

CircuitTree Industrial Controller

[Item #CT-CTR-01]

User Guide



Powered by
CircuitTree

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Please register your product online:

<http://www.CircuitTree.net/register>

You will receive notices of new software updates when available.

Technical Support:

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1. INTRODUCTION & GLOSSARY

Use any smartphone, tablet, or computer as a remote control. Compatible with all standard devices with an up-to-date web browser (e.g. Mac, Windows, Android, iOS, Linux, Chromebook, etc.) Our interface uses the latest in responsive design.

CircuitTree's secure and robust controller software goes way beyond any other solutions available on the market. Offering ultimate flexibility and control, the software is continually being improved over time, and can be easily updated when new versions are available. Security patches can be applied as needed to address the evolving landscape of security threats on the internet.

Glossary:

Within the CircuitTree ecosystem, the following terms are used:

- "Controller" refers to the Master Controller unit and the software that runs on it. This is how you connect and interact with your smart system. The Controller sends signals to the devices it controls, for example telling them when to turn on/off. The Controller also receives signals from the devices, such as collecting sensor data. The Controller and the devices are continually communicating with each other, making sure the system is healthy.
- "Node" refers to a device that is controlled by the Controller, such as a power node (smart power outlets), fluid valve, sensors, and other devices with "smart" automation capabilities like the light deprivation ("blackout") node, Architex light lifters (Rollav8r) & vortex fans, and more.

- "Router" refers to the networking device inside of the Controller. The router is what allows your smartphone, tablet, or computer to access the Controller. The router also connects your Controller to the internet in a setting where wireless or wired internet is available. (Our "Model B" router can provide direct 3G/4G LTE internet with a valid SIM card from a mobile provider.)

- "Gateway" refers to a small device that sends and receives RF signals (wireless communication). The Controller has a Gateway and so does every Node within the ecosystem. The Gateways enable communication between the Nodes and the Controller – it's the part that enables the device to "talk to" each other wirelessly.

- "Remote Access": The CircuitTree router optionally enables remote access to the Controller and other connected devices (such as security cameras, etc.) through a private, encrypted, personal, virtual LAN network. Even when "online", the CircuitTree-powered network is *not open to the public Internet* and is therefore *protected from viral IoT exploits*. Client access is supported by all platforms; including Mac, Windows, Linux, iOS, Android. Easy to setup, in most cases not requiring changes to an existing network.

- "Remote Control": You may use as many devices as you like for accessing the Controller, there is no limit. (We've made it easy for you to access the CircuitTree smart ecosystem from any device.) However, we recommend only *actively* using one device at a time in order to prevent conflicting signals being sent.

Key Concepts – Understanding Controller Connectivity:

Internet Not Required:

- The CircuitTree software is always available to access even without being connected to the internet. To access the Controller, you make a direct connection from the device you want to use as a remote control (e.g. any smartphone, tablet, or computer), to the Controller's wifi network provided through its own router. (Or you can connect via ethernet cable if preferred to have a wired connection.) In other words, if you have wifi internet at your location, you wouldn't connect your device to the internet – instead, you connect to the wifi hotspot provided from the Controller itself. In this way, the Controller does not require internet access in order to function. You can access the CircuitTree interface remotely through the internet (also known as "Remote Access"), but that is an additional feature which requires setup (described later in this User Guide).

No "App" Required:

- There is no "app" required for the Controller, such as apps downloaded from app stores. Instead, the CircuitTree software is a web app which runs in any modern web browser on any device. After accessing the Controller's interface for the first time on any device, you can then create a **shortcut** or **bookmark** for the Controller, using the web browser's own function for creating a shortcut or bookmark. On mobile devices, this would **place our icon onto your device's home screen** and you can tap it to access the software just like an app, with one tap, as long as you are connected to the Controller's network. On computers, you can create a bookmark and access the Controller any time through that bookmark.



This is different downloading an "app" from the Android or Apple store. Instead, the Controller provides a web app, which means no download is necessary and it can be accessed from any device with a web browser. To make it behave like an app on a mobile device, you need to access the web app and add a shortcut so the icon appears on your device's home screen similar to an app.

Wireless RF Communications:

- The CircuitTree Controller communicates to all the Nodes wirelessly, using RF (radio frequency) signals. This again does not require any form of internet access, and RF is different than wifi. You only need to connect to the Controller – the Controller then sends and receives RF signals with all of the Nodes, for example telling power outlets when to turn on/off, telling motors when to turn on/off, telling fluid valves when to turn on/off, and receiving environmental data from sensor nodes.

2. SYSTEM REQUIREMENTS

Basic System Requirements:

- Electricity (standard USA 120V electrical outlet)
- Internet Connection
- Surge Protection
- A device to access the Controller, such as a smartphone, tablet, or computer.

Internet Connection: An internet connection is required for updating the CircuitTree controller software, or for allowing remote access to your controller. Internet is not required for basic day-to-day operation of the automation system. It is perfectly fine to run your gear "offline" (without an internet connection) and only connect it to the internet as-needed for the purpose of software updates.

The controller offers more features when it is online, such as the ability to send alerts to you. If you run the system "offline", you will not have access to the alerts feature and certain other features (e.g. remote backup).

Surge Protection:



We recommend always using some form of surge protection with CircuitTree devices. You must use surge protection in order for your warranty to remain valid. At minimum, use a surge protector or surge protective power strip at the outlets where each device is used -- or a "Type 2" ("whole house") surge protective panel.

Many small electronics and "smart" devices are sensitive to power surges. Power surges can be introduced onto your electrical wiring by pumps, heating & air conditioning units, clothes washers & driers, and other large appliances or devices with large motors. These power surges can potentially cause malfunctions or reduce the lifespan of small electronic gear. Using a surge protector is an inexpensive but very important investment into keeping your CircuitTree automation gear safe.

Also keep in mind that momentary interruptions in power can cause your hardware to restart. To prevent this, you can use a "UPS" unit (Uninterrupted Power Supply) -- these provide a battery backup **and** surge suppression. The battery backup will keep your equipment powered on even in a temporary power outage. This is helpful for your controller especially, which is in charge of sending commands to all the rest of the nodes in your CircuitTree ecosystem.

Common Sense Usage:



You've made a smart choice to save time and energy by automating some aspects of your garden. However, this doesn't cancel the responsibility to still monitor your garden visibly as you normally would, to make sure everything is healthy and that all gear is operating as intended. Automation is not a full replacement for human participation and observation. 🤔

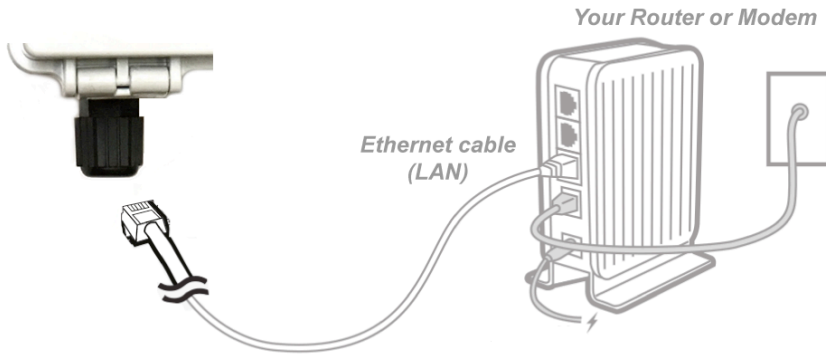
If you will regularly be located a distance away from your garden, we highly recommend using the **video camera monitoring** feature supported by our controller, which makes it easy for you to look at your garden on your phone, tablet, or computer. More about video monitoring is described in the Features section of this User Guide.

3. SETUP: QUICK-START GUIDE

First-Time Settings:

1. Wired Internet? If you have wired internet available, plug in the ethernet cable before powering up.

** (If you don't have wired internet, no problem – the controller easily works with wireless internet as well. Wired is the most ideal option if available. Wireless connectivity can be set up in step 4 below.)*



Ethernet can be plugged into the "cable gland" on the lower left of the controller. This cable gland helps maintain water resistance.

If you don't use wired internet, leave the cap on the cable gland.

2. Plug In Power Cable to a surge-protected outlet. The controller powers up automatically.

3. Connect to the Controller's Router. Using a tablet, smartphone, or a computer with WiFi, connect to the controller's built-in router as follows:

When powered up, the controller will broadcast WiFi signal with the SSID (name) starting with "GL-", in a format like: **GL-XXXXX-xxx**. Connect to that "GL-" network.

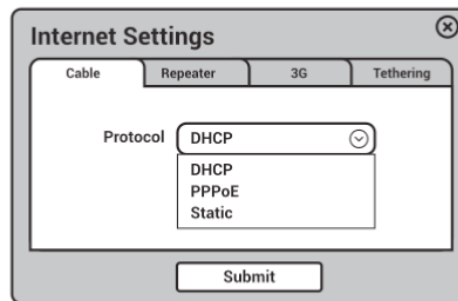
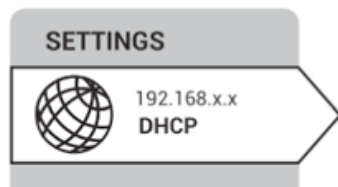
The default password is **goodlife**

Visit <http://192.168.8.1> in your browser after connecting to the controller's network.

4. Configure Router. You will see the router's main web interface. Find the **Internet Settings** icon, then click the **New Connection** button. The Internet Settings window will pop up showing four types of connection methods: **Cable**, **Repeater**, **3G Modem**, and **Tethering**.

- Select "**Cable**" if you are using a wired internet connection (ethernet).
- Select "**Repeater**" if you are using WiFi to connect the controller to internet service.

** The last 2 options (modem and tethering), though supported by the router itself, are not officially supported by CircuitTree. It requires opening up the controller case for access to the router's USB port.*



a) **Cable**: The default protocol is **DHCP** and you can leave this setting as-is in most cases. If your network needs a static setting, you can change it to **Static**. Change to **PPPoE** protocol only if you need to apply username and password provided by your internet service provider.

b) **Repeater**: Use this option to connect your controller to another existing wireless network, e.g. when your location already has WiFi available. Choose **Repeater** mode in your **Internet Settings** and the router will automatically search for SSIDs (network names). Choose a SSID and input the password for your own WiFi network.

Advanced: If you want your router to have its own subnet, choose **WISP** mode. If you want to extend your existing network by bridging the controller's router and your main router wirelessly, you can use WDS. (Make sure your existing WiFi network supports WDS – use WDS only if you are knowledgeable about this mode.)

You can manage your saved networks by clicking **Saved Stations**. Delete or choose one from the list to connect.

5. Edit DNS Settings. *Highly recommended for best security.* To protect against DNS leaks, you must customize your DNS servers. Go to **Internet Settings > Custom DNS**.

Enter **1.1.1.1** for DNS Server 1, and **1.0.0.1** for DNS Server 2.

You can enable **Force All Clients** to override the DNS server settings for your client devices.

The screenshot shows the 'Internet Status' section of a web interface, specifically the 'DNS Settings' tab. On the left, a sidebar labeled 'SETTINGS' contains a globe icon and the text '192.168.x.x DHCP'. The main area has three buttons at the top: 'New Connection', 'Clone MAC', and 'Custom DNS'. Below these, the 'DNS Settings' section contains two input fields: 'DNS Server 1' with the value '1.1.1.1' and 'DNS Server 2' with the value '1.0.0.1'. To the right of these fields is a note: 'Using public DNS Servers can prevent leaking your local DNS'. Below the input fields is a checkbox labeled 'Force all clients to use' which is checked. At the bottom of the section is an 'Apply' button.

6. Update Password of Controller's Router. (If you haven't already done so as part of the regular setup process.)

7. Access Your Controller Interface.

Controller's Local Address: <http://192.168.8.2>

Controller's Remote Address (ZeroTier): <http://10.144.8.2>

4. SETUP: ADDITIONAL NODES

- **Power Nodes:** 2x10Amp & 1x30Amp
- **Environmental Sensor Node:** Temperature, Humidity, Air Pressure, Light Sensor
- **Fluid Valve**
- **Light Deprivation Motor Controller**
- **Soil Moisture Sensor Node**
- **CO2 Sensor**
- **Architex Products:**
 - Vortex Hover Fan
 - Rollav8r Light Lifter
 - FLUX LED Lights
 - FLUX Smart Module, Light Dimming

More Descriptions Coming Soon

5. FEATURES & USAGE

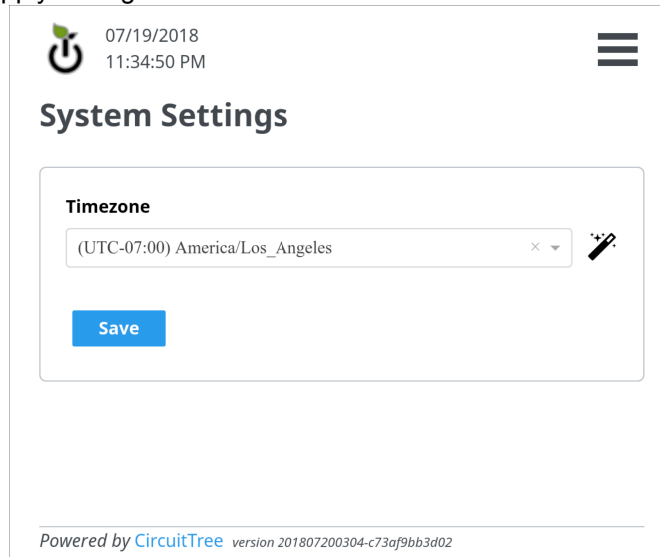
More Info Coming Soon

Automations:

Software version: 201807200304 (development)

1. Set System Timezone

- From the sidebar menu, select **Settings : System Settings**
- Select timezone or click the magic wand icon to auto-select the detected timezone of your client
- Click **Save** to apply settings



The screenshot shows a web interface for 'System Settings'. At the top left, there is a power icon, the date '07/19/2018', and the time '11:34:50 PM'. A hamburger menu icon is at the top right. The title 'System Settings' is centered. Below it, a 'Timezone' section contains a dropdown menu showing '(UTC-07:00) America/Los_Angeles' with a close icon (x) and a magic wand icon. A blue 'Save' button is below the dropdown. At the bottom, a footer reads 'Powered by CircuitTree version 201807200304-c73af9bb3d02'.

- The Clock displays current system time based on the configured **System Timezone**
- All Automation timers use the **System Timezone**

2. Create Operations

- From the sidebar menu, select **System : Operations**
- Click the add icon on the title bar to add an Operation
- Create two Operations; **ON** and **OFF**
- The **ON** Operation is **STATUS** Type with Value of **1**
- The **OFF** Operation is **STATUS** Type with Value of **0**



07/19/2018
11:48:40 PM



Operations

Automatic Operations for Timers

Operations

+

^ Create Operation

Operation Name
ON

Resource
sensor

Action
set

Type
STATUS

Value
1

Create OperationReset

Operations

Automatic Operations for Timers



Operations

+

^ Create Operation

Operation Name
OFF

Resource
sensor

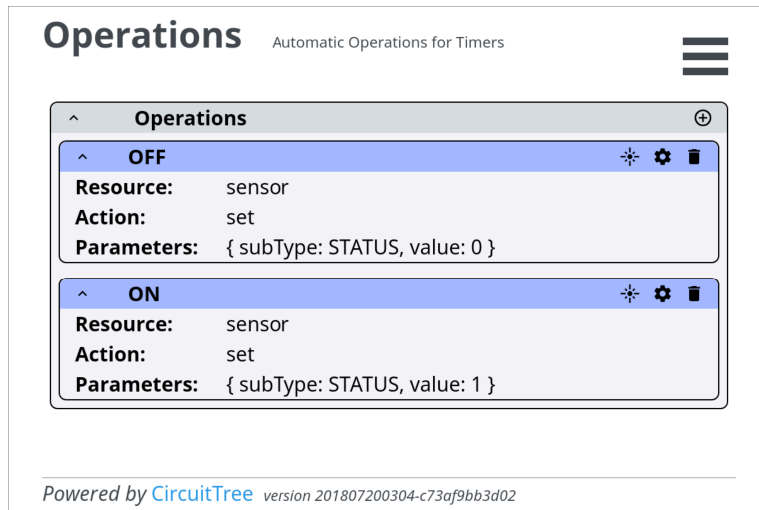
Action
set

Type
STATUS

Value
0

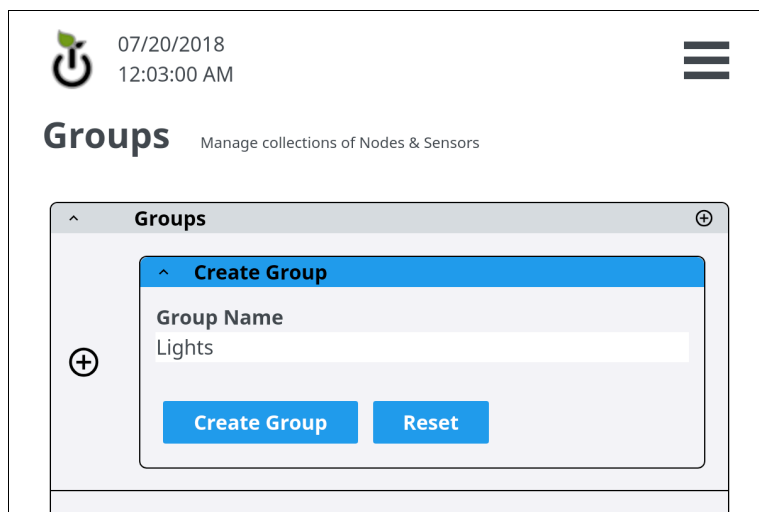
Create OperationReset

ON



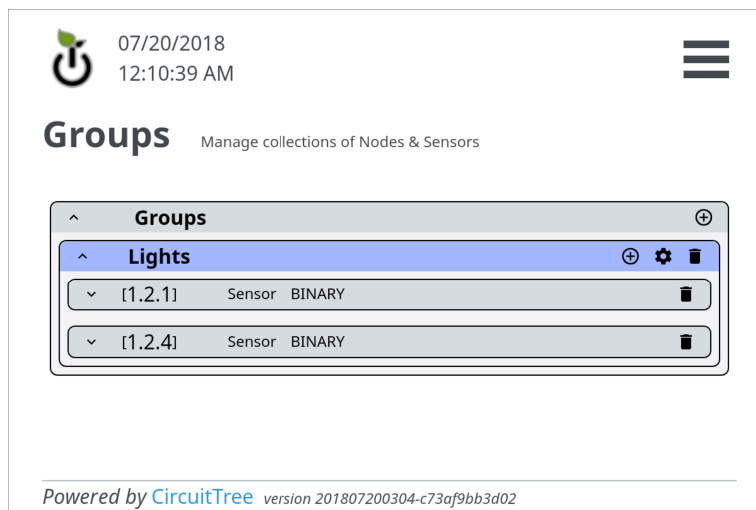
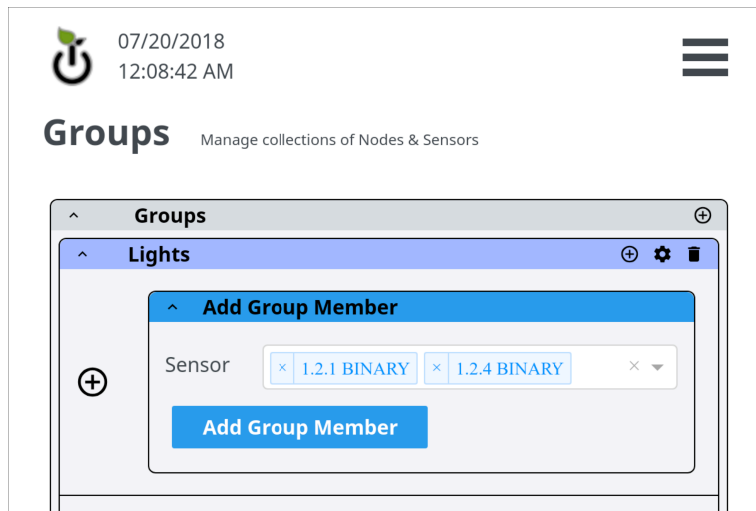
3. Create Group(s)

- From the sidebar menu, select **System : Groups**
- Click the add icon on the title bar to add a Group
- Enter a Name for the group, then click **Create Group**




4. Add Members to Groups

- Within Groups, Click the add icon on the title bar of a Group to add Group Member(s)
- Select the Sensor(s) to add as members of the group
- Tip: naming Sensors from the Resources Page can make it easier to access them
- Click **Add Group Member**



5. Create Timers

- From the sidebar menu, select **System : Timers**
- Click the add icon on the title bar to add a Timer
- Configure the Timer, then click **Create Timer**
- Timers are primarily managed using a 6-field cron syntax (the additional first field is for seconds) with *interval* and *time* Types for quicker access to building the correct cron syntax.
- The **Lock Timezone Offset** option ensures the actual time cycle remains the same regardless to changes in Daylight Saving Time or changes to the system timezone.
- In the following examples, create two Timers; one **At 06:30** and the other **At 18:30**
- The cron syntax for **06:30** is **0 30 6 * * ***

 07/20/2018
12:21:42 AM

Timers Manage automatic timers

Timers

^

+

^

Create Timer

Cron Expression

0 30 6 * * *

✓

Type

cron

×

▼

✓

Lock Timezone Offset

(UTC-07:00)

+

At 06:30

Note: Timers use the System Timezone for hourly times. For sensitive operations (like photoperiods), Enable "Lock Timezone Offset" to ensure the cycle is not interrupted by Daylight Saving Time changes.

System

(UTC-07:00)

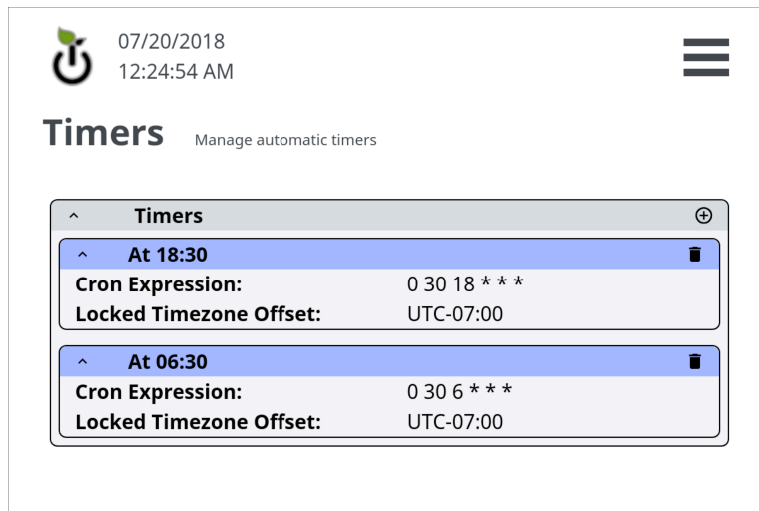
Timezone:

America/Los_Angeles

⚙️

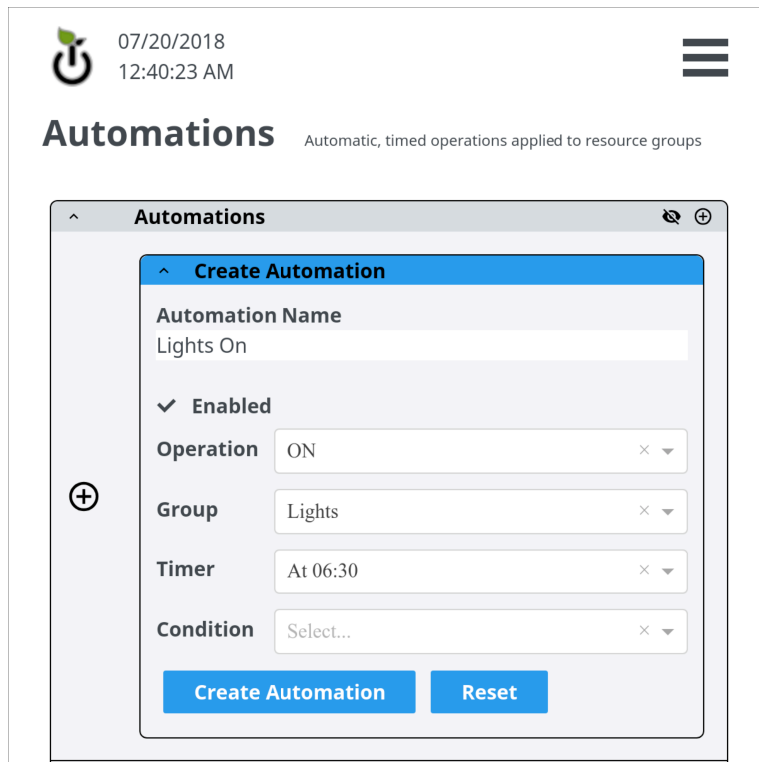
Create Timer

No Timers...



6. Create Automations

- From the sidebar menu, select **System : Automations**
- Click the add icon on the Automations widget title bar to add an Automation
- Configure the Automation, then click **Create Automation**
- Automation Conditions are optional
- Automations must be **Enabled** to activate
- Select from previously created Operations, Groups, and Timers – create more as desired





07/20/2018
12:54:15 AM



Automations

Automatic, timed operations applied to resource groups

^ Automations

+

^ Create Automation

Automation Name
Lights Off

✓ Enabled

Operation OFF

Group Lights

Timer At 18:30

Condition Select...

Create Automation Reset



07/20/2018
12:55:03 AM



Automations

Automatic, timed operations applied to resource groups

^ Automations

^ Lights Off

Operation OFF

Group Lights

Timer At 18:30

^ Lights On

Operation ON

Group Lights

Timer At 06:30

Conditional Automations

Last Revised: 2018-08-13

Software version: *b175be7* (development)

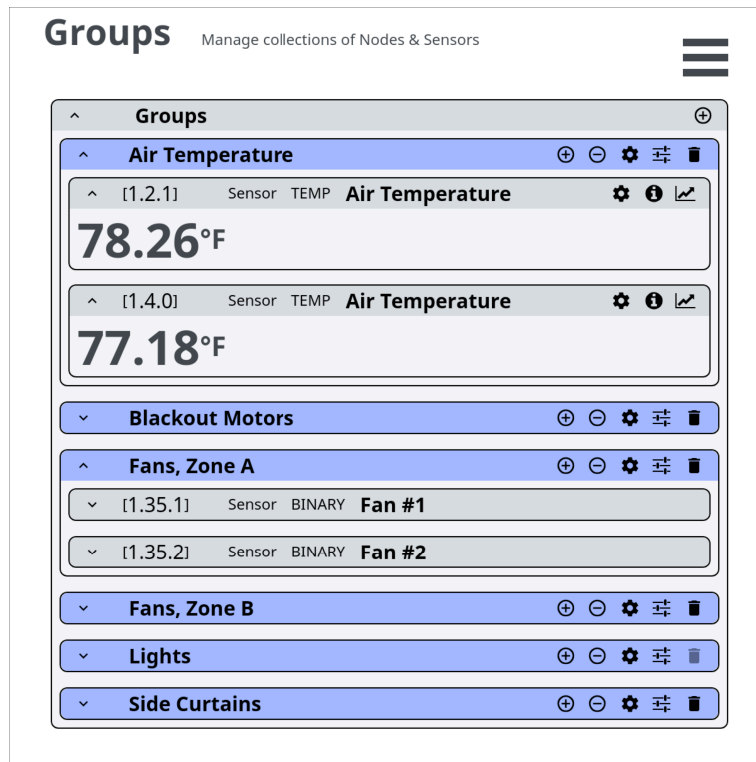
For this example, we will configure the CircuitTree software to automate turning fans on and off based on the average air temperature. The fans are plugged into a Power Node and the air temperature is reported by an Environment Sensor Node and a FLUX Light Dimmer Node. The fans will turn on when the air temperature is greater than 72°F and turn off when temperature drops below 65°F. The automation cycle runs every 15 minutes to ensure the fans are not power cycled more often than every 15 minutes.

1. **Preparation: Refer to and follow previous Manual sections for Automations, including:**
 - **Set System Timezone**
 - **Create Operations** (for **ON** and **OFF**)
2. **Rename Sensors**
 - For increased usability, give Power Node sensors custom names to match the devices plugged into them
 - From the **Dashboard**, navigate to the Power Node sensor with the fans plugged in
 - Expand the Power Node widget to reveal the Node's Sensors
 - Click the settings icon, expand the **Rename** widget, and submit a custom name for that sensor



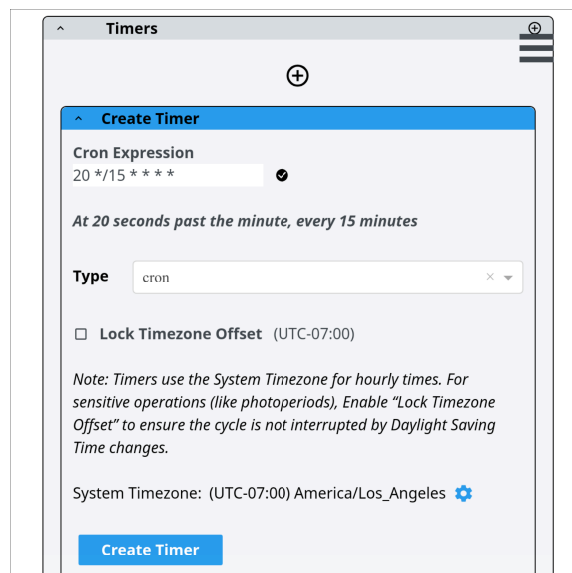
3. Create Group(s)

- Create a Group for each zone of fan control and add one or more Fan Sensors as Group Members
- Create an additional group for the Air Temperature Sensor(s) and add the sensors



4. Create Timer

- To ensure max efficiency of automation triggers, avoid excessive automation events that all fall on the minute or hour by offsetting timers from each other by a few minutes or seconds. Especially useful for Automation Groups that have many members.
- Use the cron syntax **20 */15 * * * *** to create a timer that runs *At 20 seconds past the minute, every 15 minutes*



5. Create Conditions

- From the sidebar menu, select **System : Conditions**
- Click the add icon on the title bar to add a Condition
- Select a function to be applied to multiple values, select the Group, select a target value type within the group, select the method of comparing, and finally enter the target value.
- For our example, create a Condition for “*WHEN mean OF Air Temperature IS ABOVE 72°F*”:
 1. select *mean* for an average air temperature reading
 2. select the *Air Temperature* Group
 3. the target value type is *TEMP*
 4. for this Condition, check if the average temp *IS ABOVE 72°F*
- Click **Create Condition** to create the Condition
- Create another similar Condition for “*WHEN mean OF Air Temperature IS BELOW 65°F*”

The screenshot shows the 'Create Condition' dialog box. It has a title bar with a plus icon. The main area contains the following fields:

- WHEN**: mean
- OF**: Air Temperature
- TEMP**: TEMP
- IS BELOW**: 65 °F

At the bottom of the dialog are two buttons: 'Create Condition' and 'Reset'.

Below the dialog, a summary bar displays the condition: 'WHEN mean OF Air Temperature (TEMP) > 72°F'. It includes icons for refresh, settings, and delete.

6. Create Automations

- Select from previously created Operations, Groups, Timers and Conditions to create two Automations
- Create an Automation to turn ON the Fans in Zone A when air temperature is > 72°F
- Create another Automation to turn OFF the Fans in Zone A when air temperature is < 65°F

The screenshot shows the 'Create Automation' dialog box. It has a title bar with a plus icon. The main area contains the following fields:

- Automation Name**: Fans, Zone A - ON
- Enabled**: ☒
- Operation**: ON
- Group**: Fans, Zone A
- Timer**: At 20 seconds past the minute, every 15 minutes
- Condition**: WHEN mean OF Air Temperature (TEMP) > 72°F

At the bottom of the dialog are two buttons: 'Create Automation' and 'Reset'.

^ Create Automation

Automation Name
Fans, Zone A - OFF

✓ Enabled

Operation OFF

Group Fans, Zone A

Timer At 20 seconds past the minute, every 15 minutes

Condition WHEN mean OF Air Temperature (TEMP) < 64.99°F

Create AutomationReset

Automations

Fans, Zone A - OFF

Operation OFF

Group Fans, Zone A

Timer At 20 seconds past the minute, every 15 minutes

Condition WHEN mean OF Air Temperature (TEMP) < 64.99°F

Fans, Zone A - ON

Operation ON

Group Fans, Zone A

Timer At 20 seconds past the minute, every 15 minutes

Condition WHEN mean OF Air Temperature (TEMP) > 72°F

6. SOFTWARE UPDATES

Please register your product with us [<http://www.circuittree.net/register>] to receive timely updates about new software updates as they become available.

Coming Soon: The controller software will also alert you of new updates if connected to the internet.

Appendix A: TROUBLESHOOTING & SUPPORT

Technical Support:

Please visit www.circuittree.net and click on the **Support** link in our main menu.

Also from that Support area of our web site, refer to our **Forums** section. The forums are a continuously growing collection of helpful tips and answers to common usage questions -- and you can interact directly with our support and development team there. Community discussion is encouraged.

Common Troubleshooting Tips:

- **Node Unresponsive, Requires Hard (Manual) Reboot**

Power surges and fluctuations have been known to cause nodes to become unresponsive and require a manual reboot. Unresponsive nodes that are still powered (lights stuck either ON or OFF) are generally a sign of power issue, like surges or momentary power outage. Especially if you are in an area or setting where power surges are common, the use of a "UPS" unit (Uninterrupted Power Supply) is recommended. See earlier recommendations

Appendix B: TECHNICAL SPECIFICATIONS

Computer (SBC) Technical Specs

- **OS:** Linux, customized CircuitTree OS.
- **CPU:** 64-bit 4× ARM Cortex-A53, 1.2GHz
- **RAM:** 1GB LPDDR2 900 MHz
- **Storage:** 32GB microSDHC Class 10 UHS-1 (64GB version also available)
- **Power:** 5V, 600mA - 1.6A consumption

WiFi Router Technical Specs

- **OS:** Linux, customized OpenWRT/LEDE, Open Source
- **Protocols:** 2.4GHz 802.11 b/g/n, 10/100 Ethernet, DHCP, PoE, WiFi Repeater
- **Interfaces:** 1 WAN, 1 LAN, 1 USB2.0, 1 micro USB (power), 1 Reset button

Model A variation (router):

- **Power:** 5V/1A, <2W consumption

Model B variation (router):

- **Power:** 5V/2A, <3W consumption
- **Protocol:** 3G/4G LTE
- **Interfaces:** SIM card slot, MicroSD card slot
- **Optional Backup Battery**

CircuitTree RF Network Features:

- Two RF radio types currently supported by the Treeino (CircuitTree's core logic and RF module)
 - RFM69 range: 200M to 500M (some have tested as much as 1.5 miles)
 - RFM9x (LoRa) range: 2KM to 20KM (farm sized!)
- Low power, long range
- License-free ISM band and royalty-free protocol
- Less crowded with better reception, range, and object penetration than 2.4GHz
- Self-healing mesh network; nodes can communicate directly with each other and don't all need to talk to a central gateway, just their closest neighbor or repeater node
- Wirelessly programmable over-the-air (OTA) firmware updates for nodes
- Theoretical max of over 60000 nodes per local installation (actual limit would be exceeded first in other ways depending on the hardware)
- The CircuitTree RF protocol is built as an enhanced, while backwards-compatible, extension of the OpenSource MySensors IoT protocol for robust, reliable, secure, and extendable RF communications with many relevant features
- Easy to program Arduino-compatible nodes; to empower CircuitTree vendors and users/DIYers to quickly and effectively roll-their-own "things"

Appendix C: LIMITED WARRANTY

Remember to retain your Bill of Sale for warranty service! Any items returned without a copy of the Proof of Purchase will be considered out of warranty.

As with all software-controlled products, unexpected behavior could arise if the user tries to perform operations in a non-routine manner. This product, like almost any other high-tech product, is subject to revisions and upgrades over time. Product specifications are subject to change without notice.

What the Warranty Covers:

- This warranty extends only to the original user of the equipment and is limited to the purchase price of each part. CircuitTree, LLC and its affiliated companies ("CircuitTree") warrant this system against defects in materials or workmanship as follows:

- **Labor:** For a period of one (1) year from the original date of purchase, if CircuitTree determines that the equipment is defective subject to the limitations of this warranty, it will be replaced at no charge for labor. CircuitTree warrants any such work done against defects in materials or workmanship for the remaining portion of the original warranty period.

- **Parts:** For a period of one (1) year from the original date of purchase, CircuitTree will supply, at no charge, new or re-manufactured parts in exchange for parts determined to be defective subject to the limitations of this warranty. CircuitTree warrants any such replacement parts against defects in materials or workmanship for the remaining part of the original warranty period. Note: "Parts" means items included with the sale of the item in CircuitTree's original package, which may include the router, single board computer, RF gateway, antennas, or enclosure. It does not include other parts purchased separately.

What the Warranty Does Not Cover:

- This warranty does not cover installation of the system. If applicable, such installation will be warranted under a separate installation agreement.

- This warranty does not cover consumer instruction, physical setup or adjustment of any devices, or loss of use of the system.

- This warranty does not cover cosmetic damage, damage due to lightning, electrical or network line surges, battery leakage, fire, flood, or other acts of Nature, accident, misuse, abuse, repair or alteration by other than authorized factory service, use of accessories not recommended by CircuitTree, negligence, or improper or neglected maintenance. Please refer to the notice about surge protection requirements earlier in this document. If you do not use surge protection, this warranty is void.

- This warranty does not cover shipping and handling, removal or reinstallation, shipping damage if the equipment was not packed and shipped in the manner prescribed, nor equipment purchased, serviced, or operated outside the continental United States of America or Canada.

Legal Limitations

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