignment microswitch.

1.5.2 Wiring

The TPM has a pre-wired three position pluggable terminal block. The three wires connect to pivot's Forward, Reverse, and Neutral span cable control wires. This is done on the tower box's terminal block on the side opposite the span cable connections. The TPM wires are labeled. The TPM's neutral wire is white. Because of the variation in wire colors between the different pivot manufacturers the TPM's forward and reverse wires are black. **Table 1** shows the various pivot manufacturer control wire colors.

Control Wires	Lindsay	Reinke	Valmont	TPM
Forward	Pink	Purple	Brown	Black (labeled)
Reverse	Yellow	Pink	Orange	Black (labeled)
Neutral	White	White	White	White (labeled)
Alignment Fault	Brown	Brown	Yellow	Mounts on microswitch

Table 1 – Pivot Control Wire Colors

1.6 Installation Packet Series

The TPM will automatically send five data packets via radio to the Gateway after it is powered up the first time by the Forward or Reverse control wires. It sends a version packet, a configuration packet, a status packet, a pivot monitor packet, and a location packet. These packets are sent with a special “send-it-now” flag to make the Gateway forward them immediately instead of holding them until the next normal cellular connection.

The TPM turns on its GPS receiver continuously to acquire time and location. This is indicated with short cyan flashes every two seconds. It needs date and time to set its real time clock. It needs location to send the location packet. IT MUST BE ABLE TO RECEIVE FROM GPS SATELLITES TO FUNCTION CORRECTLY. After acquiring time and before location is acquired, it sends the version, status, and pivot monitor radio packets. The TPM stays on as long as the pivot is running forward or reverse. It holds enough power to send a pivot monitor and location packet after the pivot stops.

1.7 Indicator Description

Since the TPM is housed in a tower box and the cover must be on the tower box to run the pivot and the pivot must be running forward or reverse for the TPM to be powered, the TPM indicator will not be visible. Indicator information is given here only for informational completeness.

The TPM has a red-green-blue LED indicator to convey status. But since it is only powered up while the pivot is running, the user cannot normally see this information. The table below gives the meaning of colors and flashes.

Color	Flash Timing	Meaning
Green	0.1 s flash every 2 s	On
Cyan	0.1 s flash every 2 s	GPS on
Magenta-Green	Once	Radio packet sent, acknowledge received
Magenta-Red	Once	Radio packet sent, no acknowledge received
RYGY	Rapid and repeating	Booting Firmware

Table 2 – Indicator Information

1.8 Cloud Data Services

Data from RealmFive IoT devices is stored on data servers in the cloud. The data is accessible to customers through an API allowing customer integration into their own applications and websites. Device data is also accessible through app.realmfive.com which is intended to aid installers with configuration and verification of device operation. Both require credentials for access. See the following section for information on how to obtain credentials.

1.8.1 Points of Contact

1.8.1.1 Installation User Interface

RealmFive's installer interface is at app.realmfive.com. A login username and password are required to access this website. Access to this website is needed to verify device installation. Please contact your administrator at least 24 hours prior to installation time to get your login set up if you do not have one.

1.8.1.2 Obtaining a Login

A login username and password may be obtained by emailing your administrator with the following information:

FIRST NAME
LAST NAME
PHONE NUMBER
ORGANIZATION

Your username will be your email address. You will be sent a temporary password which must be changed the first time you log in.

To log in, go to app.realmfive.com, or simply scan the QR code on a device, and enter your username and password.

1.8.1.3 Obtaining Help

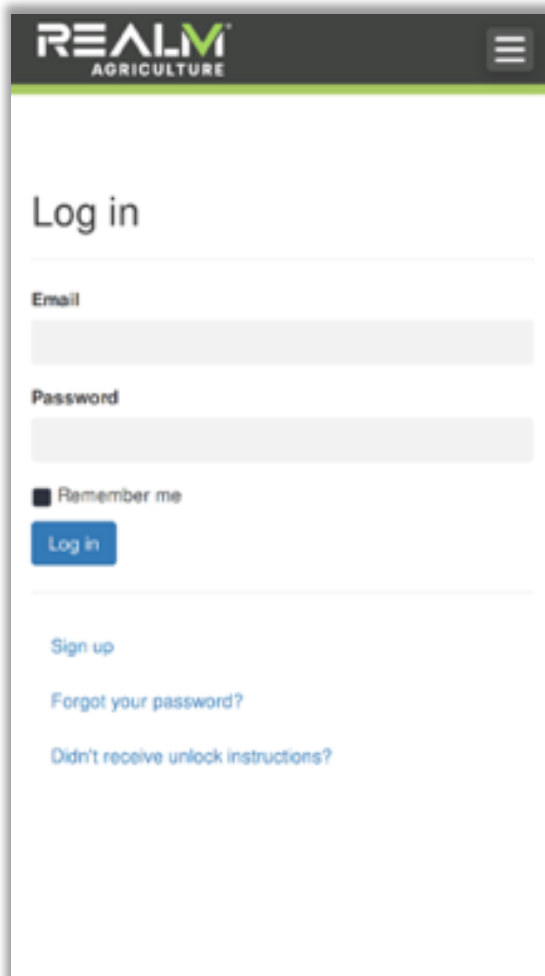
Questions and problems can also be submitted via the help desk or chat link within the app. A guide to common user tasks and frequently asked questions can be found under "Support" at app.realmfive.com. More immediate help can be obtained through a live chat under "Support" at app.realmfive.com.

2. TOWER MONITOR INSTALLATION

2.1 Log In to App

Log into RealFive's browser-based installation app.

- ☹ Not able to login.
- 😊 Refer to the Data Gateway installation guide for login instructions.

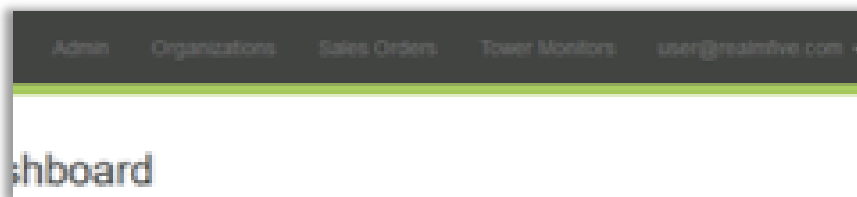


The screenshot shows the login interface for REALM AGRICULTURE. At the top is the REALM AGRICULTURE logo and a hamburger menu icon. Below the logo is the heading "Log in". There are two input fields: "Email" and "Password". Below the password field is a checkbox labeled "Remember me" and a blue "Log in" button. At the bottom, there are three links: "Sign up", "Forgot your password?", and "Didn't receive unlock instructions?".

2.2 Navigate

Navigate to

- Tower Monitor

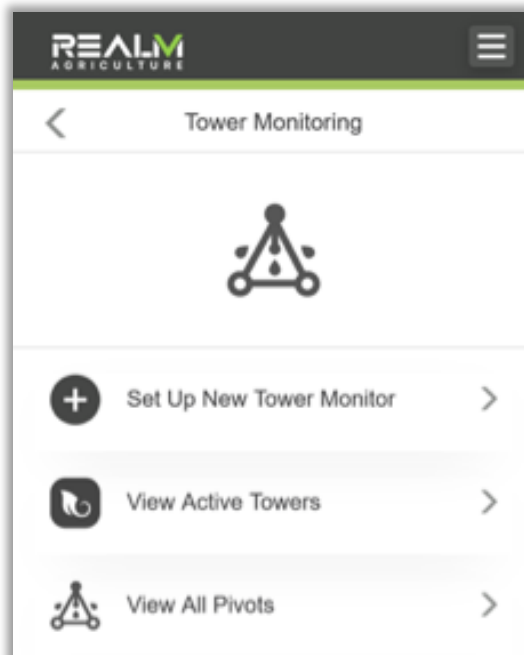


- Use in the upper right corner on mobile devices and select Tower Monitor



2.3 Add Pivot

Tap Set Up New Tower Monitor.



2.4 Navigate Organization

Navigate to (as necessary)

- Organization (Vendor)
- Grower
- Farm
- Field

☹ You are unable to find grower, farm, and/or field.

😊 You have the option to set up a grower, farm, and field as you navigate to each page. Or you can refer to the Data Gateway installation guide for how to set up grower, farm, and field.

The image displays four screenshots of the REALM AGRICULTURE mobile application interface, arranged in a 2x2 grid. Each screenshot shows a different step in the navigation process, with a progress bar at the top indicating the current step (1-7).

- Top Left: Choose Vendor**
 - Progress bar: Step 1 is active.
 - Vendor dropdown menu: Organization
 - Next button
- Top Right: Choose Farm**
 - Progress bar: Step 3 is active.
 - Farm dropdown menu: Farm
 - or
 - Add a New Farm button
 - Next button
- Bottom Left: Choose Grower**
 - Progress bar: Step 2 is active.
 - Grower dropdown menu: Grower
 - or
 - Add a New Grower button
 - Next button
- Bottom Right: Choose Field**
 - Progress bar: Step 4 is active.
 - Field dropdown menu: Field
 - or
 - Add a New Field button
 - Next button

2.5 Enter Information

Enter in information about your pivot:

- Number of Towers
- Select “Lateral Pivot” if you do not have a center pivot
- Pivot name
- Pivot brand
- Pivot model

REALM AGRICULTURE

< Enter Pivot Information

Towers: 7 ☐ Lateral Pivot

Friendly Name

optional information

Brand

Model

Next

2.6 Place Pivot

Place the pivot on the map to represent how it looks in your field. Adjust the drawing as necessary. The steps to draw the pivot include

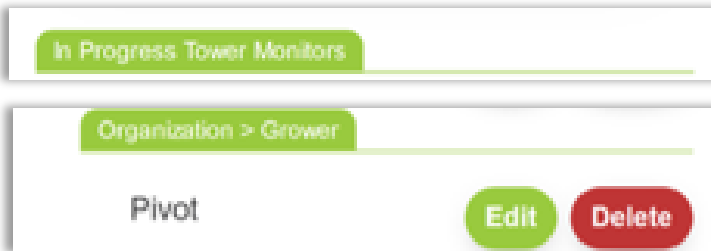
- Click the map to place the center of the pivot
- Drag the outside circles on pivot lines to increase or decrease the circumference of the pivot watering area.
- Drag the circles inside the pivot lines to change the pivot watering area if you have a dead zone in your field.
- Click the button Cover Full 360° if the pivot watering area is the entire field.



2.7 Check Progress

Navigate back to the Tower Monitors page and verify your newly created pivot is under the In Progress Tower Monitors section.

- ☹️ You scan the QR code and you forget which device goes in which field according to the app or tower that each the TPM goes on.
- 😊 Wait to scan the QR code until field install so the device in each tower and field matches what is entered the app.



FIELD INSTALL

2.8 Gather Tools

Gather all necessary tools for installation:

- Ladder (recommended)
- Small zip ties
- Phillips and straight slot screwdrivers
- Wire strippers
- Appropriate safety gear

2.9 Connect Gateway

The Tower Product Monitor needs the Data Gateway to send in its data packets. A Data Gateway must be installed before Tower Product Monitor. See Data Gateway Installation manual for how to set up the Data Gateway.



Data Gateway

TOWER PIVOT MONITOR INSTALLATION

2.10 Power Off Pivot

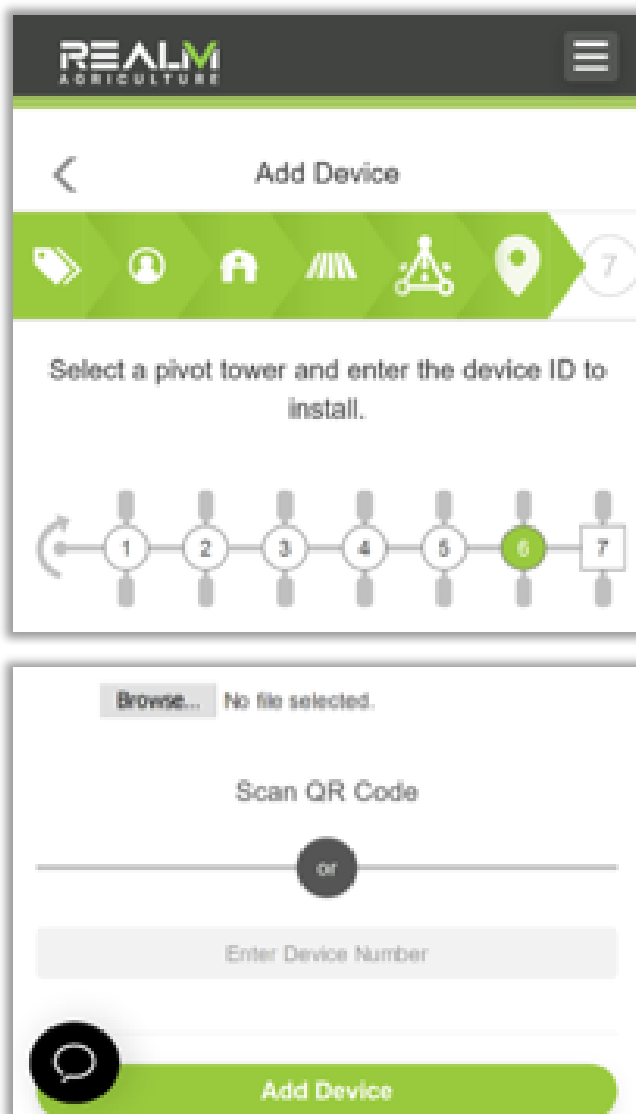
Use the pivot service disconnect to turn off the pivot. Read and follow your pivot manufacturer's safety instructions and guidelines when turning off the pivot.

2.11 Add Tower Pivot Monitor

Scan Tower Pivot Monitor QR code via smart phone when prompted from app.realmfive.com.

Or type in the device's 10 character identifier starting with 0x as it appears on the label.

Tap Add Device.



2.12 Turn Off Tower Box

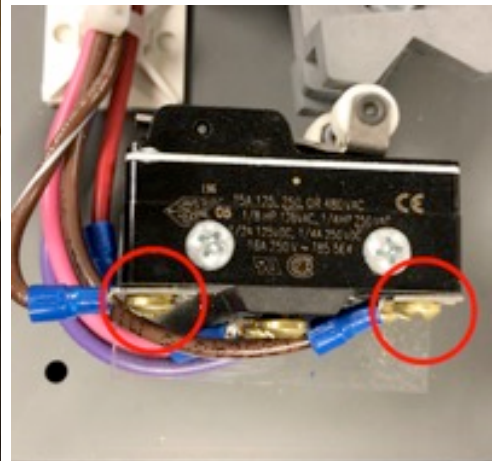
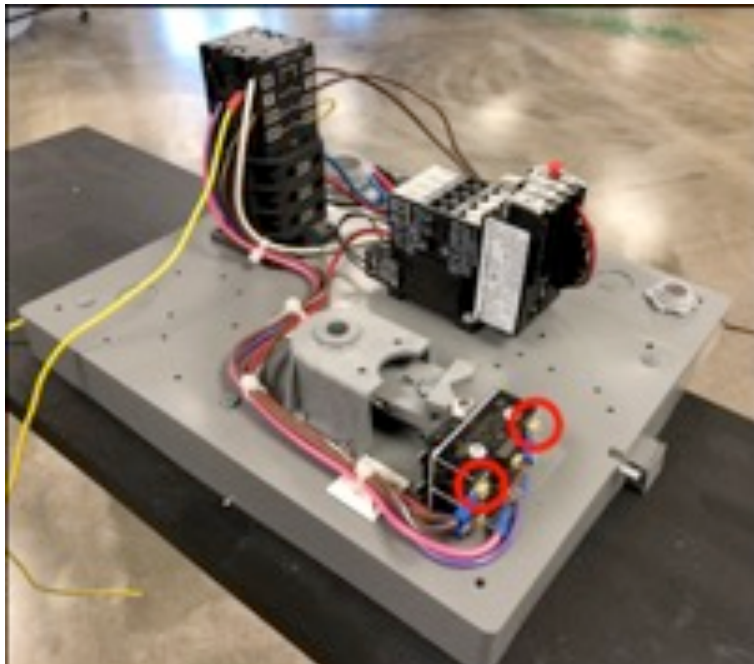
Turn off tower box switch located underneath the tower box. The switch location and look may vary by pivot manufacturer, but each pivot tower will have tower box switch.



2.13 Open Tower Box and Locate Alignment Fault Microswitch

Remove the tower box lid and locate the 2 screws attaching the forked connectors to the tower alignment microswitch. This is where the Tower Pivot Monitor will be installed.

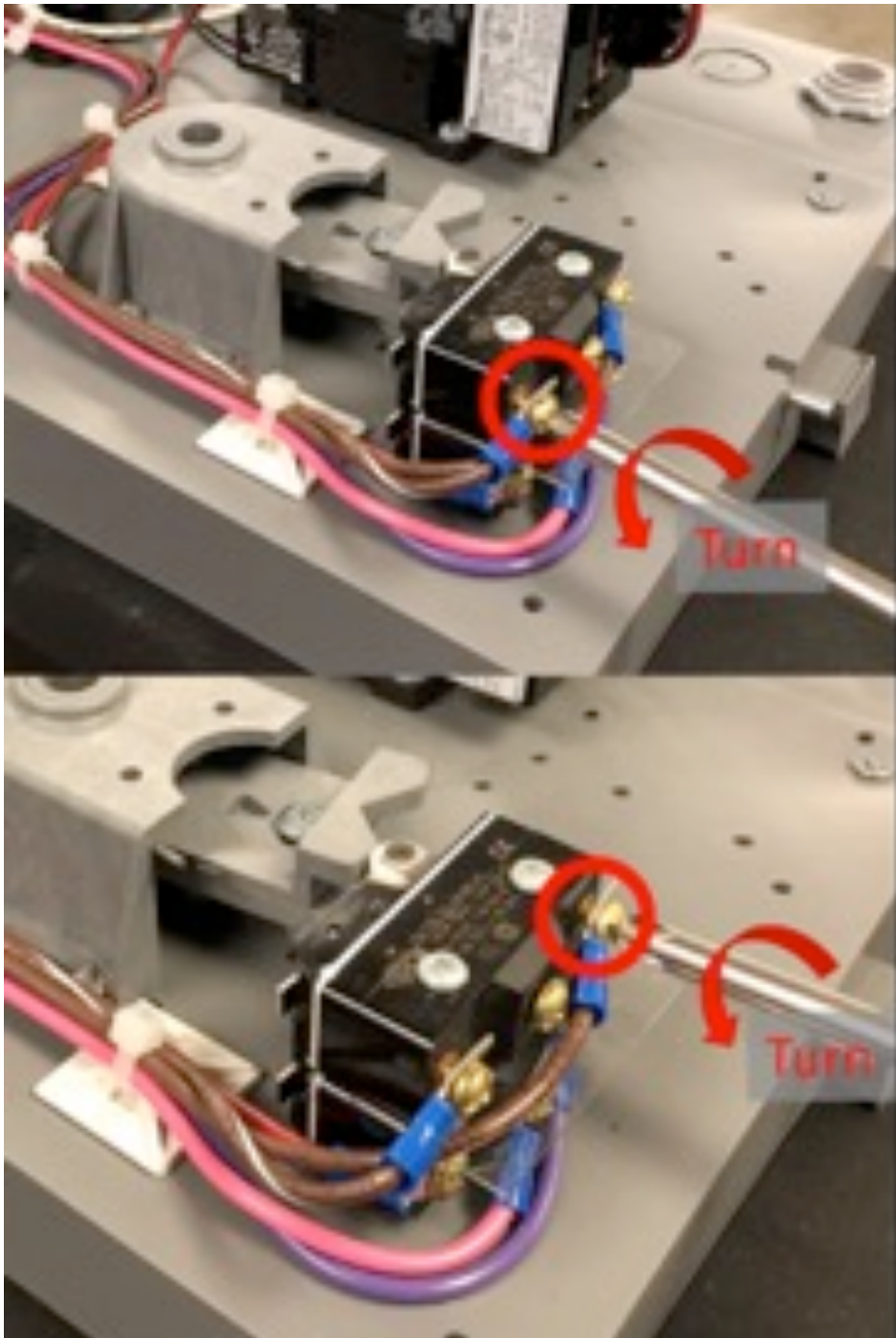
The forked connector is between the screw head and the tower alignment microswitch. The Tower Pivot Monitor will go between the forked connectors and the tower alignment microswitch for a secure connection.



2.14 Loosen Microswitch Screws

Partially unscrew both screws so there is space to install the Tower Pivot Monitor. Turning the screws about 3 turns should provide enough space. It is not necessary to remove the screws.

- ☹ The screws are short making them easy to remove accidentally while loosen them. It is easy to lose them once they are removed.
- 😊 Turning the screws about 3 turns should provide enough space to put the device in.



2.15 Inspect Microswitch Screws

Inspect the tower alignment microswitch to ensure there is a small gap between the forked connectors and the microswitch body.



2.16 Mount the Tower Pivot Monitor Board

Carefully take the Tower Pivot Monitor out of its packaging by only touching edges of the board. **DO NOT TOUCH THE CIRCUITRY**. Slide the Tower Pivot Monitor in line with the 2 screws on the tower alignment microswitch with the large power supply facing away from you.

- ☹ Touching any part of the green circuit board can permanently damage the Tower Pivot Monitor.
- 😊 Hold the Tower Pivot Monitor only by the edges of the board.

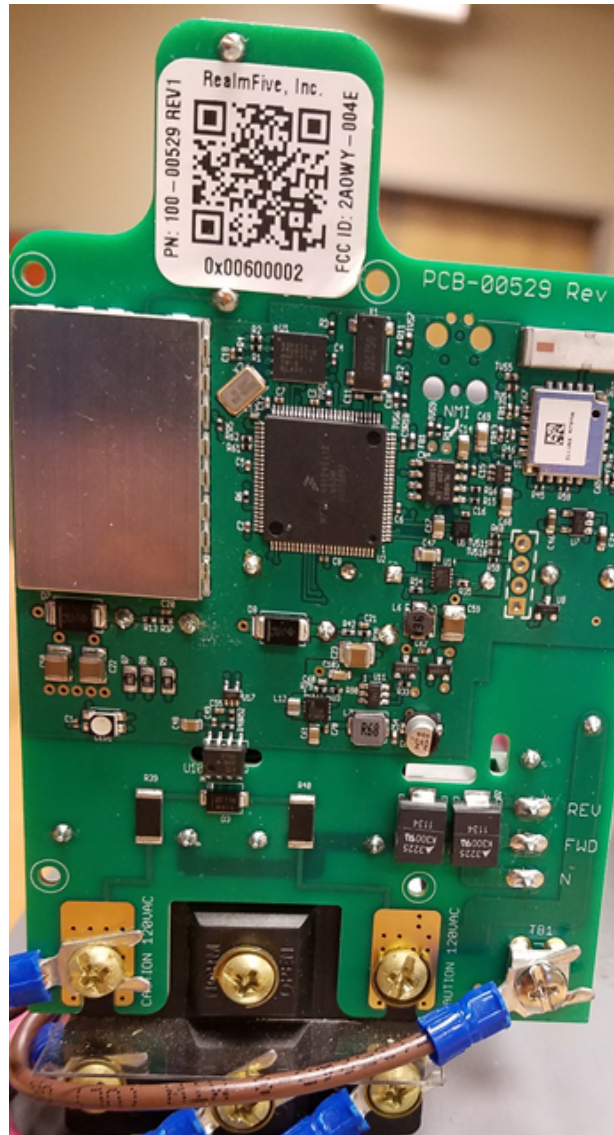


2.17 Move Right Forked Terminal Wire

Slid the gold contacts on the Tower Pivot Monitor all the way down over both screws. The device needs to be touching the forked connectors of the switch before tightening the screws.

You need to move the right fork connector from the tower alignment switch to the screw on Tower Pivot Monitor on the right- hand side. This gives the Tower Pivot Monitor the ability to stop the pivot.

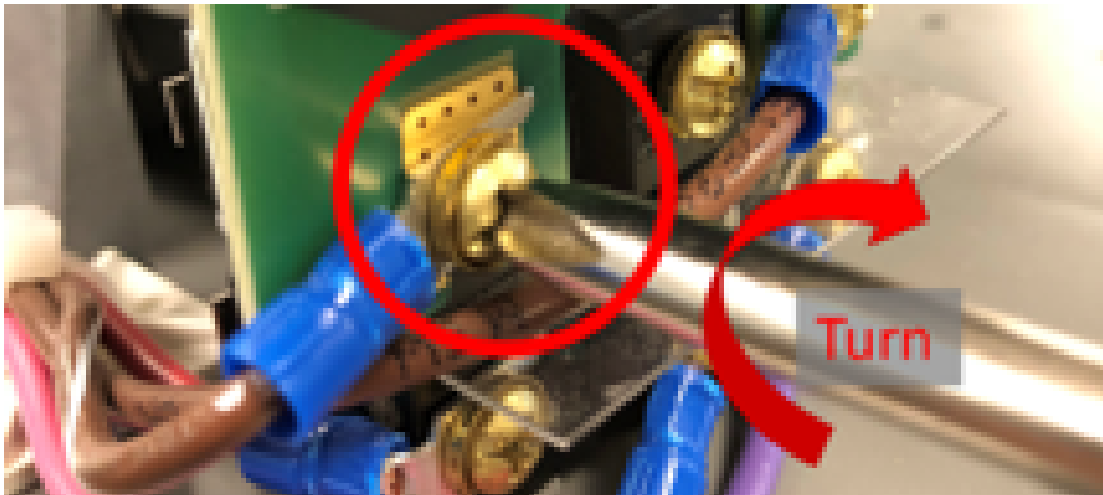
Note: Green box terminal should not be on the front of the circuit board in the top two pictures when connecting the fork connector (see picture below). I do not need the picture below; it is just for reference.



2.18 Tighten All Three Screws

Tighten both screws on the tower alignment switch so the board is secured tightly to the switch. Tighten the right-hand screw so the fork connector is secure to the Tower Pivot Monitor board.

- ☹ The pivot does not turn on or randomly shuts off without reporting an alignment fault.
- 😊 Check: Did you properly tighten the screws to the tower alignment switch and Tower Pivot monitor? Tighten the screws so the device is making a reliable contact with the microswitch.

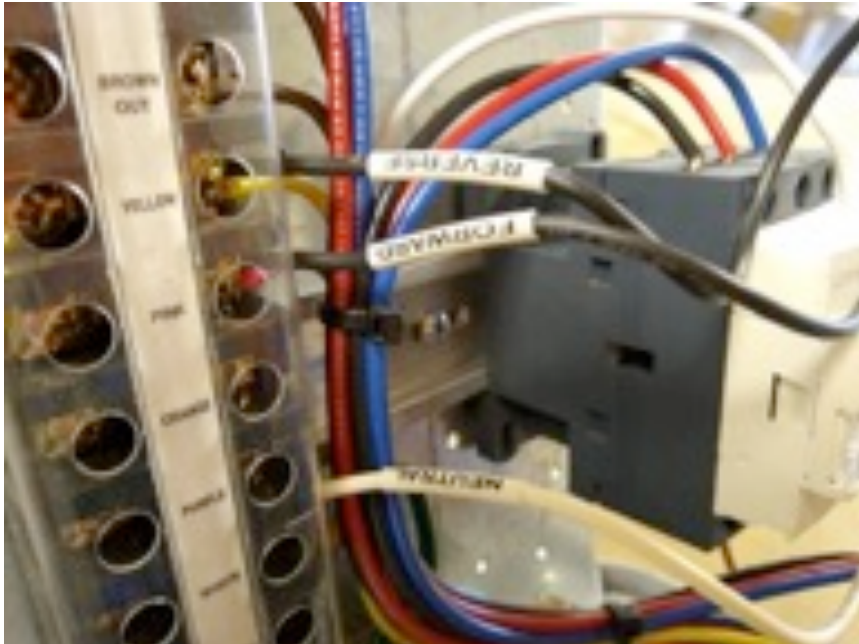


2.19 Connect the Wires

Connect the forward, reverse, and neutral cables to the forward, reverse, and neutral on the terminal block of the tower box. The terminal block location to wire the Tower Pivot Monitor cables varies based on your pivot manufacturer (see the table). The Tower Pivot Monitor cables come labeled.

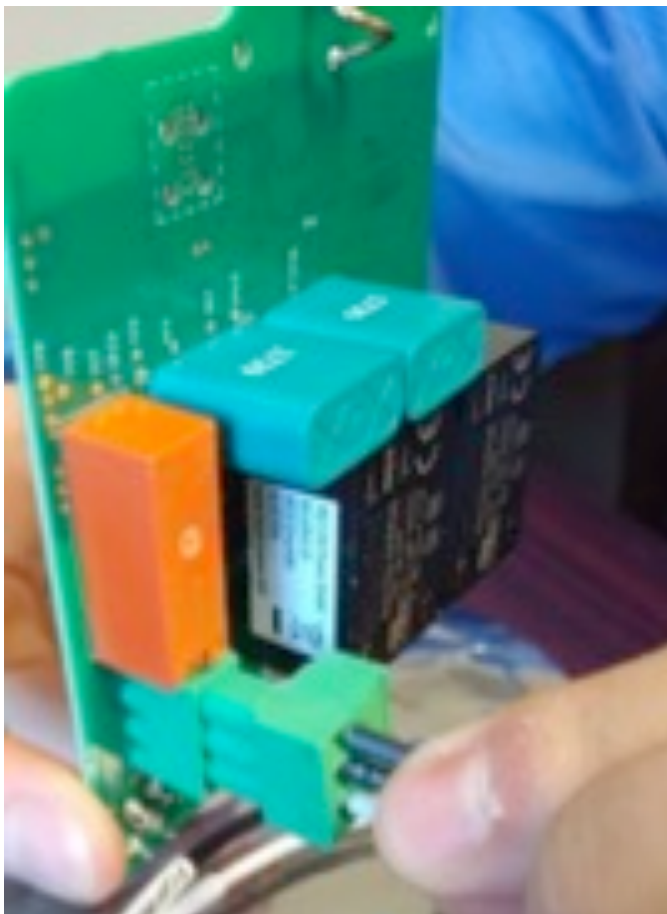
NOTE: IF YOU HAD YOUR PIVOT WIRING MODIFIED, CONSULT WITH THE PERSON THAT DID THE MODIFICATION BEFORE INSTALLING THE TOWER PIVOT MONITOR.

The Terminal Box Location to Wire the Tower Pivot Monitor Cables based on Pivot Manufacturer			
Tower Pivot Monitor Cables	Pivot Manufacturer		
		Zimmatic	Valley
	Reinke	Lindsay	Valmont
Forward	Purple	Pink	Brown
Reverse	Pink	Yellow	Orange
Neutral	White	White	White



2.20 Plug in the Connector

Connect the Tower Pivot Monitor cables to the board. Push the green terminal block plug into the green terminal block located on the back side of the board.



2.21 Secure the Wires and Replace the Lid

Ensure no cables or other components are blocking any mechanisms and all the wires are in the tower box allowing the lid to close. Use small zip ties if necessary, to secure any loose wires.

Close the tower box lid.

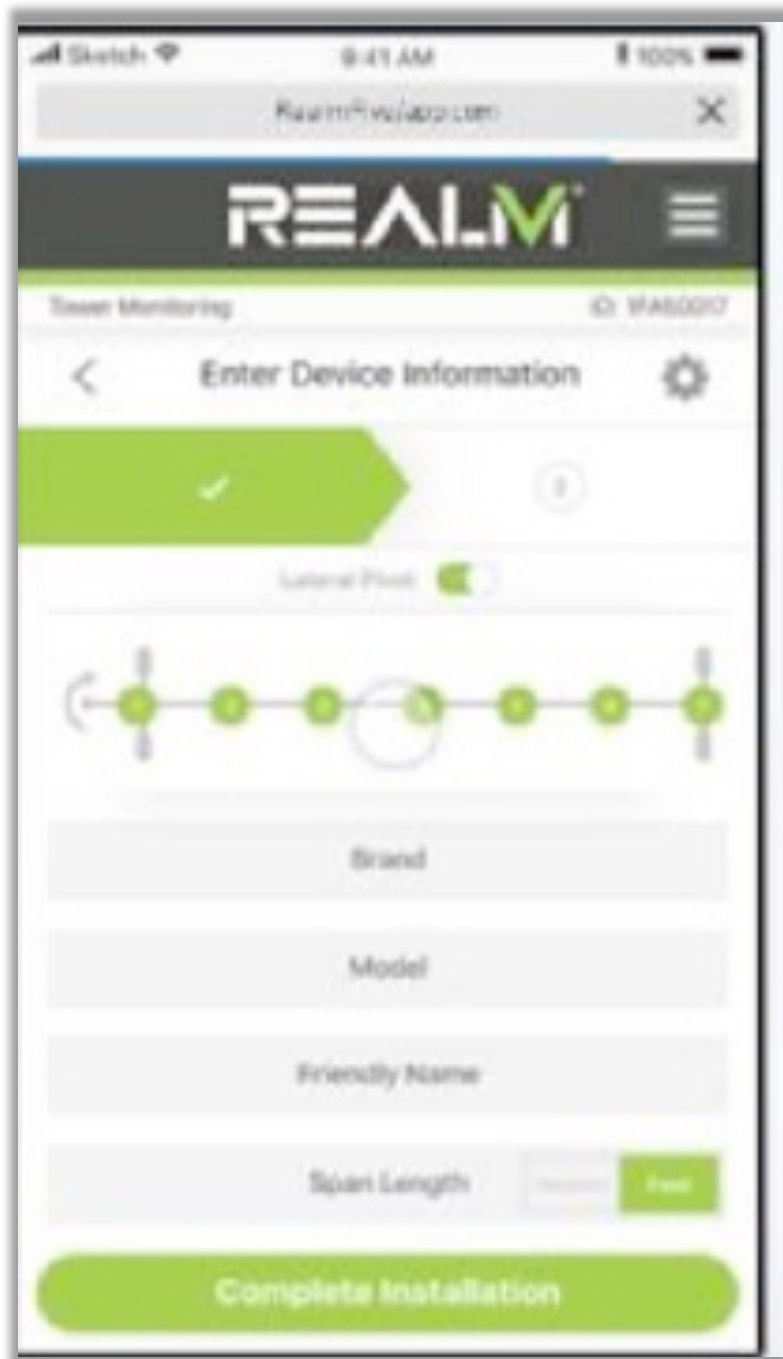
2.22 Turn on the Switch

Turn on the tower box switch located underneath the tower box.



2.23 Complete the Installation

Please verify that all installation steps have been completed and then click “Complete Installation” in the RealmFive app.



2.24 Start the Pivot

Use the pivot service disconnect to turn on the pivot. Read and follow your pivot manufacturer's safety instructions and guidelines when turning on the pivot.

Start the pivot forward or reverse.

- ☹ The pivot does not turn on.
Make sure to properly shut off the pivot. Check:
 - Did you properly tighten the screws in each tower box to the tower alignment microswitch and Tower Pivot Monitor? Tighten the screws so the monitor is making a reliable contact with the tower.
 - Make sure that no wires were damaged or were removed from their intended connection.
 - Make sure the tower box switch is turned on.
- 😊 The app shows the pivot running in the proper direction at approximately the correct position.