# Mycodo

**An environmental monitoring and regulation system**

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# 1. Home

## 1.1 Mycodo Environmental Monitoring and Regulation System

Mycodo is open source software for the Raspberry Pi that couples inputs and outputs in interesting ways to sense and manipulate the environment.

### 1.1.1 Information

See the README for features, projects using Mycodo, screenshots, and other information.

### 1.1.2 Prerequisites

- Raspberry Pi single-board computer (any version: Zero, 1, 2, 3, or 4)
- Raspberry Pi Operating System flashed to a micro SD card
- An active internet connection

### 1.1.3 Install

Once you have the Raspberry Pi booted into the Raspberry Pi OS with an internet connection, run the following command in a terminal to initiate the Mycodo install:

```
curl -L https://kizniche.github.io/Mycodo/install | bash
```

If the install is successful, open a web browser to the Raspberry Pi's IP address and you will be greeted with a screen to create an Admin user and password.

```
https://127.0.0.1
```

### 1.1.4 Support

- Mycodo on GitHub
- Mycodo Wiki
- Mycodo API
- Mycodo Forum
- Mycodo Support (Android App)

### 1.1.5 Donate

Become a Sponsor: github.com/sponsors/kizniche

Other methods: KyleGabriel.com/donate

# 2. About

Mycodo is an open-source environmental monitoring and regulation system that was built to run on the Raspberry Pi.

Originally developed for cultivating edible mushrooms, Mycodo has grown to do much more. The system consists of two parts: a backend (daemon) and a frontend (web server). The backend performs tasks such as acquiring measurements from sensors and devices and coordinating a diverse set of responses to those measurements, including the ability to modulate outputs (switch relays, generate PWM signals, operate pumps, switch wireless outlets, publish/subscribe to MQTT, among others), regulate environmental conditions with PID control, schedule timers, capture photos and stream video, trigger actions when measurements meet certain conditions, and more. The frontend hosts a web interface that enables viewing and configuration from any browser-enabled device.

There are a number of different uses for Mycodo. Some users simply store sensor measurements to monitor conditions remotely, others regulate the environmental conditions of a physical space, while others capture motion-activated or time-lapse photography, among other uses.

Input controllers acquire measurements and store them in the InfluxDB time series database. Measurements typically come from sensors, but may also be configured to use the return value of linux or Python commands, or math equations, making a very powerful system for acquiring and generating data.

Output controllers produce changes to the general input/output (GPIO) pins or may be configured to execute linux or Python commands, enabling a large number of potential uses. There are a few different types of outputs: simple switching of GPIO pins (HIGH/LOW), generating pulse-width modulated (PWM) signals, switching 315/433 MHz wireless outlets, controlling Atlas Scientific peristaltic pumps, as well as executing linux and Python commands. The most common output is using a relay to switch electrical devices on and off.

When Inputs and Outputs are combined, PID controllers may be used to create a feedback loop that uses the Output device to modulate an environmental condition the Input measures. Certain Inputs may be coupled with certain Outputs to create a variety of different control and regulation applications. Beyond simple regulation, Methods may be used to create a changing setpoint over time, enabling such things as thermal cyclers, reflow ovens, environmental simulation for terrariums, food and beverage fermentation or curing, and cooking food (sous-vide), to name a few.

Triggers can be set to activate events based on specific dates and times, according to durations of time, or the sunrise/sunset at a specific latitude and longitude. Conditionals are used to activates certain events based on the truth of custom user conditional statements (e.g. "Sensor1 > 23 and 10 < Sensor2 < 30").

## 2.1 Web User Interface

The main frontend of Mycodo is a web user interface that allows any device with a web browser to view collected data and configure the backend, or the daemon, of the system. The web interface supports an authentication system with user/password credentials, user roles that grant/deny access to parts of the system, and SSL for encrypted browsing.

An SSL certificate with an expiration of 10 years will be generated and stored in `~/Mycodo/mycodo/mycodo_flask/ssl_certs/` during the install process to allow SSL to be used to securely connect to the web interface. If you want to use your own SSL certificates, replace them with your own.

If using the auto-generated certificate from the install, be aware that it will not be verified when visiting the web interface in your browser. You may continually receive a warning message about the security of your site unless you add the certificate to your browser's trusted list.

## 2.2 Languages

The Mycodo user interface has been translated from English to Dutch, German, French, Italian, Norwegian, Polish, Portuguese, Russian, Serbian, Spanish, Swedish, and Chinese. If the default language for your web browser is one of these languages, it will be automatically selected. Otherwise, you can manually set the language from the Configuration menu.

# 3. Frequently Asked Questions

Frequently asked questions can be found here

# 4. Usage

## 4.1 Data Viewing

There are several ways to visualize collected data.

### 4.1.1 Live Measurements

Page: `Data -> Live`

The `Live` page is the first page a user sees after logging in to Mycodo. It will display the current measurements being acquired from Input and Function controllers. If there is nothing displayed on the `Live` page, ensure an Input or Function controller is both configured correctly and activated. Data will be automatically updated on the page from the measurement database.

### 4.1.2 Asynchronous Graphs

Page: `Data -> Asynchronous Graphs`

A graphical data display that is useful for viewing data sets spanning relatively long periods of time (weeks/months/years), which could be very data- and processor-intensive to view as a Live Graph. Select a time frame and data will be loaded from that time span, if it exists. The first view will be of the entire selected data set. For every view/zoom, 700 data points will be loaded. If there are more than 700 data points recorded for the time span selected, 700 points will be created from an averaging of the points in that time span. This enables much less data to be used to navigate a large data set. For instance, 4 months of data may be 10 megabytes if all of it were downloaded. However, when viewing a 4 month span, it's not possible to see every data point of that 10 megabytes, and aggregating of points is inevitable. With asynchronous loading of data, you only download what you see. So, instead of downloading 10 megabytes every graph load, only ~50kb will be downloaded until a new zoom level is selected, at which time only another ~50kb is downloaded.

> **Note**
>
> Live Graphs require measurements to be acquired, therefore at least one sensor needs to be added and activated in order to display live data.

### 4.1.3 Dashboard

Page: `Data -> Dashboard`

The dashboard can be used for both viewing data and manipulating the system, thanks to the numerous dashboard widgets available. Widgets are how data is presented to the user and how the user can control aspects of the system from the dashboard. These include graphs, gauges, indicators, and more. For a full list of supported Widgets, see Supported Widgets. Multiple dashboards can be created. Widgets can be moved and arranged on the dashboards by dragging and can be resized by pulling the bottom-left or bottom-right side of the widget.

#### Custom Widgets

There is a Custom Widget import system in Mycodo that allows user-created Widgets to be used in the Mycodo system. Custom Widgets can be uploaded on the `[Gear Icon] -> Configure -> Custom Widgets` page. After import, they will be available to use on the `Setup -> Widget` page.

If you develop a working Widget module, please consider creating a new GitHub issue or pull request, and it may be included in the built-in set.

Open any of the built-in modules located in the directory Mycodo/mycodo/widgets for examples of the proper formatting.

There are also example Custom Widgets in the directory Mycodo/mycodo/widgets/examples

Additionally, I have another github repository devoted to Custom Modules that are not included in the built-in set, at kizniche/Mycodo-custom.

### Graph Widget

A graphical data display that is useful for viewing data sets spanning relatively short periods of time (hours/days/weeks). Select a time frame to view data and continually updating data from new sensor measurements. Multiple graphs can be created on one page that enables a dashboard to be created of graphed sensor data. Each graph may have one or more data from inputs, outputs, or PIDs rendered onto it. To edit graph options, select the plus sign on the top-right of a graph.

| Setting | Description |
|---|---|
| x-Axis (minutes) | The duration to display on the x-axis of the graph. |
| Enable Auto Refresh | Automatically refresh the data on the graph Refresh Period. |
| Refresh (seconds) | The duration between acquisitions of new data to display on the graph. |
| Inputs/Outputs/PIDs | The Inputs, Outputs, and PIDs to display on the graph. |
| Enable X-Axis Reset | Reset the x-axis min/max every time new data comes in during the auto refresh. |
| Enable Title | Show a title of the graph name. |
| Enable Navbar | Show a slidable navigation bar at the bottom of the graph. |
| Enable Export | Enable a button on the top right of the graph to allow exporting of the currently-displayed data as PNG, JPEG, PDF, SVG, CSV, XLS. |
| Enable Range Selector | Show a set of navigation buttons at the top of the graph to quickly change the display duration. |
| Enable Custom Colors | Use custom colors for Input, Output, and PID lines. Select the colors with the buttons that appear below this checkbox. |
| Enable Manual Y-Axis Min/Max | Set the minimum and maximum y-axes of a particular graph. Set both the minimum and maximum to 0 to disable for a particular y-axis. |
| Enable Y-Axis Align Ticks | Align the ticks of several y-axes of the same graph. |
| Enable Y-Axis Start On Tick | Start all y-axes of a graph on the same tick. |
| Enable Y-Axis End On Tick | End all y-axes of a graph on the same tick. |

### Gauge Widget

Gauges are visual objects that allow one to quickly see what the latest measurement is of an input. An example that you may be familiar with is a speedometer in a car.

| Setting | Description |
|---|---|
| Refresh (seconds) | The duration between acquisitions of new data to display on the graph. |
| Max Age (seconds) | The maximum allowable age of the measurement. If the age is greater than this, the gauge will turn off, indicating there is an issue. |
| Gauge Min | The lowest value of the gauge. |
| Gauge Max | The highest value of the gauge. |
| Stops | The number of color ranges on the gauge. |
| Show Timestamp | Show the timestamp of the current gauge measurement. |

### Camera Widget

Cameras may be added to keep a continuous view on areas.

| Setting | Description |
|---|---|
| Refresh (seconds) | The duration between acquisitions of new data to display on the graph. |
| Max Age (seconds) | The maximum allowed age of the image timestamp before a "No Recent Image" message is returned. |
| Acquire Image (and save new file) | Acquire a new images and save the previous image. |
| Acquire Image (and erase last file) | Acquire a new image but erase the previous image. |
| Display Live Video Stream | Automatically start a video stream and display it. |
| Display Latest Timelapse Image | Display the latest timelapse image that exists. |
| Add Timestamp | Append a timestamp to the image. |

### Indicator Widget

Shows a green or red button depending if the measurement value is 0 or not 0.

| Setting | Description |
|---|---|
| Refresh (seconds) | The duration between acquisitions of new data to display on the graph. |
| Max Age (seconds) | The maximum allowable age of the measurement. If the age is greater than this, the gauge will turn off, indicating there is an issue. |
| Timestamp Font (em) | The font size of the timestamp value in em. |
| Invert | Invert/reverse the colors. |
| Measurement | The device to display information about. |

**Measurement Widget**

| Setting | Description |
|---|---|
| Refresh (seconds) | The duration between acquisitions of new data to display on the graph. |
| Max Age (seconds) | The maximum allowable age of the measurement. If the age is greater than this, the gauge will turn off, indicating there is an issue. |
| Value Font (em) | The font size of the measurement value in em. |
| Timestamp Font (em) | The font size of the timestamp value in em. |
| Decimal Places | The number of digits to display to the right of the decimal. |
| Measurement | The device to display information about. |

**Output Widget**

| Setting | Description |
|---|---|
| Refresh (seconds) | The duration between acquisitions of new data to display on the graph. |
| Max Age (seconds) | The maximum allowable age of the measurement. If the age is greater than this, the gauge will turn off, indicating there is an issue. |
| Value Font (em) | The font size of the output value in em. |
| Timestamp Font (em) | The font size of the timestamp value in em. |
| Decimal Places | The number of digits to display to the right of the decimal. |
| Feature Output Controls | Display buttons to turn On and Off the relay from the dashboard element. |
| Output | The output to display information about. |

**Output: PWM Slider Widget**

| Setting | Description |
|---|---|
| Refresh (seconds) | The duration between acquisitions of new data to display on the graph. |
| Max Age (seconds) | The maximum allowable age of the measurement. If the age is greater than this, the gauge will turn off, indicating there is an issue. |
| Value Font (em) | The font size of the output value in em. |
| Timestamp Font (em) | The font size of the timestamp value in em. |
| Decimal Places | The number of digits to display to the right of the decimal. |
| Feature Output Controls | Display buttons to turn On and Off the relay from the dashboard element. |
| Output | The output to display information about and allow setting the PWM with a slider. |

**PID Control Widget**

| Setting | Description |
|---|---|
| Refresh (seconds) | The duration between acquisitions of new data to display on the graph. |
| Max Age (seconds) | The maximum allowable age of the measurement. If the age is greater than this, the gauge will turn off, indicating there is an issue. |
| Value Font (em) | The font size of the measurement value in em. |
| Timestamp Font (em) | The font size of the timestamp value in em. |
| Decimal Places | The number of digits to display to the right of the decimal. |
| Show PID Information | Show extra PID information on the dashboard element. |
| Show Set Setpoint | Allow setting the PID setpoint on the dashboard element. |
| PID | The PID to display information about. |

**Python Code Widget**

| Setting | Description |
|---|---|
| Refresh (seconds) | The duration between acquisitions of new data to display on the graph. |
| Value Font (em) | The font size of the text in em. |
| Python Code (Loop) | The Python code to execute initially when the controller starts and every Refresh (seconds). |
| Python Code (Refresh) | The Python code to execute only when a widget on a dashboard is refreshed, every Refresh (seconds). Note: There may be multiple dashboards calling this function if multiple browser sessions exist. |

# 4.2 Inputs

Page: `Setup -> Input`

For a full list of supported Inputs, see Supported Input Devices.

Inputs, such as sensors, ADC signals, or even a response from a command, enable measuring conditions in the environment or elsewhere, which will be stored in a time-series database (InfluxDB). This database will provide measurements for Dashboards, LCDs, PID Controllers, Conditional Statements, and other parts of Mycodo to operate from. Add, configure, and activate inputs to begin recording measurements to the database and allow them to be used throughout Mycodo.

### Custom Inputs

See Building a Custom Input Module Wiki page.

There is a Custom Input import system in Mycodo that allows user-created Inputs to be created an used in the Mycodo system. Custom Inputs can be uploaded and imported from the `[Gear Icon] -> Configure -> Custom Inputs` page. After import, they will be available to use on the `Setup -> Input` page.

If you develop a working Input module, please consider creating a new GitHub issue or pull request, and it may be included in the built-in set.

Open any of the built-in modules located in the directory Mycodo/mycodo/inputs for examples of the proper formatting.

There are also example Custom Inputs in the directory Mycodo/mycodo/inputs/examples

Additionally, I have another github repository devoted to Custom Modules that are not included in the built-in set, at kizniche/Mycodo-custom.

### Input Actions

Input Actions are functions within the Input module that can be executed from the Web UI. This is useful for things such as calibration or other functionality specific to the input. By default, there is at least one action, Acquire Measurements Now, which will cause the input to acquire measurements rather than waiting until the next Period has elapsed.

> **Note**
>
> Actions can only be executed while the Input is active.

**Input Options**

In addition to several supported sensors and devices, a Linux command may be specified that will be executed and the return value stored in the measurement database to be used throughout the Mycodo system.

| Setting | Description |
|---|---|
| Activate | After the sensor has been properly configured, activation begins acquiring measurements from the sensor. Any activated conditional statements will now being operating. |
| Deactivate | Deactivation stops measurements from being acquired from the sensor. All associated conditional statements will cease to operate. |
| Save | Save the current configuration entered into the input boxes for a particular sensor. |
| Delete | Delete a particular sensor. |
| Acquire Measurements Now | Force the input to conduct measurements and them in the database. |
| Up/Down | Move a particular sensor up or down in the order displayed. |
| Power Output | Select a output that powers the sensor. This enables powering cycling (turn off then on) when the sensor returns 3 consecutive errors to attempt to fix the issue. Transistors may also be used instead of a relay (note: NPN transistors are preferred over PNP for powering sensors). |
| Location | Depending on what sensor is being used, you will need to either select a serial number (DS18B20 temperature sensor), a GPIO pin (in the case of sensors read by a GPIO), or an I2C address. or other. |
| I2C Bus | The bus to be used to communicate with the I2C address. |
| Period (seconds) | After the sensor is successfully read and a database entry is made, this is the duration of time waited until the sensor is measured again. |
| Measurement Unit | Select the unit to save the measurement as (only available for select measurements). |
| Pre Output | If you require a output to be activated before a measurement is made (for instance, if you have a pump that extracts air to a chamber where the sensor resides), this is the output number that will be activated. The output will be activated for a duration defined by the Pre Duration, then once the output turns off, a measurement by the sensor is made. |
| Pre Output Duration (seconds) | This is the duration of time that the Pre Output runs for before the sensor measurement is obtained. |
| Pre Output During Measurement | If enabled, the Pre Output stays on during the acquisition of a measurement. If disabled, the Pre Output is turned off directly before acquiring a measurement. |
| Command | A linux command (executed as the user 'root') that the return value becomes the measurement |
| Command Measurement | The measured condition (e.g. temperature, humidity, etc.) from the linux command |
| Command Units | The units of the measurement condition from the linux command |
| Edge | Edge sensors only: Select whether the Rising or Falling (or both) edges of a changing voltage are detected. A number of devices to do this when in-line with a circuit supplying a 3.3-volt input signal to a GPIO, such as simple mechanical switch, a button, a magnet (reed/hall) sensor, a PIR motion detector, and more. |
| Bounce Time (ms) | Edge sensors only: This is the number of milliseconds to bounce the input signal. This is commonly called debouncing a signal [1] and may be necessary if using a mechanical circuit. |
| Reset Period (seconds) | Edge sensors only: This is the period of time after an edge detection that another edge will not be recorded. This enables devices such as PIR motion sensors that may stay activated for longer periods of time. |

| Setting | Description |
|---|---|
| Measurement | Analog-to-digital converter only: The type of measurement being acquired by the ADC. For instance, if the resistance of a photocell is being measured through a voltage divider, this measurement would be "light". |
| Units | Analog-to-digital converter only: This is the unit of the measurement. With the above example of "light" as the measurement, the unit may be "lux" or "intensity". |
| BT Adapter | The Bluetooth adapter to communicate with the input. |
| Clock Pin | The GPIO (using BCM numbering) connected to the Clock pin of the ADC |
| CS Pin | The GPIO (using BCM numbering) connected to the CS pin of the ADC |
| MISO Pin | The GPIO (using BCM numbering) connected to the MISO pin of the ADC |
| MOSI Pin | The GPIO (using BCM numbering) connected to the MOSI pin of the ADC |
| RTD Probe Type | Select to measure from a PT100 or PT1000 probe. |
| Resistor Reference (Ohm) | If your reference resistor is not the default (400 Ohm for PT100, 4000 Ohm for PT1000), you can manually set this value. Several manufacturers now use 430 Ohm resistors on their circuit boards, therefore it's recommended to verify the accuracy of your measurements and adjust this value if necessary. |
| Channel | Analog-to-digital converter only: This is the channel to obtain the voltage measurement from the ADC. |
| Gain | Analog-to-digital converter only: set the gain when acquiring the measurement. |
| Sample Speed | Analog-to-digital converter only: set the sample speed (typically samples per second). |
| Volts Min | Analog-to-digital converter only: What is the minimum voltage to use when scaling to produce the unit value for the database. For instance, if your ADC is not expected to measure below 0.2 volts for your particular circuit, set this to "0.2". |
| Volts Max | Analog-to-digital converter only: This is similar to the Min option above, however it is setting the ceiling to the voltage range. Units Min Analog-to-digital converter only: This value will be the lower value of a range that will use the Min and Max Voltages, above, to produce a unit output. For instance, if your voltage range is 0.0 -1.0 volts, and the unit range is 1 -60, and a voltage of 0.5 is measured, in addition to 0.5 being stored in the database, 30 will be stored as well. This enables creating calibrated scales to use with your particular circuit. |
| Units Max | Analog-to-digital converter only: This is similar to the Min option above, however it is setting the ceiling to the unit range. |
| Weighting | The This is a number between 0 and 1 and indicates how much the old reading affects the new reading. It defaults to 0 which means the old reading has no effect. This may be used to smooth the data. |
| Pulses Per Rev | The number of pulses for a complete revolution. |
| Port | The server port to be queried (Server Port Open input). |
| Times to Check | The number of times to attempt to ping a server (Server Ping input). |
| Deadline (seconds) | The maximum amount of time to wait for each ping attempt, after which 0 (offline) will be returned (Server Ping input). |
| Number of Measurement | The number of unique measurements to store data for this input. |
| Application ID | The Application ID on The Things Network. |
| App API Key | The Application API Key on The Things Network. |
| Device ID | The Device ID of the Application on The Things Network. |

1. Debouncing a signal

### The Things Network

The Things Network (TTN) Input module enables downloading of data from TTN if the Data Storage Integration is enabled in your TTN Application. The Data Storage Integration will store data for up to 7 days. Mycodo will download this data periodically and store the measurements locally.

The payload on TTN must be properly decoded to variables that correspond to the "Variable Name" option under "Channel Options", in the lower section of the Input options. For instance, in your TTN Application, if a custom Payload Format is selected, the decoder code may look like this:

```
function Decoder(bytes, port) {
    var decoded = {};
    var rawTemp = bytes[0] + bytes[1] * 256;
    decoded.temperature = sflt162f(rawTemp) * 100;
    return decoded;
}

function sflt162f(rawSflt16) {
    rawSflt16 &= 0xFFFF;
    if (rawSflt16 === 0x8000)
        return -0.0;
    var sSign = ((rawSflt16 & 0x8000) !== 0) ? -1 : 1;
    var exp1 = (rawSflt16 >> 11) & 0xF;
    var mant1 = (rawSflt16 & 0x7FF) / 2048.0;
    return sSign * mant1 * Math.pow(2, exp1 - 15);
}
```

This will decode the 2-byte payload into a temperature float value with the name "temperature". Set "Number of Measurements" to "1", then set the "Variable Name" for the first channel (CH0) to "temperature" and the "Measurement Unit" to "Temperature: Celsius (°C)".

Upon activation of the Input, data will be downloaded for the past 7 days. The latest data timestamp will be stored so any subsequent activation of the Input will only download new data (since the last known timestamp).

This Input also allows multiple measurements to be stored. You merely have to change "Number of Measurements" to a number larger than 1, save, and there will now be multiple variable names and measurement units to set.

There are several example Input modules that, in addition to storing the measurements of a sensor in the influx database, will write the measurements to a serial device. This is useful of you have a LoRaWAN transmitter connected via serial to receive measurement information from Mycodo and transmit it to a LoRaWAN gateway (and subsequently to The Things Network). The data on TTN can then be downloaded elsewhere with the TTN Input. These example Input modules are located in the following locations:

`~/Mycodo/mycodo/inputs/examples/bme280_ttn.py`

`~/Mycodo/mycodo/inputs/examples/k30_ttn.py`

For example, the following excerpt from `bme_280.py` will write a set of comma-separated strings to the user-specified serial device with the first string (the letter "B") used to denote the sensor/measurements, followed by the actual measurements (humidity, pressure, and temperature, in this case).

```
string_send = 'B,{},{},{}'.format(
    return_dict[1]['value'],
    return_dict[2]['value'],
    return_dict[0]['value'])
self.serial_send = self.serial.Serial(self.serial_device, 9600)
self.serial_send.write(string_send.encode())
```

This is useful if multiple data strings are to be sent to the same serial device (e.g. if both `bme280_ttn.py` and `k30_ttn.py` are being used at the same time), allowing the serial device to distinguish what data is being received.

The full code used to decode both `bme280_ttn.py` and `k30_ttn.py`, with informative comments, is located at `~/Mycodo/mycodo/inputs/examples/ttn_data_storage_decoder_example.js`.

These example Input modules may be modified to suit your needs and imported into Mycodo through the `[Gear Icon] -> Configure -> Custom Inputs` page. After import, they will be available to use on the `Setup -> Input` page.

# 4.3 Maths

Page: `Setup -> Input` (Previously `Setup -> Data`)

> **Warning**
>
> Math controllers have been deprecated since Mycodo version 8.9.0. All Math controller functionality has been ported to Functions. No new Math controllers can be created in Mycodo 8.9.0 and beyond, but already-existing Math controllers are permitted to operate until further notice. If you are using Mycodo version 8.9.0 or beyond, it is advised to create Functions for all your current Math controllers, because at some point in the future Math controllers will be completely removed. This manual page only serves as reference material for those still using Math controllers.

> **Note**
>
> "Last" means the controller will only acquire the last (latest) measurement in the database for performing math with. "Past" means the controller will acquire all measurements from the present until the "Max Age (seconds)" set by the user (e.g. if measurements are acquired every 10 seconds, and a Max Age is set to 60 seconds, there will on average be 6 measurements returned to have math performed).

### Math Options

Types of math controllers.

| Type | Description |
|---|---|
| Average (Last, Multiple Channels) | Stores the statistical mean of the last measurement of multiple selected measurement channels. |
| Average (Past, Single Channel) | Stores the statistical mean of one selected measurement channel over a duration of time determined by the Max Age (seconds) option. |
| Sum (Last, Multiple Channels) | Stores the sum of multiple selected measurement channels. |
| Sum (Past, Single Channel) | Stores the sum of one selected measurement channel over a duration of time determined by the Max Age(seconds) option. |
| Difference | Stores the mathematical difference (value_1 - value_2). |
| Equation | Stores the calculated value of an equation. |
| Redundancy | Select multiple Inputs and if one input isn't available, the next measurement will be used. For example, this is useful if an Input stops but you don't want a PID controller to stop working if there is another measurement that can be used. More than one Input can be and the preferred Order of Use can be defined. |
| Verification | Ensures the greatest difference between any selected Inputs is less than Max Difference, and if so, stores the average of the selected measurements. |
| Statistics | Calculates mean, median, minimum, maximum, standard deviation (SD), SD upper, and SD lower for a set of measurements. |
| Humidity (Wet/ Dry-Bulb) | Calculates and stores the percent relative humidity from the dry-bulb and wet-bulb temperatures, and optional pressure. |

Math controller options.

| Setting | Description |
|---|---|
| Input | Select the Inputs to use with the particular Math controller |
| Period (seconds) | The duration of time between calculating and storing a new value |
| Max Age (seconds) | The maximum allowed age of the Input measurements. If an Input measurement is older than this period, the calculation is cancelled and the new value is not stored in the database. Consequently, if another controller has a Max Age set and cannot retrieve a current Math value, it will cease functioning. A PID controller, for instance, may stop regulating if there is no new Math value created, preventing the PID controller from continuing to run when it should not. |
| Start Offset (seconds) | Wait this duration before attempting the first calculation/measurement. |
| Measurement | This is the condition being measured. For instance, if all of the selected measurements are temperature, this should also be temperature. A list of the pre-defined measurements that may be used is below. |
| Units | This is the units to display along with the measurement, on Graphs. If a pre-defined measurement is used, this field will default to the units associated with that measurement. |
| Reverse Equation | For Difference calculations, this will reverse the equation order, from `value_1 - value_2` to `value_2 - value_1`. |
| Absolute Value | For Difference calculations, this will yield an absolute value (positive number). |
| Max Difference | If the difference between any selected Input is greater than this value, no new value will be stored in the database. |
| Dry-Bulb Temperature | The measurement that will serve as the dry-bulb temperature (this is the warmer of the two temperature measurements) |
| Wet-Bulb Temperature | The measurement that will serve as the wet-bulb temperature (this is the colder of the two temperature measurements) |
| Pressure | This is an optional pressure measurement that can be used to calculate the percent relative humidity. If disabled, a default 101325 Pa will be used in the calculation. |
| Equation | An equation that will be solved with Python's eval() function. Let "x" represent the input value. Valid equation symbols include: + - * / ^ |
| Order of Use | This is the order in which the selected Inputs will be used. This must be a comma separated list of Input IDs (integers, not UUIDs). |

## 4.4 Outputs

Page: `Setup -> Output`

For a full list of supported Outputs, see Supported Outputs Devices.

Outputs are various signals that can be generated that operate devices. An output can be a HIGH/LOW signal on a GPIO pin, a pulse-width modulated (PWM) signal, a 315/433 MHz signal to switch a radio frequency-operated relay, driving of pumps and motors, or an execution of a linux or Python command, to name a few.

### 4.4.1 Custom Outputs

There is a Custom Output import system in Mycodo that allows user-created Outputs to be created an used in the Mycodo system. Custom Outputs can be uploaded and imported from the `[Gear Icon] -> Configure -> Custom Outputs` page. After import, they will be available to use on the `Setup -> Output` page.

If you develop a working Output module, please consider creating a new GitHub issue or pull request, and it may be included in the built-in set.

Open any of the built-in modules located in the directory Mycodo/mycodo/outputs for examples of the proper formatting.

There are also example Custom Outputs in the directory Mycodo/mycodo/outputs/examples

Additionally, I have another github repository devoted to Custom Modules that are not included in the built-in set, at kizniche/Mycodo-custom.

For Outputs that require new measurements/units, they can be added on the `[Gear Icon] -> Configure -> Measurements` page.

## 4.4.2 Output Options

| Setting | Description |
|---|---|
| Pin (GPIO) | This is the GPIO that will be the signal to the output, using BCM numbering. |
| WiringPi Pin | This is the GPIO that will be the signal to the output, using WiringPi numbering. |
| On State | This is the state of the GPIO to signal the output to turn the device on. HIGH will send a 3.3-volt signal and LOW will send a 0-volt signal. If you output completes the circuit (and the device powers on) when a 3.3-volt signal is sent, then set this to HIGH. If the device powers when a 0-volt signal is sent, set this to LOW. |
| Protocol | This is the protocol to use to transmit via 315/433 MHz. Default is 1, but if this doesn't work, increment the number. |
| UART Device | The UART device connected to the device. |
| Baud Rate | The baud rate of the UART device. |
| I2C Address | The I2C address of the device. |
| I2C Bus | The I2C bus the device is connected to. |
| Output Mode | The Output mode, if supported. |
| Flow Rate | The flow rate to dispense the volume (ml/min). |
| Pulse Length | This is the pulse length to transmit via 315/433 MHz. Default is 189 ms. |
| Bit Length | This is the bit length to transmit via 315/433 MHz. Default is 24-bit. |
| Execute as User | Select which user executes Linux Commands. |
| On Command | This is the command used to turn the output on. For wireless relays, this is the numerical command to be transmitted, and for command outputs this is the command to be executed. Commands may be for the linux terminal or Python 3 (depending on which output type selected). |
| Off Command | This is the command used to turn the output off. For wireless relays, this is the numerical command to be transmitted, and for command outputs this is the command to be executed. Commands may be for the linux terminal or Python 3 (depending on which output type selected). |
| Force Command | If an Output is already on, enabling this option will allow the On command to be executed rather than returning "Output is already On". |
| PWM Command | This is the command used to set the duty cycle. The string "((duty_cycle))" in the command will be replaced with the actual duty cycle before the command is executed. Ensure "((duty_cycle))" is included in your command for this feature to work correctly. Commands may be for the linux terminal or Python 3 (depending on which output type selected). |
| Current Draw (amps) | The is the amount of current the device powered by the output draws. Note: this value should be calculated based on the voltage set in the Energy Usage Settings. |
| Startup State | This specifies whether the output should be ON or OFF when mycodo initially starts. Some outputs have an additional options. |
| Startup Value | If the Startup State is set to User Set Value (such as for PWM Outputs), then this value will be set when Mycodo starts up. |
| Shutdown State | This specifies whether the output should be ON or OFF when mycodo initially shuts down. Some outputs have an additional options. |
| Shutdown Value | If the Shutdown State is set to User Set Value (such as for PWM Outputs), then this value will be set when Mycodo shuts down. |
| Trigger at Startup | Select to enable triggering Functions (such as Output Triggers) when Mycodo starts and if Start State is set to ON. |
| Seconds to turn On | This is a way to turn a output on for a specific duration of time. This can be useful for testing the outputs and powered devices or the measured effects a device may have on an environmental condition. |

### 4.4.3 On/Off (GPIO)

The On/Off (GPIO) output merely turns a GPIO pin High (3.3 volts) or Low (0 volts). This is useful for controlling things like electromechanical switches, such as relays, to turn electrical devices on and off.

Relays are electromechanical or solid-state devices that enable a small voltage signal (such as from a microprocessor) to activate a much larger voltage, without exposing the low-voltage system to the dangers of the higher voltage.

Add and configure outputs in the Output tab. Outputs must be properly set up before they can be used in the rest of the system.

To set up a wired relay, set the "GPIO Pin" (using BCM numbering) to the pin you would like to switch High (5 volts) and Low (0 volts), which can be used to activate relays and other devices. *On Trigger* should be set to the signal state (High or Low) that induces the device to turn on. For example, if your relay activates when the potential across the coil is 0-volts, set *On Trigger* to "Low", otherwise if your relay activates when the potential across the coil is 5 volts, set it to "High".

### 4.4.4 Pulse-Width Modulation (PWM)

Pulse-width modulation (PWM) is a modulation technique used to encode a message into a pulsing signal, at a specific frequency in Hertz (Hz). The average value of voltage (and current) fed to the load is controlled by turning the switch between supply and load on and off at a fast rate. The longer the switch is on compared to the off periods, the higher the total power supplied to the load.

The PWM switching frequency has to be much higher than what would affect the load (the device that uses the power), which is to say that the resultant waveform perceived by the load must be as smooth as possible. The rate (or frequency) at which the power supply must switch can vary greatly depending on load and application, for example

> **Quote**
>
> Switching has to be done several times a minute in an electric stove; 120 Hz in a lamp dimmer; between a few kilohertz (kHz) to tens of kHz for a motor drive; and well into the tens or hundreds of kHz in audio amplifiers and computer power supplies.

The term duty cycle describes the proportion of 'on' time to the regular interval or 'period' of time; a low duty cycle corresponds to low power, because the power is off for most of the time. Duty cycle is expressed in percent, with 0% being always off, 50% being off for half of the time and on for half of the time, and 100% being always on.

### 4.4.5 Pulse-Width Modulation (PWM) Options

| Setting | Description |
|---|---|
| Library | Select the method for producing the PWM signal. Hardware pins can produce up to a 30 MHz PWM signal, while any other (non-hardware PWM) pin can produce up to a 40 kHz PWM signal. See the table, below, for the hardware pins on various Pi boards. |
| Pin (GPIO) | This is the GPIO pin that will output the PWM signal, using BCM numbering. |
| Frequency (Hertz) | This is frequency of the PWM signal. |
| Invert Signal | Send an inverted duty cycle to the output controller. |
| Duty Cycle | This is the proportion of the time on to the time off, expressed in percent (0 -100). |

**Non-hardware PWM Pins**

When using non-hardware PWM pins, there are only certain frequencies that can be used. These frequencies in Hertz are 40000, 20000, 10000, 8000, 5000, 4000, 2500, 2000, 1600, 1250, 1000, 800, 500, 400, 250, 200, 100, and 50 Hz. If you attempt to set a frequency that is not listed here, the nearest frequency from this list will be used.

### Hardware PWM Pins

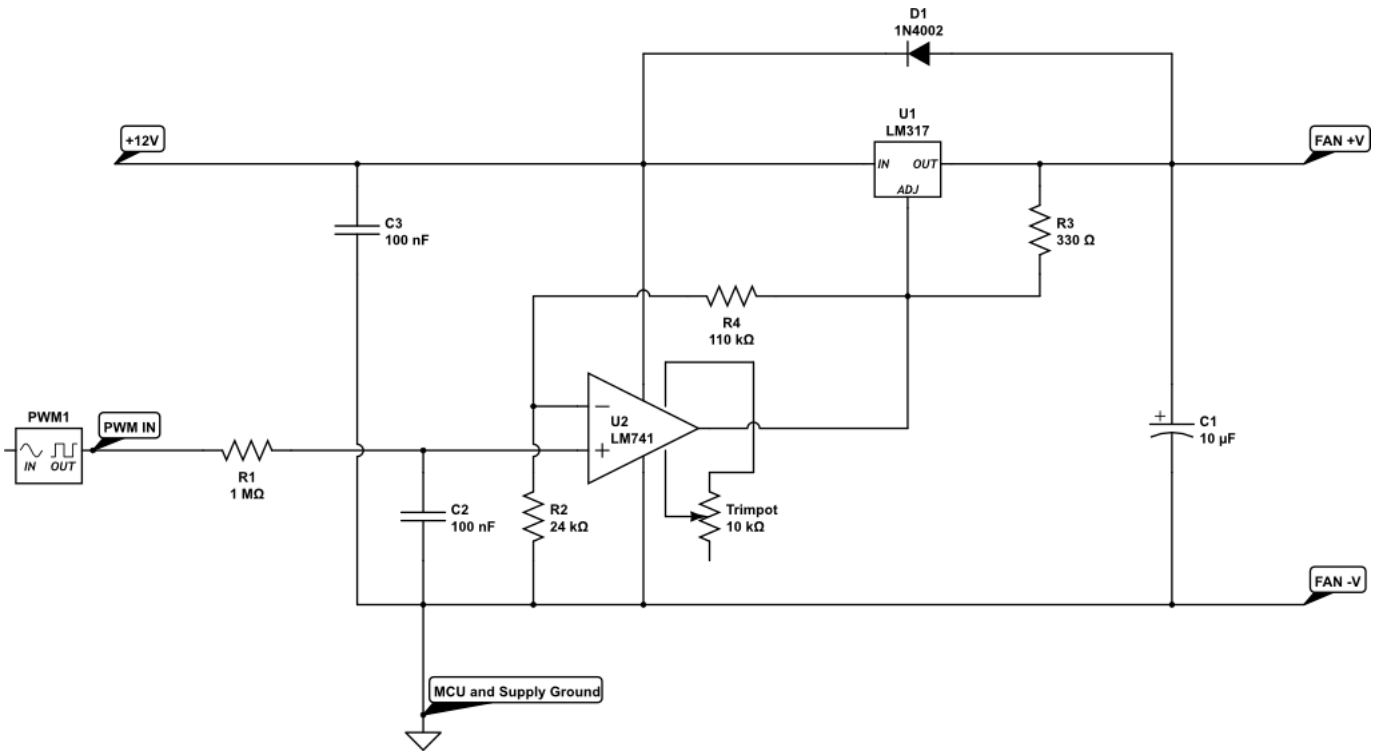
The exact frequency may be set when using hardware PWM pins. The same PWM channel is available on multiple GPIO. The latest frequency and duty cycle setting will be used by all GPIO pins which share a PWM channel.

| BCM Pin | PWM Channel | Raspberry Pi Version |
|---|---|---|
| 12 | 0 | All models except A and B |
| 13 | 1 | All models except A and B |
| 18 | 0 | All models |
| 19 | 1 | All models except A and B |
| 40 | 0 | Compute module only |
| 41 | 1 | Compute module only |
| 45 | 1 | Compute module only |
| 52 | 0 | Compute module only |
| 53 | 1 | Compute module only |

### Schematics for DC Fan Control

Below are hardware schematics that enable controlling direct current (DC) fans from the PWM output from Mycodo.

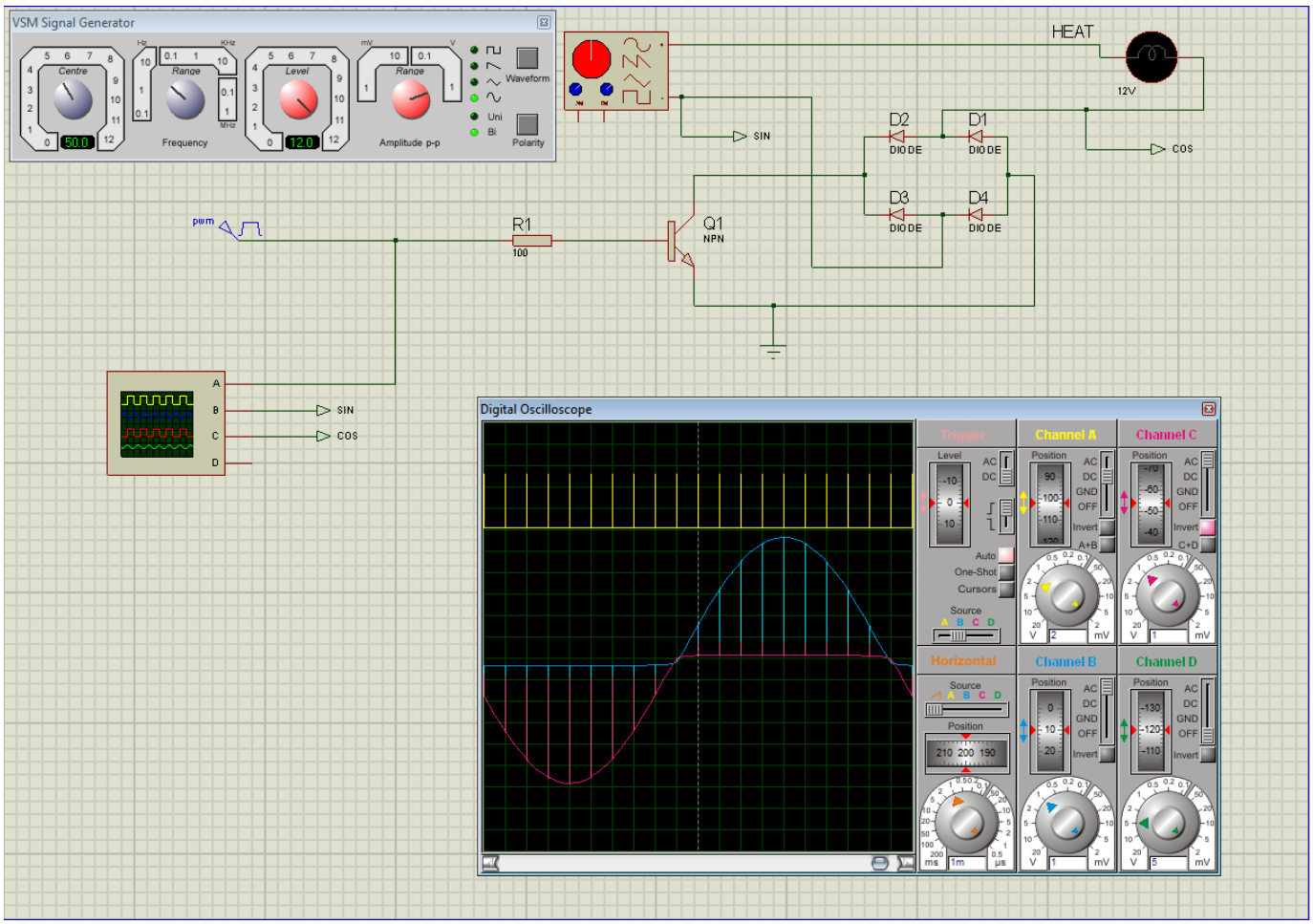
PWM output controlling a 12-volt DC fan (such as a PC fan)



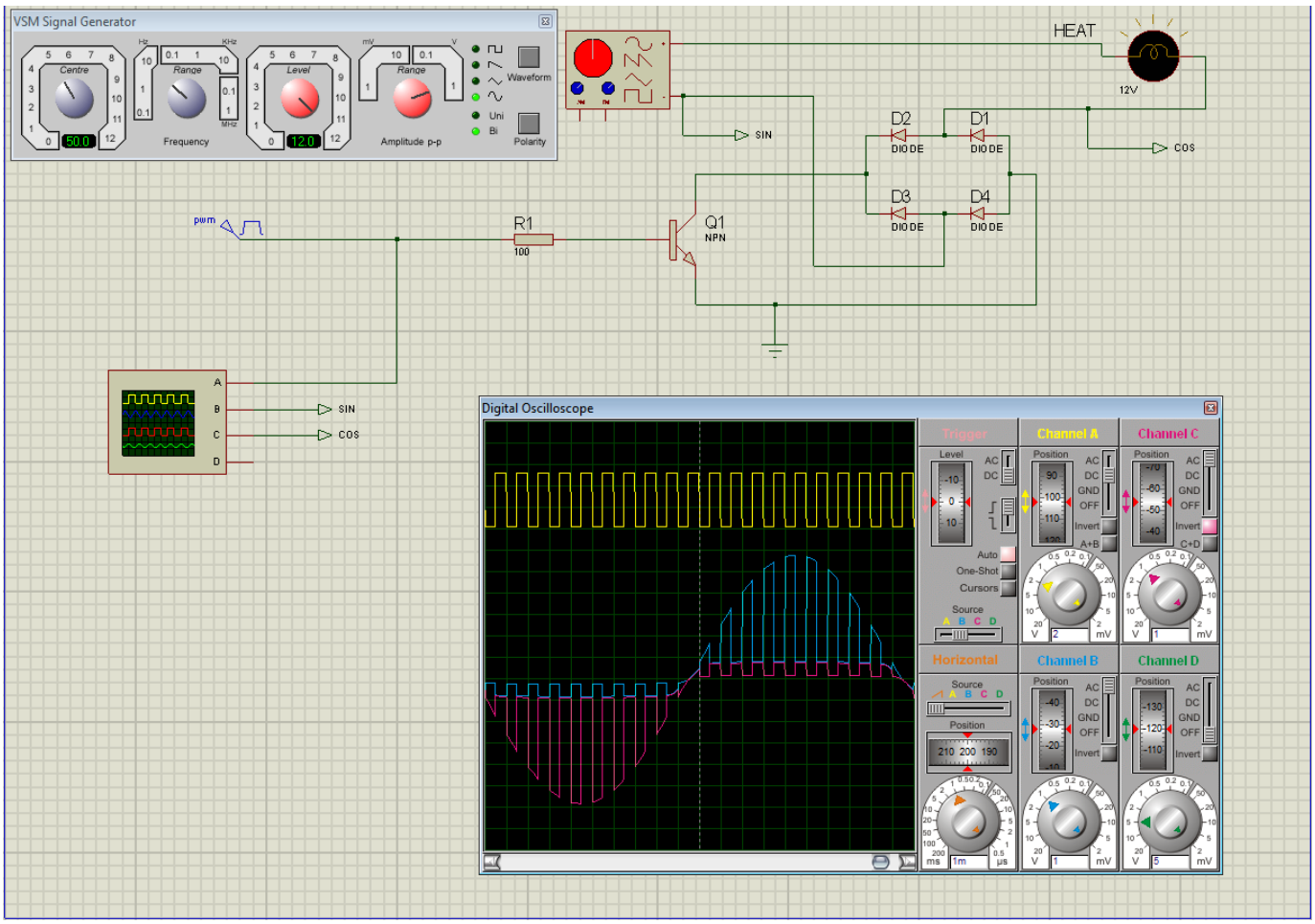

### Schematics for AC Modulation

Below are hardware schematics that enable the modulation of alternating current (AC) from the PWM output from Mycodo.

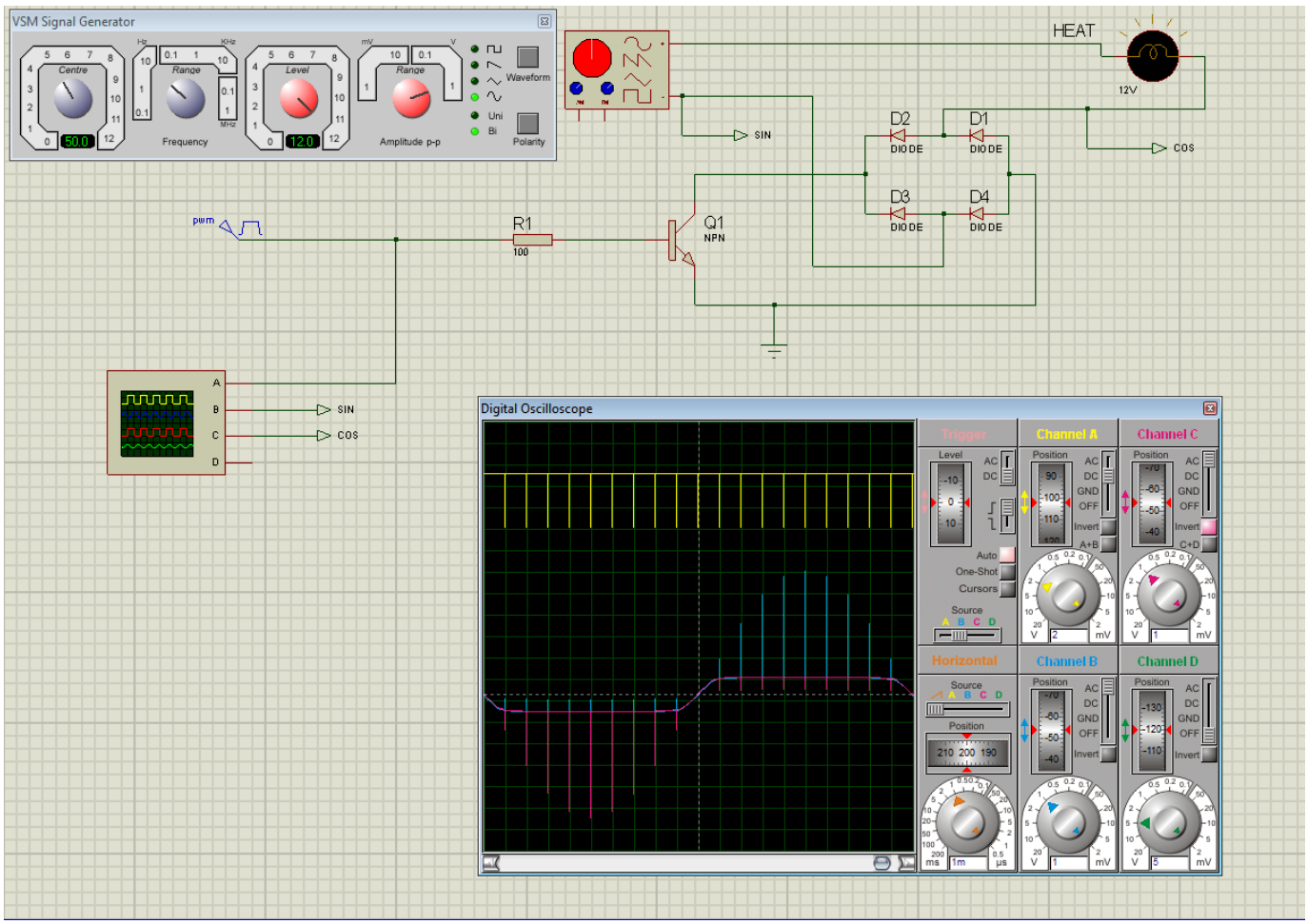
PWM output modulating alternating current (AC) at 1% duty cycle




PWM output modulating alternating current (AC) at 50% duty cycle




PWM output modulating alternating current (AC) at 99% duty cycle




## 4.4.6 Peristaltic Pump

There are two peristaltic pump Output modules that Mycodo supports, a generic peristaltic pump Output, and the Atlas Scientific EZO-PMP peristaltic pump.

### Generic Peristaltic Pump

Any peristaltic pump can be used with the Generic Peristaltic Pump Output to dispense liquids. The most basic dispensing abilities are to start dispensing, stop dispensing, or dispense for a duration of time. If the pump rate has been measured, this value can be entered into the Fastest Rate (ml/min) setting and the Output controller will then be able to dispense specific volumes rather than merely for durations of time. In oder to dispense specific volumes, the Output Mode will also need to be set in addition to the Desired Flow Rate (ml/min), if the Output Mode has been set to Specify Flow Rate.

To determine your pump's flow rate, first purge all air from your pump's hose. Next, instruct the pump to dispense for 60 seconds and collect the liquid it dispenses. Once finished, measure the amount of liquid and enter this value, in milliliters into the Fastest Rate (ml/min) setting. Once your pump's flow rate is set, you can now start dispensing specific volumes rather than durations.

This Output module relies on switching a GPIO pin High and Low to switch the peristaltic pump on and off. This is most easily accomplished with the use of a relay in-line with your pump's power supply or using the GPIO as an input signal directly to the pump (if supported). When using a relay, it's important to develop your circuit to provide the fastest possible switching of the pump. Since the volume dispensed by the pump is dependent on time, the faster the pump switching can occur, the more accurate the dispensing will be. Many peristaltic pumps operate on DC voltage and require an AC-DC converter. These converters can take a significant amount of time to energize once power is applied as well as de-energize once power is removed, causing significant delays that can impact dispensing accuracy. To alleviate this issue, the DC power should be switched, rather than the AC power, which will remove this potential delay.

#### Atlas Scientific Peristaltic Pump

The Atlas Scientific peristaltic pump is a peristaltic pump and microcontroller combined that allows it to be communicated with via I2C or Serial and can accurately dispense specific volumes of fluid. There are several commands the pump can accept, including commands to calibrate, turn on, turn off, and dispense at a specific rate, among others. Atlas Scientific peristaltic pumps are good options, but are more expensive than generic peristaltic pumps.

#### Peristaltic Pump Options

| Setting | Description |
|---|---|
| Output Mode | "Fastest low Rate" will pump liquid at the fastest rate the pump can perform. "Specify Flow Rate" will pump liquid at the rate set by the "Flow Rate (ml/min)" option. |
| Flow Rate (ml/min) | This is how fast liquid will be pumped if the "Specify Flow Rate" option is selected for the Output Mode option. |
| Fastest Rate (ml/min) | This is the rate at which the pump dispenses liquid, in ml/min. |
| Minimum On (sec/min) | This is the minimum duration (seconds) the pump should be turned on for every 60 second period of pumping. This option is only used when Specify Flow Rate is selected as the output Mode. |

### 4.4.7 Wireless 315/433 MHz

Certain 315/433 MHz wireless relays may be used, however you will need to set the pin of the transmitter (using BCM numbering), pulse length, bit length, protocol, on command, and off command. To determine your On and Off commands, connect a 315/433 MHz receiver to your Pi, then run the receiver script, below, replacing 17 with the pin your receiver is connected to (using BCM numbering), and press one of the buttons on your remote (either on or off) to detect the numeric code associated with that button.

```
sudo ~/Mycodo/env/bin/python ~/Mycodo/mycodo/devices/wireless_rpi_rf.py -d 2 -g 17
```

433 MHz wireless relays have been successfully tested with SMAKN 433MHz RF Transmitters/Receivers and Etekcity Wireless Remote Control Electrical Outlets (see Issue 88 for more information). If you have a 315/433 MHz transmitter/receiver and a wireless relay that does not work with the current code, submit a new issue with details of your hardware.

### 4.4.8 Linux Command

Another option for output control is to execute a terminal command when the output is turned on, off, or a duty cycle is set. Commands will be executed as the user 'root'. When a Linux Command output is created, example code is provided to demonstrate how to use the output.

### 4.4.9 Python Command

The Python Command output operates similarly to the Linux Command output, however Python 3 code is being executed. When a Python Command output is created, example code is provided to demonstrate how to use the output.

### 4.4.10 Output Notes

Wireless and Command (Linux/Python) Outputs: Since the wireless protocol only allows 1-way communication to 315/433 MHz devices, wireless relays are assumed to be off until they are turned on, and therefore will appear red (off) when added. If a wireless relay is turned off or on outside Mycodo (by a remote, for instance), Mycodo will ***not*** be able to determine the state of the relay and will indicate whichever state the relay was last. This is, if Mycodo turns the wireless relay on, and a remote is used to turn the relay off, Mycodo will still assume the relay is on.

## 4.5 Functions

Page: `Setup -> Function`

For a full list of supported Inputs, see Supported Functions.

Function controllers perform tasks that often involve the use of Inputs and Outputs.

> **Note**
>
> "Last" means the Function will only acquire the last (latest) measurement in the database. "Past" means the Function will acquire all measurements from the present until the "Max Age (seconds)" that's been set (e.g. if measurements are acquired every 10 seconds, and a Max Age is set to 60 seconds, there will on average be 6 measurements returned to the Function to operate with).

### 4.5.1 Custom Functions

There is a Custom Function import system in Mycodo that allows user-created Functions to be used in the Mycodo system. Custom Functions can be uploaded on the `[Gear Icon] -> Configure -> Custom Functions` page. After import, they will be available to use on the `Setup -> Function` page.

If you develop a working Function module, please consider creating a new GitHub issue or pull request, and it may be included in the built-in set.

Open any of the built-in modules located in the directory Mycodo/mycodo/functions for examples of the proper formatting.

There are also example Custom Functions in the directory Mycodo/mycodo/functions/examples

Additionally, I have another github repository devoted to Custom Modules that are not included in the built-in set, at kizniche/Mycodo-custom.

For Functions that require new measurements/units, they can be added on the `[Gear Icon] -> Configure -> Measurements` page.

### 4.5.2 PID Controller

A proportional-derivative-integral (PID) controller is a control loop feedback mechanism used throughout industry for controlling systems. It efficiently brings a measurable condition, such as the temperature, to a desired state and maintains it there with little overshoot and oscillation. A well-tuned PID controller will raise to the setpoint quickly, have minimal overshoot, and maintain the setpoint with little oscillation.

PID settings may be changed while the PID is activated and the new settings will take effect immediately. If settings are changed while the controller is paused, the values will be used once the controller resumes operation.

**PID Controller Options**

| Setting | Description |
|---|---|
| Activate/ Deactivate | Turn a particular PID controller on or off. |
| Pause | When paused, the control variable will not be updated and the PID will not turn on the associated outputs. Settings can be changed without losing current PID output values. |
| Hold | When held, the control variable will not be updated but the PID will turn on the associated outputs, Settings can be changed without losing current PID output values. |
| Resume | Resume a PID controller from being held or paused. |
| Direction | This is the direction that you wish to regulate. For example, if you only require the temperature to be raised, set this to "Up," but if you require regulation up and down, set this to "Both." |
| Period | This is the duration between when the PID acquires a measurement, the PID is updated, and the output is modulated. |
| Start Offset (seconds) | Wait this duration before attempting the first calculation/measurement. |
| Max Age | The time (in seconds) that the sensor measurement age is required to be less than. If the measurement is not younger than this age, the measurement is thrown out and the PID will not actuate the output. This is a safety measure to ensure the PID is only using recent measurements. |
| Setpoint | This is the specific point you would like the environment to be regulated at. For example, if you would like the humidity regulated to 60%, enter 60. |
| Band (+/- Setpoint) | Hysteresis option. If set to a non-0 value, the setpoint will become a band, which will be between the band_max=setpoint+band and band_min=setpoint-band. If Raising, the PID will raise above band_max, then wait until the condition falls below band_min to resume regulation. If Lowering, the PID will lower below band_min, then wait until the condition rises above band_max to resume regulating. If set to Both, regulation will only occur to the outside min and max of the band, and cease when within the band. Set to 0 to disable Hysteresis. |
| Store Lower as Negative | Checking this will store all output variables (PID and output duration/duty cycle) as a negative values in the measurement database. This is useful for displaying graphs that indicate whether the PID is currently lowering or raising. Disable this if you desire all positive values to be stored in the measurement database. |
| $K_P$ Gain | Proportional coefficient (non-negative). Accounts for present values of the error. For example, if the error is large and positive, the control output will also be large and positive. |
| $K_I$ Gain | Integral coefficient (non-negative). Accounts for past values of the error. For example, if the current output is not sufficiently strong, the integral of the error will accumulate over time, and the controller will respond by applying a stronger action. |
| $K_D$ Gain | Derivative coefficient (non-negative). Accounts for predicted future values of the error, based on its current rate of change. |
| Integrator Min | The minimum allowed integrator value, for calculating Ki_total: (Ki_total = Ki * integrator; and PID output = Kp_total + Ki_total + Kd_total) |
| Integrator Max | The maximum allowed integrator value, for calculating Ki_total: (Ki_total = Ki * integrator; and PID output = Kp_total + Ki_total + Kd_total) |
| Output (Raise/ Lower) | This is the output that will cause the particular environmental condition to rise or lower. In the case of raising the temperature, this may be a heating pad or coil. |
| Min On Duration, Duty Cycle, or Amount (Raise/ Lower) | This is the minimum value that the PID output must be before Output (Lower) turns on. If the PID output is less than this value, Duration Outputs will not turn on, and PWM Outputs will be turned off unless Always Min is enabled. |

| Setting | Description |
| --- | --- |
| Max On Duration, Duty Cycle, or Amount (Raise/Lower) | This is the maximum duration, volume, or duty cycle the Output (Raise) can be set to. If the PID output is greater than this value, the Max value set here will be used. |
| Min Off Duration (Raise/Lower) | For On/Off (Duration) Outputs, this is the minimum amount of time the Output must have been off for before it is allowed to turn back on. Ths is useful for devices that can be damaged by rapid power cycling (e.g. fridges). |
| Always Min (Raise/Lower) | For PWM Outputs only. If enabled, the duty cycle will never be set below the Min value. |
| Setpoint Tracking Method | Set a method to change the setpoint over time. |

### PID Output Calculation

PID Controllers can control a number of different output types (e.g. duration, volume, or PWM duty cycle). For most output types, the PID output (Control Variable) will be proportional (i.e. `Output Duration = PID Control Variable`). However, when outputting a duty cycle, it will be calculated as `Duty Cycle = (Control Variable / Period) * 100`.

> **Note**
>
> Control Variable = P Output + I Output + D Output. Duty cycle is limited within the 0 - 100 % range and the set Min Duty Cycle and Max Duty Cycle. An output duration is limited by the set Min On Duration and Max On Duration, and output volume similarly.

### PID Tuning

PID tuning can be a complex process, depending on the output device(s) used and the environment or system under control. A system with large perturbations will be more difficult to control than one that is stable. Similarly, output devices that are unsuitable may make PID tuning difficult or impossible. Learning how PID controllers operate and the theory behind their tuning will not only better prepare you to operate a PID controller, but also in the development of your system and selection and implementation of the output devices used to regulate your system.

#### PID TUNING RESOURCES

- Sous Vide PID Tuning and the Unexpected Electrical Fire

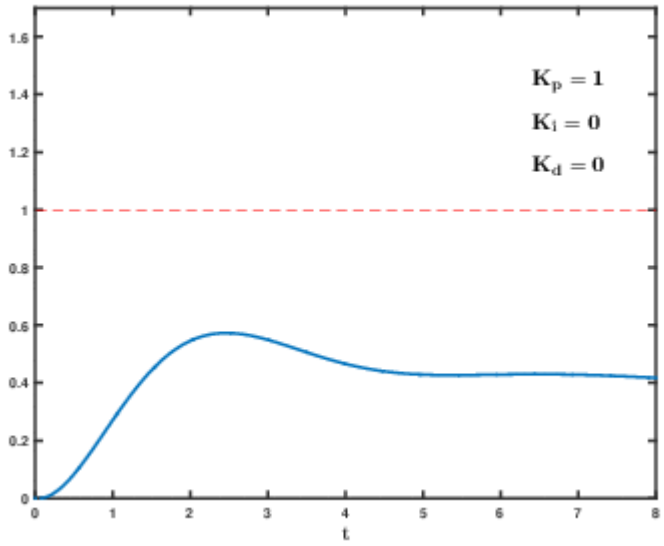
#### PID CONTROL THEORY

The PID controller is the most common regulatory controller found in industrial settings, for it"s ability to handle both simple and complex regulation. The PID controller has three paths, the proportional, integral, and derivative.

The **P**roportional takes the error and multiplies it by the constant $K_P$, to yield an output value. When the error is large, there will be a large proportional output.

The **I**ntegral takes the error and multiplies it by $K_I$, then integrates it ($K_I \cdot 1/s$). As the error changes over time, the integral will continually sum it and multiply it by the constant $K_I$. The integral is used to remove perpetual error in the control system. If using $K_P$ alone produces an output that produces a perpetual error (i.e. if the sensor measurement never reaches the Set Point), the integral will increase the output until the error decreases and the Set Point is reached.

The **D**erivative multiplies the error by $K_D$, then differentiates it ($K_D \cdot s$). When the error rate changes over time, the output signal will change. The faster the change in error, the larger the derivative path becomes, decreasing the output rate of change. This has the effect of dampening overshoot and undershoot (oscillation) of the Set Point.




The $K_P$, $K_I$, and $K_D$ gains determine how much each of the P, I, and D variables influence the final PID output value. For instance, the greater the value of the gain, the more influence that variable has on the output.

Proportional Integral Derivative

$$u(t) = K_p e(t) + K_i \int_0^t e(\tau)d\tau + K_d \frac{d}{dt} e(t)$$

The output from the PID controller can be used in a number of ways. A simple use is to use this value as the number of seconds an output is turned on during a periodic interval (Period). For instance, if the Period is set to 30 seconds, the PID equation has the desired measurement and the actual measurement used to calculate the PID output every 30 seconds. The more the output is on during this period, the more it will affect the system. For example, an output on for 15 seconds every 30 seconds is at a 50 % duty cycle, and would affect the system roughly half as much as when the output is on for 30 seconds every 30 seconds, or at at 100 % duty cycle. The PID controller will calculate the output based on the amount of error (how far the actual measurement is from the desired measurement). If the error increases or persists, the output increases, causing the output to turn on for a longer duration within the Period, which usually in term causes the measured condition to change and the error to reduce. When the error reduces, the control variable decreases, meaning the output is turned on for a shorter duration of time. The ultimate goal of a well-tuned PID controller is to bring the actual measurement to the desired measurement quickly, with little overshoot, and maintain the setpoint with minimal oscillation.

---

Using temperature as an example, the Process Variable (PV) is the measured temperature, the Setpoint (SP) is the desired temperature, and the Error (e) is the distance between the measured temperature and the desired temperature (indicating if the actual temperature is too hot or too cold and to what degree). The error is manipulated by each of the three PID components, producing an output, called the Manipulated Variable (MV) or Control Variable (CV). To allow control of how much each path contributes to the output value, each path is multiplied by a gain (represented by $K_P$, $K_I$, and $K_D$). By adjusting the gains, the sensitivity of the system to each path is affected. When all three paths are summed, the PID output is produced. If a gain is set to 0, that path does not contribute to the output and that path is essentially turned off.

The output can be used a number of ways, however this controller was designed to use the output to affect the measured value (PV). This feedback loop, with a *properly tuned* PID controller, can achieve a set point in a short period of time, maintain regulation with little oscillation, and respond quickly to disturbance.

Therefor, if one would be regulating temperature, the sensor would be a temperature sensor and the feedback device(s) would be able to heat and cool. If the temperature is lower than the Set Point, the output value would be positive and a heater would

activate. The temperature would rise toward the desired temperature, causing the error to decrease and a lower output to be produced. This feedback loop would continue until the error reaches 0 (at which point the output would be 0). If the temperature continues to rise past the Set Point (this is may be acceptable, depending on the degree), the PID would produce a negative output, which could be used by the cooling device to bring the temperature back down, to reduce the error. If the temperature would normally lower without the aid of a cooling device, then the system can be simplified by omitting a cooler and allowing it to lower on its own.

Implementing a controller that effectively utilizes $K_P$, $K_I$, and $K_D$ can be challenging. Furthermore, it is often unnecessary. For instance, the $K_I$ and $K_D$ can be set to 0, effectively turning them off and producing the very popular and simple P controller. Also popular is the PI controller. It is recommended to start with only $K_P$ activated, then experiment with $K_P$ and $K_I$, before finally using all three. Because systems will vary (e.g. airspace volume, degree of insulation, and the degree of impact from the connected device, etc.), each path will need to be adjusted through experimentation to produce an effective output.

#### QUICK SETUP EXAMPLES

These example setups are meant to illustrate how to configure regulation in particular directions, and not to achieve ideal values to configure your $K_P$, $K_I$, and $K_D$ gains. There are a number of online resources that discuss techniques and methods that have been developed to determine ideal PID values (such as here, here, here, here, and here) and since there are no universal values that will work for every system, it is recommended to conduct your own research to understand the variables and essential to conduct your own experiments to effectively implement them.

Provided merely as an example of the variance of PID values, one of my setups had temperature PID values (up regulation) of $K_P = 30$, $K_I = 1.0$, and $K_D = 0.5$, and humidity PID values (up regulation) of $K_P = 1.0$, $K_I = 0.2$, and $K_D = 0.5$. Furthermore, these values may not have been optimal but they worked well for the conditions of my environmental chamber.

#### EXACT TEMPERATURE REGULATION

This will set up the system to raise and lower the temperature to a certain level with two regulatory devices (one that heats and one that cools).

Add a sensor, then save the proper device and pin/address for each sensor and activate the sensor.

Add two outputs, then save each GPIO and On Trigger state.

Add a PID, then select the newly-created sensor. Change *Setpoint* to the desired temperature, *Regulate Direction* to "Both". Set *Raise Output* to the relay attached to the heating device and the *Lower Relay* to the relay attached to the cooling device.

Set $K_P = 1$, $K_I = 0$, and $K_D = 0$, then activate the PID.

If the temperature is lower than the Set Point, the heater should activate at some interval determined by the PID controller until the temperature rises to the set point. If the temperature goes higher than the Set Point (or Set Point + Buffer), the cooling device will activate until the temperature returns to the set point. If the temperature is not reaching the Set Point after a reasonable amount of time, increase the $K_P$ value and see how that affects the system. Experiment with different configurations involving only *Read Interval* and $K_P$ to achieve a good regulation. Avoid changing the $K_I$ and $K_D$ from 0 until a working regulation is achieved with $K_P$ alone.

View graphs in the 6 to 12 hour time span to identify how well the temperature is regulated to the Setpoint. What is meant by well-regulated will vary, depending on your specific application and tolerances. Most applications of a PID controller would like to see the proper temperature attained within a reasonable amount of time and with little oscillation around the Setpoint.

Once regulation is achieved, experiment by reducing $K_P$ slightly (~25%) and increasing $K_I$ by a low amount to start, such as 0.1 (or lower, 0.01), then start the PID and observe how well the controller regulates. Slowly increase $K_I$ until regulation becomes both quick and with little oscillation. At this point, you should be fairly familiar with experimenting with the system and the $K_D$ value can be experimented with once both $K_P$ and $K_I$ have been tuned.

#### HIGH TEMPERATURE REGULATION

Often the system can be simplified if two-way regulation is not needed. For instance, if cooling is unnecessary, this can be removed from the system and only up-regulation can be used.

Use the same configuration as the Exact Temperature Regulation example, except change *Regulate Direction* to "Raise" and do not touch the "Down Relay" section.

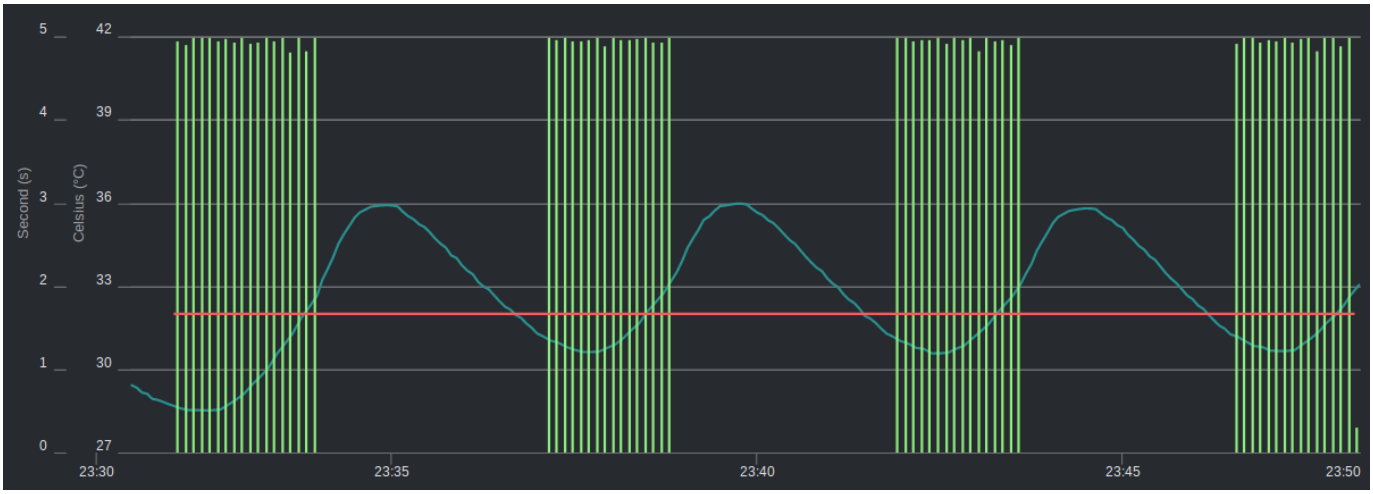
## 4.5.3 PID Autotune

> **Warning**
>
> This is an experimental feature. It is best not used until you are familiar with the theory, operation, and tuning of a PID.

The Autotune function is a standalone controller that is useful for determining appropriate Kp, Ki, and Kd gains for use in the a PID controller. The autotuner will manipulate an output and analyze the measured response in a particular environment/system. It will take several cycles of perturbing the system with the chosen output before enough data is available to calculate the PID gains. In order to use this feature, select a Measurement and an Output that can module the specific condition being measured. Then, configure the Noise Band and Outstep and activate the function. Log lines of the autotuner will appear in the daemon log ( `[Gear Icon] -> Mycodo Logs -> Daemon Log` ). While the autotune is being performed, it is recommended to create a dashboard graph that includes the Measurement and Output in order to see what the PID Autotuner is doing and to notice any potential issues with the autotune settings that have been configured. If the autotune is taking a long time to complete, there may not be enough stability in the system being manipulated to calculate a reliable set of PID gains. This may be because there are too many perturbations to the system, or conditions are changing too rapidly to acquire consistent measurement oscillations. If this is the case, try modifying your system to increase stability and yield consistent measurement oscillations. Once the autotune successfully completes, perturbations may be reintroduced in order to further tune the PID controller to handle them.

| Setting | Description |
|---|---|
| Measurement | This is the Input or Math measurement that is measuring the specific condition that the Output will affect. For instance, this could be a temperature measurement and the output could be a heater. |
| Output | This is the Output that will affect the measurement when it's activated. The autotune function will periodically turn this output on in order to raise the measurement beyond the setpoint. |
| Period | This is the period of time between the Output being turned on. This should be set to the same Period you wish to use for your PID controller. A different Period can significantly affect the PID gains that the autotune produces. |
| Setpoint | This is the desired measurement condition value. For instance, if temperature is being measured, this should be set a several degrees higher than the current temperature so the output, when activated, will cause the temperature to rise beyond the setpoint. |
| Noise Band | This is the amount above the setpoint the measured condition must reach before the output turns off. This is also how much below the setpoint the measured condition must fall before the output turns back on. |
| Outstep | This is how many seconds the output will turn on every PID Period. For instance, to autotune with 50% power, ensure the Outstep is half the value of the PID Period. |
| Direction | This is the direction for which the Output will push the Measurement. For instance, a heater will raise temperature, whereas a cooler will lower temperature. |

Typical graph output will look like this:




And typical Daemon Log output will look like this:

```
2018-08-04 23:32:20,876 - mycodo.pid_3b533dff - INFO - Activated in 187.2 ms
2018-08-04 23:32:20,877 - mycodo.pid_autotune - INFO - PID Autotune started
2018-08-04 23:33:50,823 - mycodo.pid_autotune - INFO -
2018-08-04 23:33:50,830 - mycodo.pid_autotune - INFO - Cycle: 19
2018-08-04 23:33:50,831 - mycodo.pid_autotune - INFO - switched state: relay step down
2018-08-04 23:33:50,832 - mycodo.pid_autotune - INFO - input: 32.52
2018-08-04 23:36:00,854 - mycodo.pid_autotune - INFO -
2018-08-04 23:36:00,860 - mycodo.pid_autotune - INFO - Cycle: 45
2018-08-04 23:36:00,862 - mycodo.pid_autotune - INFO - found peak: 34.03
2018-08-04 23:36:00,863 - mycodo.pid_autotune - INFO - peak count: 1
2018-08-04 23:37:20,802 - mycodo.pid_autotune - INFO -
2018-08-04 23:37:20,809 - mycodo.pid_autotune - INFO - Cycle: 61
2018-08-04 23:37:20,810 - mycodo.pid_autotune - INFO - switched state: relay step up
2018-08-04 23:37:20,811 - mycodo.pid_autotune - INFO - input: 31.28
2018-08-04 23:38:30,867 - mycodo.pid_autotune - INFO -
2018-08-04 23:38:30,874 - mycodo.pid_autotune - INFO - Cycle: 75
2018-08-04 23:38:30,876 - mycodo.pid_autotune - INFO - found peak: 32.17
2018-08-04 23:38:30,878 - mycodo.pid_autotune - INFO - peak count: 2
2018-08-04 23:38:40,852 - mycodo.pid_autotune - INFO -
2018-08-04 23:38:40,858 - mycodo.pid_autotune - INFO - Cycle: 77
2018-08-04 23:38:40,860 - mycodo.pid_autotune - INFO - switched state: relay step down
2018-08-04 23:38:40,861 - mycodo.pid_autotune - INFO - input: 32.85
2018-08-04 23:40:50,834 - mycodo.pid_autotune - INFO -
2018-08-04 23:40:50,835 - mycodo.pid_autotune - INFO - Cycle: 103
2018-08-04 23:40:50,836 - mycodo.pid_autotune - INFO - found peak: 33.93
2018-08-04 23:40:50,836 - mycodo.pid_autotune - INFO - peak count: 3
2018-08-04 23:42:05,799 - mycodo.pid_autotune - INFO -
2018-08-04 23:42:05,805 - mycodo.pid_autotune - INFO - Cycle: 118
2018-08-04 23:42:05,806 - mycodo.pid_autotune - INFO - switched state: relay step up
2018-08-04 23:42:05,807 - mycodo.pid_autotune - INFO - input: 31.27
2018-08-04 23:43:15,816 - mycodo.pid_autotune - INFO -
2018-08-04 23:43:15,822 - mycodo.pid_autotune - INFO - Cycle: 132
2018-08-04 23:43:15,824 - mycodo.pid_autotune - INFO - found peak: 32.09
2018-08-04 23:43:15,825 - mycodo.pid_autotune - INFO - peak count: 4
2018-08-04 23:43:25,790 - mycodo.pid_autotune - INFO -
2018-08-04 23:43:25,796 - mycodo.pid_autotune - INFO - Cycle: 134
2018-08-04 23:43:25,797 - mycodo.pid_autotune - INFO - switched state: relay step down
2018-08-04 23:43:25,798 - mycodo.pid_autotune - INFO - input: 32.76
2018-08-04 23:45:30,802 - mycodo.pid_autotune - INFO -
2018-08-04 23:45:30,808 - mycodo.pid_autotune - INFO - Cycle: 159
2018-08-04 23:45:30,810 - mycodo.pid_autotune - INFO - found peak: 33.98
2018-08-04 23:45:30,811 - mycodo.pid_autotune - INFO - peak count: 5
2018-08-04 23:45:30,812 - mycodo.pid_autotune - INFO -
2018-08-04 23:45:30,814 - mycodo.pid_autotune - INFO - amplitude: 0.9099999999999989
2018-08-04 23:45:30,815 - mycodo.pid_autotune - INFO - amplitude deviation: 0.06593406593406595
2018-08-04 23:46:40,851 - mycodo.pid_autotune - INFO -
2018-08-04 23:46:40,857 - mycodo.pid_autotune - INFO - Cycle: 173
2018-08-04 23:46:40,858 - mycodo.pid_autotune - INFO - switched state: relay step up
2018-08-04 23:46:40,859 - mycodo.pid_autotune - INFO - input: 31.37
2018-08-04 23:47:55,860 - mycodo.pid_autotune - INFO -
2018-08-04 23:47:55,866 - mycodo.pid_autotune - INFO - Cycle: 188
2018-08-04 23:47:55,868 - mycodo.pid_autotune - INFO - found peak: 32.36
2018-08-04 23:47:55,869 - mycodo.pid_autotune - INFO - peak count: 6
2018-08-04 23:47:55,870 - mycodo.pid_autotune - INFO -
2018-08-04 23:47:55,871 - mycodo.pid_autotune - INFO - amplitude: 0.9149999999999979
2018-08-04 23:47:55,872 - mycodo.pid_autotune - INFO - amplitude deviation: 0.032786885245900406
2018-08-04 23:47:55,873 - mycodo.pid_3b533dff - INFO - time:  16 min
2018-08-04 23:47:55,874 - mycodo.pid_3b533dff - INFO - state: succeeded
2018-08-04 23:47:55,874 - mycodo.pid_3b533dff - INFO -
2018-08-04 23:47:55,875 - mycodo.pid_3b533dff - INFO - rule: ziegler-nichols
2018-08-04 23:47:55,876 - mycodo.pid_3b533dff - INFO - Kp: 0.40927018474290117
2018-08-04 23:47:55,877 - mycodo.pid_3b533dff - INFO - Ki: 0.05846588600007114
2018-08-04 23:47:55,879 - mycodo.pid_3b533dff - INFO - Kd: 0.7162385434443115
2018-08-04 23:47:55,880 - mycodo.pid_3b533dff - INFO -
2018-08-04 23:47:55,881 - mycodo.pid_3b533dff - INFO - rule: tyreus-luyben
```

```
2018-08-04 23:47:55,887 - mycodo.pid_3b533dff - INFO - Kp: 0.3162542336649691
2018-08-04 23:47:55,889 - mycodo.pid_3b533dff - INFO - Ki: 0.010165091543194185
2018-08-04 23:47:55,890 - mycodo.pid_3b533dff - INFO - Kd: 0.7028026111719073
2018-08-04 23:47:55,891 - mycodo.pid_3b533dff - INFO -
2018-08-04 23:47:55,892 - mycodo.pid_3b533dff - INFO - rule: ciancone-marlin
2018-08-04 23:47:55,892 - mycodo.pid_3b533dff - INFO - Kp: 0.21083615577664605
2018-08-04 23:47:55,893 - mycodo.pid_3b533dff - INFO - Ki: 0.06626133746674728
2018-08-04 23:47:55,893 - mycodo.pid_3b533dff - INFO - Kd: 0.3644161687558038
2018-08-04 23:47:55,894 - mycodo.pid_3b533dff - INFO -
2018-08-04 23:47:55,894 - mycodo.pid_3b533dff - INFO - rule: pessen-integral
2018-08-04 23:47:55,895 - mycodo.pid_3b533dff - INFO - Kp: 0.49697093861638
2018-08-04 23:47:55,895 - mycodo.pid_3b533dff - INFO - Ki: 0.0887428626786794
2018-08-04 23:47:55,896 - mycodo.pid_3b533dff - INFO - Kd: 1.04627757151908
2018-08-04 23:47:55,896 - mycodo.pid_3b533dff - INFO -
2018-08-04 23:47:55,897 - mycodo.pid_3b533dff - INFO - rule: some-overshoot
2018-08-04 23:47:55,898 - mycodo.pid_3b533dff - INFO - Kp: 0.23191977135431066
2018-08-04 23:47:55,898 - mycodo.pid_3b533dff - INFO - Ki: 0.03313066873337365
2018-08-04 23:47:55,899 - mycodo.pid_3b533dff - INFO - Kd: 1.0823160212047374
2018-08-04 23:47:55,899 - mycodo.pid_3b533dff - INFO -
2018-08-04 23:47:55,900 - mycodo.pid_3b533dff - INFO - rule: no-overshoot
2018-08-04 23:47:55,900 - mycodo.pid_3b533dff - INFO - Kp: 0.1391518628125864
2018-08-04 23:47:55,901 - mycodo.pid_3b533dff - INFO - Ki: 0.01987840124002419
2018-08-04 23:47:55,901 - mycodo.pid_3b533dff - INFO - Kd: 0.6493896127228425
2018-08-04 23:47:55,902 - mycodo.pid_3b533dff - INFO -
2018-08-04 23:47:55,902 - mycodo.pid_3b533dff - INFO - rule: brewing
2018-08-04 23:47:55,903 - mycodo.pid_3b533dff - INFO - Kp: 5.566074512503456
2018-08-04 23:47:55,904 - mycodo.pid_3b533dff - INFO - Ki: 0.11927040744014512
2018-08-04 23:47:55,904 - mycodo.pid_3b533dff - INFO - Kd: 4.101408080354794
```

## 4.5.4 Conditional

Conditional controllers are used to perform certain Actions based a user-generated Conditional Statement.

**Conditional Options**

| Setting | Description |
|---|---|
| Conditional Statement | User-created Python 3 code that will be executed. |
| Period (seconds) | The period (seconds) that the Conditional Statement will be executed. |
| Start Offset (seconds) | The duration (seconds) to wait before executing the Conditional for the first after it is activated. |
| Log Level: Debug | Show debug lines in the daemon log. |
| Message Includes Code | Include the Conditional Statement code in the message (self.message) that is passed to Actions. |

Conditions are functions that can be used within the Conditional Statement, and return specific information.

| Condition | Description |
|---|---|
| Measurement (Single, Last) | Acquires the latest measurement from an Input or device. Set Max Age (seconds) to restrict how long to accept values. If the latest value is older than this duration, "None" is returned. |
| Measurement (Single, Past, Average) | Acquires the past measurements from an Input or device, then averages them. Set Max Age (seconds) to restrict how long to accept values. If all values are older than this duration, "None" is returned. |
| Measurement (Single, Past, Sum) | Acquires the past measurements from an Input or device, then sums them. Set Max Age (seconds) to restrict how long to accept values. If all values are older than this duration, "None" is returned. |
| Measurement (Multiple, Past) | Acquires the past measurements from an Input or device. Set Max Age (seconds) to restrict how long to accept values. If no values are found in this duration, "None" is returned. This differs from the "Measurement (Single)" Condition because it returns a list of dictionaries with 'time' and 'value' key pairs. |
| GPIO State | Acquires the current GPIO state and returns 1 if HIGH or 0 if LOW. If the latest value is older than this duration, "None" is returned. |
| Output State | Returns 'on' if the output is currently on, and 'off' if it's currently off. |
| Output Duration On | Returns how long the output has currently been on, in seconds. Returns 0 if off. |
| Controller Running | Returns True if the controller is active, False if inactive. |
| Max Age (seconds) | The minimum age (seconds) the measurement can be. If the last measurement is older than this, "None" will be returned instead of a measurement. |

### Conditional Setup Guide

Python 3 is the environment that these conditionals will be executed. The following functions can be used within your Conditional Statement code.

> **Note**
>
> Python code indentations must use 4 spaces (not 2 spaces, tabs, or anything else).

| Function | Description |
|---|---|
| self.condition("{ID}") | Returns a measurement for the Condition with ID. |
| self.condition_dict("{ID}") | Returns a dictionary of measurement for the Condition with ID. |
| self.run_action("{ID}") | Executes the Action with ID. |
| self.run_all_actions() | Executes all actions. |
| self.logger.info() | Writes a log line to the Daemon log. "info" may also be changed to "warning", "error" or "debug". Debug log lines will only appear in the Daemon log when Logging Level: Debug is enabled for the Input. |

There are additional functions that can be used, but these must use the full UUID (not an abridged version as the functions above). See /home/pi/Mycodo/mycodo/mycodo_client.py for the functions available for use. These may be accessed via the 'control' object. An example, below, will return how long the output has been on (or 0 if it's currently off):

```
output_on_seconds = control.output_sec_currently_on("1b6ada50-1e69-403a-9fa6-ec748b16dc23")
```

Since the Python code contained in the Conditional Statement must be formatted properly, it's best to familiarize yourself with the basics of Python.

**Note**

There are two different IDs in use here, one set of IDs are found under the `Conditions` section of the Conditional Controller, and one set of IDs are found under the `Actions` section of the Conditional Controller. Read all of this section, including the examples, below, to fully understand how to properly set up a Conditional Controller.

**Info**

If a measurement hasn't been acquired within the set `Max Age`, "None" will be returned when self.condition("{ID}") is called in the code. It is very important that you account for this. All examples below incorporate a test for the measurement being None, and this should not be removed. If an error occurs (such as if the statement resolves to comparing None to a numerical value, such as "if None < 23"), then the code will stop there and an error will be logged in the daemon log. Accounting for None is useful for determining if an Input is no longer acquiring measurements (e.g. dead sensor, malfunction, etc.).

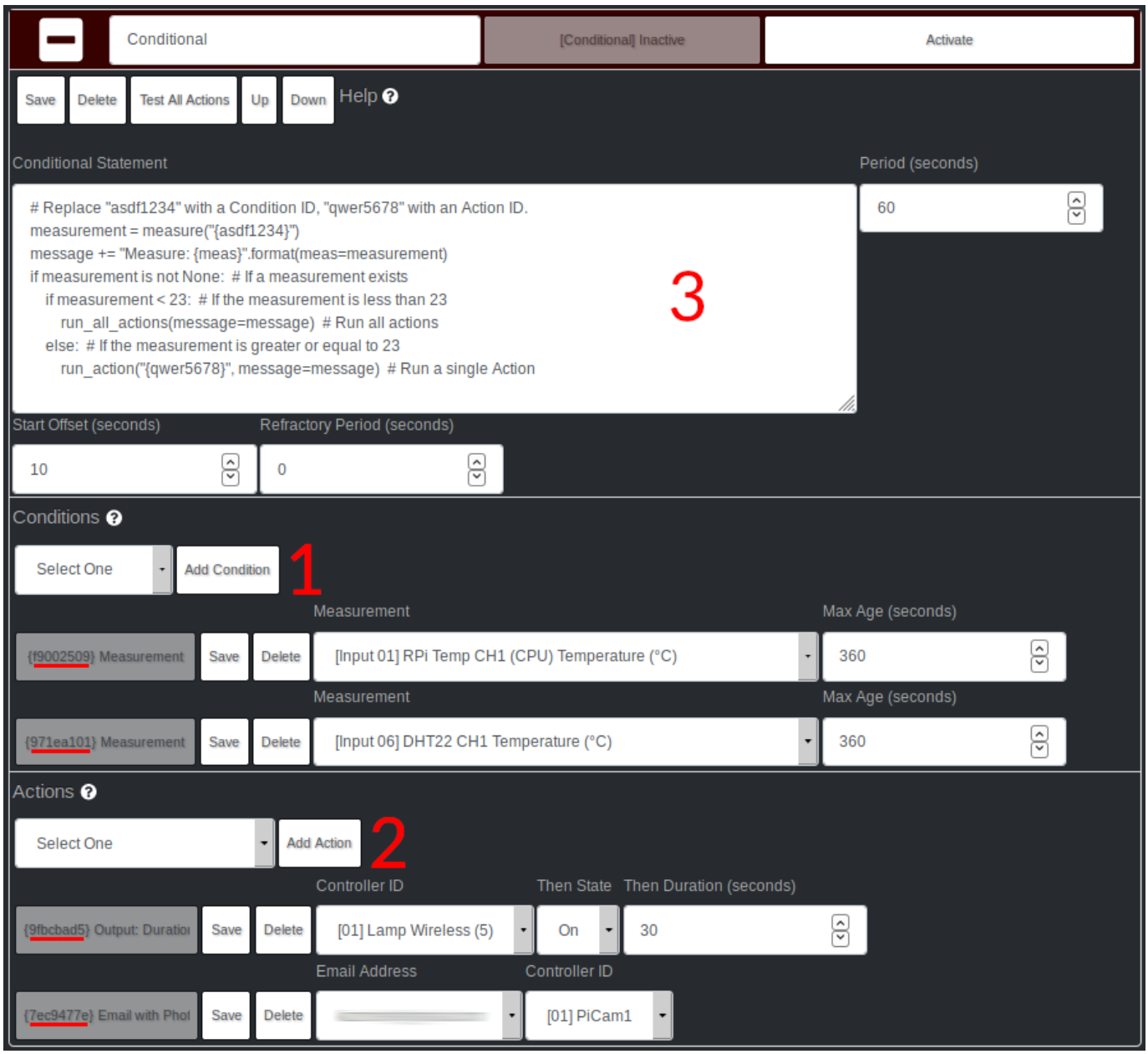
To create a basic conditional, follow these steps, using the numbers in the screenshots, below, that correspond to the numbers in parentheses:

- Navigate to the `Setup -> Function` page.
- Select "Controller: Conditional", then click `Add`.
- Under Conditions (1), select a condition option, then click `Add Condition`.
- Configure the newly-added Condition then click `Save`.
- Under Actions (2), select an action option, then click `Add Action`.
- Configure the newly-added Action then click `Save`.
- Notice that each Condition and each Action has its own ID (underlined).
- The default Conditional Statement (3) contains placeholder IDs that need to be changed to your Condition and Action IDs. Change the ID in self.condition("{asdf1234}") to your Condition ID. Change the ID in self.run_action("{qwer5678}", message=message) to your Action ID. Click `Save` at the top of the Conditional.
- The logic used in the Conditional Statement will need to be adjusted to suit your particular needs. Additionally, you may add more Conditions or Actions. See the `Advanced Conditional Statement examples`, below, for usage examples.

If your `Conditional Statement` has been formatted correctly, your Conditional will save and it will be ready to activate. If an error is returned, your options will not have been saved. Inspect the error for which line is causing the issue and read the error message itself to try to understand what the problem is and how to fix it. There are an unfathomable number of ways to configure a Conditional, but this should hopefully get you started to developing one that suits your needs.

**Note**

Mycodo is constantly changing, so the screenshots below may not match what you see exactly. Be sure to read this entire section of the manual to understand how to use Conditional Controllers.




Beginner `Conditional Statement` examples:

Each self.condition("{ID}") will return the most recent measurement obtained from that particular measurement under the `Conditions` section of the Conditional Controller, as long as it's within the set Max Age.

```
# Example 1, no measurement (i.e. None) returned
# useful with the Email Notify Action to email when an Input stops working
if self.condition("{asdf1234}") is None:
    self.run_all_actions()  # Execute all configured actions

# Example 2, test two measurement conditions
measure_1 = self.condition("{asdf1234}")
measure_2 = self.condition("{hjkl5678}")
if None not in [measure_1, measure_2]:
    # If neither measurement is None (both are working)
    if measure_1 < 20 and measure_2 > 10:
        # If measure_1 is less than 20 and measure_2 is greater than 10
        self.run_all_actions()  # Execute all configured actions

# Example 3, test two measurements and sum of measurements
measure_1 = self.condition("{asdf1234}")
measure_2 = self.condition("{hjkl5678}")
if None not in [measure_1, measure_2]:
    sum_ = measure_1 + measure_2
    if measure_1 > 2 and 10 < measure_2 < 23 and sum_ < 30.5:
        self.run_all_actions()
```

```
# Example 4, combine into one conditional
measurement = self.condition("{asdf1234}")
if measurement is not None and 20 < measurement < 30:  # combine conditions
    self.run_all_actions()

# Example 5, test two measurements
# convert Edge Input from 0 or 1 to True or False
measure_1 = self.condition("{asdf1234}")
measure_2 = self.condition("{hjkl5678}")
if None not in [measure_1, measure_2]:
    if bool(measure_1) and measure_2 > 10:
        self.run_all_actions()

# Example 6, test measurement with "or" and a rounded measurement
measure_1 = self.condition("{asdf1234}")
measure_2 = self.condition("{hjkl5678}")
if None not in [measure_1, measure_2]:
    if measure_1 > 20 or int(round(measure_2)) in [20, 21, 22]:
        self.run_all_actions()

# Example 7, use self to store variables across multiple executions
measurement = self.condition("{asdf1234}")
if not hasattr(self, "stored_measurement"):  # Initialize variable
    self.stored_measurement = measurement
if measurement is not None:
    if abs(measurement - self.stored_measurement) > 10:
        self.run_all_actions()  # if difference is greater than 10
    self.stored_measurement = measurement  # Store measurement
```

The "Measurement (Multiple)" Condition is useful if you desire to check if a particular value has been stored in any of the past measurements (within the set Max Age), not just the last measurement. This is useful if you have an alert system that each numerical value represents a different alert that you need to check each past value if it occurred. Here is an example that retrieves all measurements from the past 30 minutes and checks if any of the measurements in the returned list is equal to "119". If "119" exists, the Actions are executed and `break` is used to exit the `for` loop.

```
# Example 1, find a measurement in the past 30 minutes (Max Age: 1800 seconds)
measurements = self.condition_dict("{asdf1234}")
if measurements:  # If the list is not empty
    for each_measure in measurements:  # Loop through each measurement in the list
        if each_measure['value'] == 119:
            self.logger.info("Alert 119 found at timestamp {time}".format(
                time=each_measure['time']))
            self.run_all_actions()
            break  # Exit the for loop
```

Advanced `Conditional Statement` examples:

These examples expand on the beginner examples, above, by activating specific actions. The following examples will reference actions with IDs that can be found under the `Actions` section of the Conditional Controller. Two example action IDs will be used: "qwer1234" and "uiop5678". Additionally, self.run_all_actions() is used here, which will run all actions in the order in which they were created.

```
# Example 1
measurement = self.condition("{asdf1234}")
if measurement is None:
    self.run_action("{qwer1234}")
elif measurement > 23:
    self.run_action("{uiop5678}")
else:
    self.run_all_actions()

# Example 2, test two measurements
measure_1 = self.condition("{asdf1234}")
measure_2 = self.condition("{hjkl5678}")
if None not in [measure_1, measure_2]:
    if measure_1 < 20 and measure_2 > 10:
        self.run_action("{qwer1234}")
        self.run_action("{uiop5678}")

# Example 3, test two measurements and sum of measurements
measure_1 = self.condition("{asdf1234}")
measure_2 = self.condition("{hjkl5678}")
if None not in [measure_1, measure_2]:
    sum_ = measure_1 + measure_2
    if measure_1 > 2 and 10 < measure_2 < 23 and sum_ < 30.5:
        self.run_action("{qwer1234}")
    else:
        self.run_action("{uiop5678}")

# Example 4, combine into one conditional
measurement = self.condition("{asdf1234}")
if measurement is not None and 20 < measurement < 30:
    self.run_action("{uiop5678}")

# Example 5, test two measurements, convert Edge Input from 0/1 to True/False
```

```
measure_1 = self.condition("{asdf1234}")
measure_2 = self.condition("{hjkl5678}")
if None not in [measure_1, measure_2]:
    if bool(measure_1) and measure_2 > 10:
        self.run_all_actions()

# Example 6, test measurement with "or" and a rounded measurement
measure_1 = self.measure("{asdf1234}")
measure_2 = self.measure("{hjkl5678}")
if None not in [measure_1, measure_2]:
    if measure_1 > 20 or int(round(measure_2)) in [20, 21, 22]:
        self.run_action("{qwer1234}")
        if measure_1 > 30:
            self.run_action("{uiop5678}")
```

If your Action is a type that receives a message (E-Mail or Note), you can modify this message to include extra information before it is passed to the function (so the new information is passed to the Note, E-Mail, etc.). To do this, append a string to the variable `self.message` and add this to the `message` parameter of self.run_action() or self.run_all_actions(). Below are some examples. Note the use of "+=" instead of "=", which appends the string to the variable `self.message` instead of overwriting it.

```
# Example 1
measurement = self.measure("{asdf1234}")
if measurement is None and measurement > 23:
    self.message += "Measurement was {}".format(measurement)
    self.run_action("{uiop5678}", message=self.message)

# Example 2
measure_1 = self.measure("{asdf1234}")
measure_2 = self.measure("{hjkl5678}")
if None not in [measure_1, measure_2]:
    if measure_1 < 20 and measure_2 > 10:
        self.message += "Measurement 1: {m1}, Measurement 2: {m2}".format(
            m1=measure_1, m2=measure_2)
        self.run_all_actions(message=self.message)
```

Logging can also be used to log messages to the daemon log using `self.logger`. Logging levels include "info", "warning", "error" and "debug". Debug log lines will only appear in the Daemon log when Logging Level: Debug is enabled for the Input.

```
# Example 1
measurement = self.measure("{asdf1234}")
if measurement is None and measurement > 23:
    self.logging.error("Warning, measurement was {}".format(measurement))
    self.message += "Measurement was {}".format(measurement)
    self.run_action("{uiop5678}", message=self.message)
```

Before activating any conditionals, it's advised to thoroughly explore all possible scenarios and plan a configuration that eliminates conflicts. Some devices or outputs may respond atypically or fail when switched on and off in rapid succession. Therefore, trial run your configuration before connecting devices to any outputs.

## 4.5.5 Trigger

A Trigger Controller will execute actions when events are triggered, such as an output turning on or off, a GPIO pin changing it's voltage state (Edge detection, rising or falling), timed events that include various timers (duration, time period, time point, etc), or the sunrise/sunset time at a specific latitude and longitude. Once the trigger is configured, add any number of Actions to be executed when that event is triggered.

#### Output (On/Off) Options

Monitor the state of an output.

| Setting | Description |
|---|---|
| If Output | The Output to monitor for a change of state. |
| If State | If the state of the output changes to On or Off the conditional will trigger. If "On (any duration) is selected, th trigger will occur no matter how long the output turns on for, whereas if only "On" is selected, the conditional will trigger only when the output turns on for a duration of time equal to the set "Duration (seconds)". |
| If Duration (seconds) | If "On" is selected, an optional duration (seconds) may be set that will trigger the conditional only if the Output is turned on for this specific duration. |

#### Output (PWM) Options

Monitor the state of a PWM output.

| Setting | Description |
|---|---|
| If Output | The Output to monitor for a change of state. |
| If State | If the duty cycle of the output is greater than,less than, or equal to the set value, trigger the Conditional Actions. |
| If Duty Cycle (%) | The duty cycle for the Output to be checked against. |

#### Edge Options

Monitor the state of a pin for a rising and/or falling edge.

| Setting | Description |
|---|---|
| If Edge Detected | The conditional will be triggered if a change in state is detected, either Rising when the state changes from LOW (0 volts) to HIGH (3.5 volts) or Falling when the state changes from HIGH (3.3 volts) to LOW (0 volts), or Both (Rising and Falling). |

#### Run PWM Method Options

Select a Duration Method and this will set the selected PWM Output to the duty cycle specified by the method.

| Setting | Description |
|---|---|
| Duration Method | Select which Method to use. |
| PWM Output | Select which PWM Output to use. |
| Period (seconds) | Select the interval of time to calculate the duty cycle, then apply to the PWM Output. |
| Trigger Every Period | Trigger Conditional Actions every period. |
| Trigger when Activated | Trigger Conditional Actions when the Conditional is activated. |

#### Sunrise/Sunset Options

Trigger events at sunrise or sunset (or a time offset of those), based on latitude and longitude.

| Setting | Description |
|---|---|
| Rise or Set | Select which to trigger the conditional, at sunrise or sunset. |
| Latitude (decimal) | Latitude of the sunrise/sunset, using decimal format. |
| Longitude (decimal) | Longitude of the sunrise/sunset, using decimal format. |
| Zenith | The Zenith angle of the sun. |
| Date Offset (days) | Set a sunrise/sunset offset in days (positive or negative). |
| Time Offset (minutes) | Set a sunrise/sunset offset in minutes (positive or negative). |

#### Timer (Duration) Options

Run a timer that triggers Conditional Actions every period.

| Setting | Description |
|---|---|
| Period (seconds) | The period of time between triggering Conditional Actions. |
| Start Offset (seconds) | Set this to start the first trigger a number of seconds after the Conditional is activated. |

#### Timer (Daily Time Point) Options

Run a timer that triggers Conditional Actions at a specific time every day.

| Setting | Description |
|---|---|
| Start Time (HH:MM) | Set the time to trigger Conditional Actions, in the format "HH:MM", with HH denoting hours, and MM denoting minutes. Time is in 24-hour format. |

#### Timer (Daily Time Span) Options

Run a timer that triggers Conditional Actions at a specific period if it's between the set start and end times. For example, if the Start Time is set to 10:00 and End Time set to 11:00 and Period set to 120 seconds, the Conditional Actions will trigger every 120 seconds when the time is between 10 AM and 11 AM.

This may be useful, for instance, if you desire an Output to remain on during a particular time period and you want to prevent power outages from interrupting the cycle (which a simple Time Point Timer could not prevent against because it only triggers once at the Start Time). By setting an Output to turn the lights on every few minutes during the Start -> End period, it ensured the Output remains on during this period.

| Setting | Description |
|---|---|
| Start Time (HH:MM) | Set the start time to trigger Conditional Actions, in the format "HH:MM", with HH denoting hours, and MM denoting minutes. Time is in 24-hour format. |
| End Time (HH:MM) | Set the end time to trigger Conditional Actions, in the format "HH:MM", with HH denoting hours, and MM denoting minutes. Time is in 24-hour format. |
| Period (seconds) | The period of time between triggering Conditional Actions. |

## 4.5.6 Function Actions

These are the actions that can be added to Controllers (i.e. Conditional, Trigger).

| Setting | Description |
|---|---|
| Actions: Pause | Pause executing actions for a duration of time (seconds). |
| Camera: Capture Photo | Capture a photo with the selected camera. |
| Create Note | Create a note containing the conditional statement and actions, using a particular tag. |
| Controller: Activate | Activate a particular controller. |
| Controller: Deactivate | Deactivate a particular controller. |
| E-Mail | Send an email containing the conditional statement and actions. |
| E-Mail with Photo Attachment | Send an email containing the conditional statement, actions, and captured photo. |
| E-Mail with Video Attachment | Send an email containing the conditional statement, actions, and captured video. |
| Execute Command | Execute a command in the linux shell (as user 'root'). |
| LCD: Backlight | Turn the LCD backlight on or off. Note: Only some LCDs are supported. |
| LCD: Flash | Start of stop the LCD flashing to indicate an alert. Note: Only some LCDs are supported. |
| Output: Duration | Turn a output on, off, or on for a duration of time. |
| Output: Duty Cycle | Turn a PWM output off or on for a duty cycle. |
| PID: Pause | Pause a particular PID controller. |
| PID: Hold | Hold a particular PID controller. |
| PID: Resume | Resume a particular PID controller. |
| PID: Set Method | Set the Method of a particular PID controller. |
| PID: Set Setpoint | Set the Setpoint of a particular PID controller. |
| System: Restart | Restart the System. |
| System: Shutdown | Shutdown the System. |

# 4.6 Methods

Page: `Setup -> Method`

Methods enable Setpoint Tracking in PIDs and time-based duty cycle changes in timers. Normally, a PID controller will regulate an environmental condition to a specific setpoint. If you would like the setpoint to change over time, this is called setpoint tracking. Setpoint Tracking is useful for applications such as reflow ovens, thermal cyclers (DNA replication), mimicking natural daily cycles, and more. Methods may also be used to change a duty cycle over time when used with a Run PWM Method Conditional.

## 4.6.1 Method Options

These options are shared with several method types.

| Setting | Description |
|---|---|
| Start Time/Date | This is the start time of a range of time. |
| End Time/Date | This is the end time of a range of time. |
| Start Setpoint | This is the start setpoint of a range of setpoints. |
| End Setpoint | This is the end setpoint of a range of setpoints. |

## 4.6.2 Time/Date Method

A time/date method allows a specific time/date span to dictate the setpoint. This is useful for long-running methods, that may take place over the period of days, weeks, or months.

## 4.6.3 Duration Method

A Duration Method allows a **Setpoint** (for PIDs) or **Duty Cycle** (for Conditional) to be set after specific durations of time. Each new duration added will stack, meaning it will come after the previous duration, meaning a newly-added **Start Setpoint** will begin after the previous entry's **End Setpoint**.

If the "Repeat Method" option is used, this will cause the method to repeat once it has reached the end. If this option is used, no more durations may be added to the method. If the repeat option is deleted then more durations may be added. For instance, if your method is 200 seconds total, if the Repeat Duration is set to 600 seconds, the method will repeat 3 times and then automatically turn off the PID or Conditional.

## 4.6.4 Daily (Time-Based) Method

The daily time-based method is similar to the time/date method, however it will repeat every day. Therefore, it is essential that only the span of one day be set in this method. Begin with the start time at 00:00:00 and end at 23:59:59 (or 00:00:00, which would be 24 hours from the start). The start time must be equal or greater than the previous end time.

## 4.6.5 Daily (Sine Wave) Method

The daily sine wave method defines the setpoint over the day based on a sinusoidal wave. The sine wave is defined by y = [A * sin(B * x + C)] + D, where A is amplitude, B is frequency, C is the angle shift, and D is the y-axis shift. This method will repeat daily.

## 4.6.6 Daily (Bezier Curve) Method

A daily Bezier curve method define the setpoint over the day based on a cubic Bezier curve. If unfamiliar with a Bezier curve, it is recommended you use the graphical Bezier curve generator and use the 8 variables it creates for 4 points (each a set of x and y).

The x-axis start (x3) and end (x0) will be automatically stretched or skewed to fit within a 24-hour period and this method will repeat daily.

## 4.6.7 Cascade Method

This method combines multiple methods and outputs the average of the methods. For examples, let's combine a Duration method set to 100 for 60 seconds and 0 for 60 seconds (and set to repeat forever) with a Daily Method that rises from 0 at 00:00:00 to 50 at 12:00:00, and falls back to 0 at 23:59:59. At 00:00:00, the combined methods would produce an output that oscillates from 0 ((0 / 100) * (0 / 100) = 0) to 0 ((100 / 100) * (0 / 100) = 0) every 60 seconds, and gradually increase until at 12:00:00 the output would be oscillating from 0 ((0 / 100) * (50 / 100)) to 50 ((100 / 100) * (50 / 100)) every 60 seconds. This is a simple example, but combinations can become very complex.

## 4.7 LCDs

Page: `Setup -> LCD`

Data may be output to a liquid crystal display (LCD) for easy viewing. Please see LCD Displays for specific information regarding compatibility.

There may be multiple displays created for each LCD. If there is only one display created for the LCD, it will refresh at the set period. If there is more than one display, it will cycle from one display to the next every set period.

| Setting | Description |
|---|---|
| Reset Flashing | If the LCD is flashing to alert you because it was instructed to do so by a triggered Conditional Statement, use this button to stop the flashing. |
| Type | Select either a 16x2 or 20x4 character LCD display. |
| I2C Address | Select the I2C to communicate with the LCD. |
| Period | This is the period of time (in seconds) between redrawing the LCD with new data or switching to the next set of displays (if multiple displays are used). |
| Add Display Set | Add a set of display lines to the LCD. |
| Display Line # | Select which measurement to display on each line of the LCD. |
| Max Age (seconds) | The maximum age the measurement is allowed to be. If no measurement was acquired in this time frame, the display will indicate "NO DATA". |

## 4.8 Alerts

Alerts can be used to notify users about the state of the system. For things like sensor monitoring, this could be a threshold that indicates something needs attention. E-Mail notifications are built-in to Mycodo in a number of places, however there are several places (Inputs, Outputs, Controllers) that allow custom Python code to be used, enabling many other notification options to be built.

See Alert Settings for more information about setting up Alerts.

# 4.9 Notes

Page: `More -> Notes`

Notes may be created that can then be displayed on graphs or referenced at a later time. All notes are timestamped with the date/time of creation or may be created with a custom date/time. Each note must have at least one tag selected. Tags are what are selected to be displayed on a graph and all notes with that tag will appear in the time frame selected on the graph.

## 4.9.1 Tag Options

| Setting | Description |
|---|---|
| Name | A name for the tag. Must not contain spaces. |
| Rename | Rename the tag. |

## 4.9.2 Note Options

| Setting | Description |
|---|---|
| Name | A name for the note. |
| Use Custom Date/Time | Check to enter a custom date/time for the note. |
| Custom Date/Time | Store the note with this custom date/time. |
| Attached Files | Attach one or more files to the note. |
| Tags | Associate the note with at least one tag. |
| Note | The text body of the note. The text will appear monospaced, so code will format properly. |

## 4.10 Camera

Page: `More -> Camera`

Cameras can be used to capture still images, create time-lapses, and stream video. Cameras may also be used by Functions to trigger a camera image or video capture.

There are several libraries that may be used to access your camera, which includes picamera (Raspberry Pi Camera), fswebcam, opencv, urllib, and requests (among potentially others). These libraries enable images to be acquired from the Raspberry Pi camera, USB cameras and webcams, and IP cameras that are accessible by a URL. Furthermore, using the urllib and request libraries, any image URL can be used to acquire images.

# 4.11 Energy Usage

Page: `More -> Energy Usage`

There are two methods for calculating energy usage. The first relies on determining how long Outputs have been on. Based on this, if the number of Amps the output draws has been set in the output Settings, then the kWh and cost can be calculated. Discovering the number of amps the device draws can be accomplished by calculating this from the output typically given as watts on the device label, or with the use of a current clamp while the device is operating. The limitation of this method is PWM Outputs are not currently used to calculate these figures due to the difficulty determining the current consumption of devices driven by PWM signals.

The second method for calculating energy consumption is more accurate and is the recommended method if you desire the most accurate estimation of energy consumption and cost. This method relies on an Input or Math measuring Amps. One way to do this is with the used of an analog-to-digital converter (ADC) that converts the voltage output from a transformer into current (Amps). One wire from the AC line that powers your device(s) passes thorough the transformer and the device converts the current that passes through that wire into a voltage that corresponds to the amperage. For instance, the below sensor converts 0 -50 amps input to 0 - 5 volts output. An ADC receives this output as its input. One would set this conversion range in Mycodo and the calculated amperage will be stored. On the Energy Usage page, add this ADC Input measurement and a report summary will be generated. Keep in mind that for a particular period (for example, the past week) to be accurate, there needs to be a constant measurement of amps at a periodic rate. The faster the rate the more accurate the calculation will be. This is due to the amperage measurements being averaged for this period prior to calculating kWh and cost. If there is any time turing this period where amp measurements aren't being acquired when in fact there are devices consuming current, the calculation is likely to not be accurate.


Greystone CS-650-50 AC Solid Core Current Sensor (Transformer)

The following settings are for calculating energy usage from an amp measurement. For calculating based on Output duration, see Energy Usage Settings.

| Setting | Description |
|---|---|
| Select Amp Measurement | This is a measurement with the amp (A) units that will be used to calculate energy usage. |

# 5. Supported Devices

## 5.1 Inputs Sorted by Measurement

Measurements

- Acceleration
- Acceleration (X)
- Acceleration (Y)
- Acceleration (Z)
- ADC
- Altitude
- Angle
- Battery
- Boolean
- CO2
- Color (Y)
- Color (Blue)
- Color (Green)
- Color (Red)
- Color (x)
- Color (y)
- CPU Load 15 min
- CPU Load 1 min
- CPU Load 5 min
- Dewpoint
- Direction
- Disk
- Dissolved Oxygen
- Duration
- Duty Cycle
- GPIO Edge
- Electrical Conductivity
- Electrical Current
- Electrical Potential
- Energy
- Frequency
- GPIO State
- Humidity
- Ion Concentration
- Length
- Light
- Magnetic Flux Density
- Moisture
- Oxidation Reduction Potential
- PM10
- PM1
- PM2.5
- Power

- Apparent Power
- Power Factor
- Reactive Power
- Pressure
- Pulse Width
- Volume Flow Rate
- Resistance
- Revolutions
- Speed
- Temperature
- Vapor Pressure Deficit
- Version
- VOC
- Volume

### 5.1.1 Acceleration

**Ruuvi: RuuviTag**

### 5.1.2 Acceleration (X)

**Analog Devices: ADXL34x (343, 344, 345, 346)**

**Raspberry Pi Foundation: Sense HAT**

**Ruuvi: RuuviTag**

### 5.1.3 Acceleration (Y)

**Analog Devices: ADXL34x (343, 344, 345, 346)**

**Raspberry Pi Foundation: Sense HAT**

**Ruuvi: RuuviTag**

### 5.1.4 Acceleration (Z)

**Analog Devices: ADXL34x (343, 344, 345, 346)**

**Raspberry Pi Foundation: Sense HAT**

**Ruuvi: RuuviTag**

### 5.1.5 ADC

**AMS: AS7262**

### 5.1.6 Altitude

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME680**

**BOSCH: BME680**

**BOSCH: BMP180**

**BOSCH: BMP280**

**BOSCH: BMP280**

### 5.1.7 Angle

**Raspberry Pi Foundation: Sense HAT**

### 5.1.8 Battery

**Ruuvi: RuuviTag**

**Sensorion: SHT31 Smart Gadget**

**Xiaomi: Miflora**

**Xiaomi: Mijia LYWSD03MMC (ATC and non-ATC modes)**

### 5.1.9 Boolean

**System: Server Ping**

**System: Server Port Open**

### 5.1.10 CO2

**AMS: CCS811 (with Temperature)**

**AMS: CCS811 (without Temperature)**

**Atlas Scientific: Atlas CO2**

**CO2Meter: K30**

**Cozir: Cozir CO2**

**Sensirion: SCD30**

**Sensirion: SCD30**

**Winsen: MH-Z16**

**Winsen: MH-Z19**

**Winsen: MH-Z19B**

### 5.1.11 Color (Y)

**Atlas Scientific: Atlas Color**

### 5.1.12 Color (Blue)

**Atlas Scientific: Atlas Color**

### 5.1.13 Color (Green)

**Atlas Scientific: Atlas Color**

### 5.1.14 Color (Red)

**Atlas Scientific: Atlas Color**

### 5.1.15 Color (x)

**Atlas Scientific: Atlas Color**

### 5.1.16 Color (y)

**Atlas Scientific: Atlas Color**

### 5.1.17 CPU Load 15 min

**System: CPU Load**

### 5.1.18 CPU Load 1 min

**System: CPU Load**

### 5.1.19 CPU Load 5 min

**System: CPU Load**

### 5.1.20 Dewpoint

**AOSONG: AM2315/AM2320**

**AOSONG: DHT11**

**AOSONG: DHT22**

**Atlas Scientific: Atlas Humidity**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME680**

**BOSCH: BME680**

**Cozir: Cozir CO2**

**Ruuvi: RuuviTag**

**Seeedstudio: DHT11/22**

**Sensirion: SCD30**

**Sensirion: SCD30**

**Sensirion: SHT1x/7x**

**Sensirion: SHT2x**

**Sensirion: SHT31-D**

**Sensirion: SHT3x (30, 31, 35)**

**Sensirion: SHT4X**

**Sensorion: SHT31 Smart Gadget**

**Sonoff: TH16/10 (Tasmota firmware) with AM2301**

**TE Connectivity: HTU21D**

**Texas Instruments: HDC1000**

**Weather: OpenWeatherMap (City, Current)**

**Weather: OpenWeatherMap (Lat/Lon, Current/Future)**

## 5.1.21 Direction

**Raspberry Pi Foundation: Sense HAT**

**Weather: OpenWeatherMap (City, Current)**

**Weather: OpenWeatherMap (Lat/Lon, Current/Future)**

## 5.1.22 Disk

**Mycodo: Mycodo RAM**

**System: Free Space**

## 5.1.23 Dissolved Oxygen

**Atlas Scientific: Atlas DO**

## 5.1.24 Duration

**Weather: OpenWeatherMap (Lat/Lon, Current/Future)**

### 5.1.25 Duty Cycle

**Raspberry Pi: Signal (PWM)**

### 5.1.26 GPIO Edge

**Raspberry Pi: Edge Detection**

### 5.1.27 Electrical Conductivity

**AnyLeaf: AnyLeaf EC**

**Atlas Scientific: Atlas EC**

**Generic: ADS1115: Analog pH/EC**

**Xiaomi: Miflora**

### 5.1.28 Electrical Current

**Tasmota: Tasmota Outlet Energy Monitor (HTTP)**

**Texas Instruments: INA219x**

### 5.1.29 Electrical Potential

**Microchip: MCP3008**

**Microchip: MCP342x (x=2,3,4,6,7,8)**

**Tasmota: Tasmota Outlet Energy Monitor (HTTP)**

**Texas Instruments: ADS1015**

**Texas Instruments: ADS1115**

**Texas Instruments: ADS1256**

**Texas Instruments: ADS1x15**

**Texas Instruments: INA219x**

### 5.1.30 Energy

**Tasmota: Tasmota Outlet Energy Monitor (HTTP)**

### 5.1.31 Frequency

**Raspberry Pi: Signal (PWM)**

### 5.1.32 GPIO State

**Raspberry Pi: GPIO State**

## 5.1.33 Humidity

**AOSONG: AM2315/AM2320**

**AOSONG: DHT11**

**AOSONG: DHT22**

**ASAIR: AHTx0**

**Atlas Scientific: Atlas Humidity**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME680**

**BOSCH: BME680**

**Cozir: Cozir CO2**

**Raspberry Pi Foundation: Sense HAT**

**Ruuvi: RuuviTag**

**Seeedstudio: DHT11/22**

**Sensirion: SCD30**

**Sensirion: SCD30**

**Sensirion: SHT1x/7x**

**Sensirion: SHT2x**

**Sensirion: SHT31-D**

**Sensirion: SHT3x (30, 31, 35)**

**Sensirion: SHT4X**

**Sensorion: SHT31 Smart Gadget**

**Sonoff: TH16/10 (Tasmota firmware) with AM2301**

**TE Connectivity: HTU21D**

**Texas Instruments: HDC1000**

**Weather: OpenWeatherMap (City, Current)**

**Weather: OpenWeatherMap (Lat/Lon, Current/Future)**

**Xiaomi: Mijia LYWSD03MMC (ATC and non-ATC modes)**

## 5.1.34 Ion Concentration

**AnyLeaf: AnyLeaf pH**

**Atlas Scientific: Atlas pH**

**Generic: ADS1115: Analog pH/EC**

## 5.1.35 Length

**Atlas Scientific: Atlas Color**

**Multiple Manufacturers: HC-SR04**

**STMicroelectronics: VL53L0X**

**STMicroelectronics: VL53L1X**

## 5.1.36 Light

**AMS: TSL2561**

**AMS: TSL2591**

**Atlas Scientific: Atlas Color**

**Catnip Electronics: Chirp**

**ROHM: BH1750**

**Xiaomi: Miflora**

## 5.1.37 Magnetic Flux Density

**Raspberry Pi Foundation: Sense HAT**

## 5.1.38 Moisture

**Adafruit: I2C Capacitive Moisture Sensor**

**Catnip Electronics: Chirp**

**Xiaomi: Miflora**

### 5.1.39 Oxidation Reduction Potential

**AnyLeaf: AnyLeaf ORP**

**Atlas Scientific: Atlas ORP**

### 5.1.40 PM10

**Winsen: ZH03B**

### 5.1.41 PM1

**Winsen: ZH03B**

### 5.1.42 PM2.5

**Winsen: ZH03B**

### 5.1.43 Power

**Tasmota: Tasmota Outlet Energy Monitor (HTTP)**

### 5.1.44 Apparent Power

**Tasmota: Tasmota Outlet Energy Monitor (HTTP)**

### 5.1.45 Power Factor

**Tasmota: Tasmota Outlet Energy Monitor (HTTP)**

### 5.1.46 Reactive Power

**Tasmota: Tasmota Outlet Energy Monitor (HTTP)**

### 5.1.47 Pressure

**Atlas Scientific: Atlas Pressure**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME680**

**BOSCH: BME680**

**BOSCH: BMP180**

**BOSCH: BMP280**

**BOSCH: BMP280**

**Raspberry Pi Foundation: Sense HAT**

**Ruuvi: RuuviTag**

**Weather: OpenWeatherMap (City, Current)**

**Weather: OpenWeatherMap (Lat/Lon, Current/Future)**

### 5.1.48 Pulse Width

**Raspberry Pi: Signal (PWM)**

### 5.1.49 Volume Flow Rate

**Atlas Scientific: Atlas Flow Meter**

**Generic: Hall Flow Meter**

### 5.1.50 Resistance

**BOSCH: BME680**

**BOSCH: BME680**

### 5.1.51 Revolutions

**Raspberry Pi: Signal (Revolutions)**

### 5.1.52 Speed

**Weather: OpenWeatherMap (City, Current)**

**Weather: OpenWeatherMap (Lat/Lon, Current/Future)**

### 5.1.53 Temperature

**AMS: CCS811 (with Temperature)**

**AOSONG: AM2315/AM2320**

**AOSONG: DHT11**

**AOSONG: DHT22**

**ASAIR: AHTx0**

**Adafruit: I2C Capacitive Moisture Sensor**

**Analog Devices: ADT7410**

**Atlas Scientific: Atlas Humidity**

**Atlas Scientific: Atlas PT-1000**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME680**

**BOSCH: BME680**

**BOSCH: BMP180**

**BOSCH: BMP280**

**BOSCH: BMP280**

**Catnip Electronics: Chirp**

**Cozir: Cozir CO2**

**MAXIM: DS1822**

**MAXIM: DS1825**

**MAXIM: DS18B20**

**MAXIM: DS18B20**

**MAXIM: DS18S20**

**MAXIM: DS28EA00**

**MAXIM: MAX31850K**

**MAXIM: MAX31855**

**MAXIM: MAX31856**

**MAXIM: MAX31865**

**MAXIM: MAX31865**

**Melexis: MLX90614**

**Microchip: MCP9808**

**Panasonic: AMG8833**

**Raspberry Pi Foundation: Sense HAT**

**Raspberry Pi: CPU/GPU Temperature**

**Ruuvi: RuuviTag**

**Seeedstudio: DHT11/22**

**Sensirion: SCD30**

**Sensirion: SCD30**

**Sensirion: SHT1x/7x**

**Sensirion: SHT2x**

**Sensirion: SHT31-D**

**Sensirion: SHT3x (30, 31, 35)**

**Sensirion: SHT4X**

**Sensorion: SHT31 Smart Gadget**

**Sonoff: TH16/10 (Tasmota firmware) with AM2301**

**Sonoff: TH16/10 (Tasmota firmware) with DS18B20**

**TE Connectivity: HTU21D**

**Texas Instruments: HDC1000**

**Texas Instruments: TMP006**

**Weather: OpenWeatherMap (City, Current)**

**Weather: OpenWeatherMap (Lat/Lon, Current/Future)**

**Xiaomi: Miflora**

**Xiaomi: Mijia LYWSD03MMC (ATC and non-ATC modes)**

## 5.1.54 Vapor Pressure Deficit

**AOSONG: AM2315/AM2320**

**AOSONG: DHT11**

**AOSONG: DHT22**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME280**

**BOSCH: BME680**

**BOSCH: BME680**

**Ruuvi: RuuviTag**

**Seeedstudio: DHT11/22**

**Sensirion: SCD30**

**Sensirion: SCD30**

**Sensirion: SHT1x/7x**

**Sensirion: SHT2x**

**Sensirion: SHT31-D**

**Sensirion: SHT3x (30, 31, 35)**

**Sensirion: SHT4X**

**Sensorion: SHT31 Smart Gadget**

**Sonoff: TH16/10 (Tasmota firmware) with AM2301**

**TE Connectivity: HTU21D**

**Texas Instruments: HDC1000**

## 5.1.55 Version

**Mycodo: Mycodo Version**

## 5.1.56 VOC

**AMS: CCS811 (with Temperature)**

**AMS: CCS811 (without Temperature)**

## 5.1.57 Volume

**Atlas Scientific: Atlas Flow Meter**

**Generic: Hall Flow Meter**

## 5.2 Supported Inputs

Supported Inputs are listed below.

### 5.2.1 Built-In Inputs (System)

**Linux: Bash Command**

- Manufacturer: Linux
- Measurements: Return Value
- Interfaces: Mycodo

This Input will execute a command in the shell and store the output as a float value. Perform any unit conversions within your script or command. A measurement/unit is required to be selected.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**Command Timeout**

- Type: Integer
- Default Value: 60
- Description: How long to wait for the command to finish before killing the process.

**User**

- Type: Text
- Default Value: mycodo
- Description: The user to execute the command

**CWD**

- Type: Text
- Default Value: /home/pi
- Description: The current working directory of the shell environment.

### Linux: Python 3 Code

- Manufacturer: Linux
- Measurements: Store Value(s)
- Interfaces: Mycodo

All channels require a Measurement Unit to be selected and saved in order to store values to the database.

#### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Mycodo: MQTT Subscribe (JSON payload)

- Manufacturer: Mycodo
- Measurements: Variable measurements
- Interfaces: Mycodo
- Libraries: paho-mqtt
- Dependencies: paho-mqtt

A single topic is subscribed to and the returned JSON payload contains one or more key/value pairs. If the set JSON Key exists in the payload, the corresponding value will be stored for that channel. Be sure you select and save the Measurement Unit for each of channels. Once the unit has been saved, you can convert to other units in the Convert Measurement section.

#### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Host

- Type: Text
- Default Value: localhost
- Description: Host address or IP

**Port**

- Type: Integer
- Default Value: 1883
- Description: Host port number

**Topic**

- Type: Text
- Default Value: mqtt/test/input
- Description: The topic to subscribe to

**Keep Alive**

- Type: Integer
- Default Value: 60
- Description: Maximum amount of time between received signals. Set to 0 to disable.

**Client ID**

- Type: Text
- Default Value: mycodo_mqtt_client
- Description: Unique client ID for connecting to the server

**Use Login**

- Type: Boolean
- Description: Send login credentials

**Use TLS**

- Type: Boolean
- Description: Send login credentials using TLS

**Username**

- Type: Text
- Default Value: user
- Description: Username for connecting to the server

**Password**

- Type: Text
- Description: Password for connecting to the server. Leave blank to disable.

**CHANNEL OPTIONS**

**Name**

- Type: Text
- Description: A name to distinguish this from others

**JSON Key**

- Type: Text
- Description: JSON Key for the value to be stored

### Mycodo: MQTT Subscribe (value payload)

- Manufacturer: Mycodo
- Measurements: Variable measurements

- Interfaces: Mycodo
- Libraries: paho-mqtt
- Dependencies: paho-mqtt

A topic is subscribed to for each channel Subscription Topic and the returned payload value will be stored for that channel. Be sure you select and save the Measurement Unit for each of the channels. Once the unit has been saved, you can convert to other units in the Convert Measurement section.

**OPTIONS**

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Host**

- Type: Text
- Default Value: localhost
- Description: Host address or IP

**Port**

- Type: Integer
- Default Value: 1883
- Description: Host port number

**Keep Alive**

- Type: Integer
- Default Value: 60
- Description: Maximum amount of time between received signals. Set to 0 to disable.

**Client ID**

- Type: Text
- Default Value: mycodo_mqtt_client
- Description: Unique client ID for connecting to the server

**Use Login**

- Type: Boolean
- Description: Send login credentials

**Use TLS**

- Type: Boolean
- Description: Send login credentials using TLS

**Username**

- Type: Text
- Default Value: user
- Description: Username for connecting to the server

**Password**

- Type: Text
- Description: Password for connecting to the server. Leave blank to disable.

#### CHANNEL OPTIONS

##### Name

- Type: Text
- Description: A name to distinguish this from others

##### Subscription Topic

- Type: Text
- Description: The MQTT topic to subscribe to

### Mycodo: Mycodo RAM

- Manufacturer: Mycodo
- Measurements: Size RAM in Use
- Interfaces: Mycodo
- Libraries: resource.getrusage()

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

### Mycodo: Mycodo Version

- Manufacturer: Mycodo
- Measurements: Version as Major.Minor.Revision
- Interfaces: Mycodo

#### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

### Mycodo: TTN Integration: Data Storage

- Manufacturer: Mycodo
- Measurements: Variable measurements
- Interfaces: Mycodo
- Libraries: requests
- Dependencies: requests

This Input receives and stores measurements from the Data Storage Integration on The Things Network.

#### OPTIONS

##### Measurements Enabled

- Type: Multi-Select

- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Start Offset (seconds)**

- Type: Integer
- Description: The duration (seconds) to wait before the first operation

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**Application ID**

- Type: Text
- Description: The Things Network Application ID

**App API Key**

- Type: Text
- Description: The Things Network Application API Key

**Device ID**

- Type: Text
- Description: The Things Network Device ID

**CHANNEL OPTIONS**

**Name**

- Type: Text
- Description: A name to distinguish this from others

**Variable Name**

- Type: Text
- Description: The TTN variable name

### Raspberry Pi: CPU/GPU Temperature

- Manufacturer: Raspberry Pi
- Measurements: Temperature
- Interfaces: RPi

The internal CPU and GPU temperature of the Raspberry Pi.

#### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

### Raspberry Pi: Edge Detection

- Manufacturer: Raspberry Pi
- Measurements: Rising/Falling Edge
- Interfaces: GPIO
- Libraries: RPi.GPIO
- Dependencies: RPi.GPIO

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Pin Mode

- Type: Select
- Options: [**Floating** | Pull Down | Pull Up] (Default in **bold**)
- Description: Enables or disables the pull-up or pull-down resistor

### Raspberry Pi: GPIO State

- Manufacturer: Raspberry Pi
- Measurements: GPIO State
- Interfaces: GPIO
- Libraries: RPi.GPIO
- Dependencies: RPi.GPIO

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Pin Mode

- Type: Select
- Options: [**Floating** | Pull Down | Pull Up] (Default in **bold**)
- Description: Enables or disables the pull-up or pull-down resistor

### Raspberry Pi: Signal (PWM)

- Manufacturer: Raspberry Pi
- Measurements: Frequency/Pulse Width/Duty Cycle
- Interfaces: GPIO
- Libraries: pigpio
- Dependencies: pigpio

#### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Raspberry Pi: Signal (Revolutions)

- Manufacturer: Raspberry Pi
- Measurements: RPM
- Interfaces: GPIO
- Libraries: pigpio
- Dependencies: pigpio

##### OPTIONS

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### System: CPU Load

- Manufacturer: System
- Measurements: CPULoad
- Interfaces: Mycodo
- Libraries: os.getloadavg()

##### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

### System: Free Space

- Manufacturer: System
- Measurements: Unallocated Disk Space

- Interfaces: Mycodo
- Libraries: os.statvfs()

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

### System: Server Ping

- Manufacturer: System
- Measurements: Boolean
- Interfaces: Mycodo
- Libraries: ping

This Input executes the bash command "ping -c [times] -w [deadline] [host]" to determine if the host can be pinged.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### System: Server Port Open

- Manufacturer: System
- Measurements: Boolean
- Interfaces: Mycodo
- Libraries: nc

This Input executes the bash command "nc -zv [host] [port]" to determine if the host at a particular port is accessible.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select

- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

## 5.2.2 Built-In Inputs (Devices)

**AMS: AS7262**

- Manufacturer: AMS
- Measurements: Light at 450, 500, 550, 570, 600, 650 nm
- Interfaces: $I^2C$
- Libraries: as7262
- Dependencies: as7262
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### Gain

- Type: Select
- Options: [1x | 3.7x | 16x | **64x**] (Default in **bold**)
- Description: Set the sensor gain

#### Illumination LED Current

- Type: Select
- Options: [**12.5 mA** | 25 mA | 50 mA | 100 mA] (Default in **bold**)

- Description: Set the illumination LED current (milliamps)

##### Illumination LED Mode

- Type: Select
- Options: [**On** | Off] (Default in **bold**)
- Description: Turn the illumination LED on or off during a measurement

##### Indicator LED Current

- Type: Select
- Options: [**1 mA** | 2 mA | 4 mA | 8 mA] (Default in **bold**)
- Description: Set the indicator LED current (milliamps)

##### Indicator LED Mode

- Type: Select
- Options: [**On** | Off] (Default in **bold**)
- Description: Turn the indicator LED on or off during a measurement

##### Integration Time

- Type: Decimal
- Default Value: 15.0
- Description: The integration time (0 - ~91 ms)

### AMS: CCS811 (with Temperature)

- Manufacturer: AMS
- Measurements: CO2/VOC/Temperature
- Interfaces: $I^2C$
- Libraries: Adafruit_CCS811
- Dependencies: Adafruit_CCS811, Adafruit-GPIO
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2

##### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### AMS: CCS811 (without Temperature)

- Manufacturer: AMS
- Measurements: CO2/VOC
- Interfaces: $I^2C$
- Libraries: Adafruit_CircuitPython_CCS811
- Dependencies: pyusb, Adafruit-extended-bus, adafruit-circuitpython-ccs811
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link
- Additional URL: Link

#### OPTIONS

#### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

#### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal

- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### AMS: TSL2561

- Manufacturer: AMS
- Measurements: Light
- Interfaces: $I^2C$
- Libraries: tsl2561
- Dependencies: Adafruit-GPIO, Adafruit-PureIO, tsl2561
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

##### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### AMS: TSL2591

- Manufacturer: AMS
- Measurements: Light
- Interfaces: $I^2C$
- Libraries: maxlklaxl/python-tsl2591
- Dependencies: tsl2591
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### AOSONG: AM2315/AM2320

- Manufacturer: AOSONG
- Measurements: Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: quick2wire-api
- Dependencies: quick2wire-api
- Datasheet URL: Link

- Product URL: Link

**OPTIONS**

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### AOSONG: DHT11

- Manufacturer: AOSONG
- Measurements: Humidity/Temperature
- Interfaces: GPIO
- Libraries: pigpio
- Dependencies: pigpio
- Datasheet URL: Link
- Product URL: Link

**OPTIONS**

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal

- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### AOSONG: DHT22

- Manufacturer: AOSONG
- Measurements: Humidity/Temperature
- Interfaces: GPIO
- Libraries: pigpio
- Dependencies: pigpio
- Datasheet URL: Link
- Product URL: Link

##### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### ASAIR: AHTx0

- Manufacturer: ASAIR
- Measurements: Temperature/Humidity
- Interfaces: $I^2C$
- Libraries: Adafruit-CircuitPython-AHTx0
- Dependencies: pyusb, Adafruit-extended-bus, adafruit-circuitpython-ahtx0
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

##### I²C Address

- Type: Text
- Description: The I2C address of the device

##### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Adafruit: I2C Capacitive Moisture Sensor

- Manufacturer: Adafruit
- Measurements: Moisture/Temperature
- Interfaces: $I^2C$
- Libraries: adafruit_seesaw
- Dependencies: pyusb, Adafruit-extended-bus, adafruit-circuitpython-seesaw
- Manufacturer URL: Link
- Product URL: Link

#### OPTIONS

##### I²C Address

- Type: Text
- Description: The I2C address of the device

##### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Analog Devices: ADT7410

- Manufacturer: Analog Devices
- Measurements: Temperature
- Interfaces: $I^2C$
- Libraries: Adafruit_CircuitPython
- Dependencies: pyusb, Adafruit-extended-bus, adafruit-circuitpython-adt7410
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

#### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

#### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal

- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Analog Devices: ADXL34x (343, 344, 345, 346)

- Manufacturer: Analog Devices
- Measurements: Acceleration
- Interfaces: $I^2C$
- Libraries: Adafruit_CircuitPython
- Dependencies: pyusb, Adafruit-extended-bus, adafruit-circuitpython-adxl34x
- Datasheet URLs: Link 1, Link 2, Link 3, Link 4
- Product URLs: Link 1, Link 2, Link 3, Link 4

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Range

- Type: Select
- Options: [±2 g (±19.6 m/s/s) | ±4 g (±39.2 m/s/s) | ±8 g (±78.4 m/s/s) | **±16 g (±156.9 m/s/s)**] (Default in **bold**)

- Description: Set the measurement range

#### AnyLeaf: AnyLeaf EC

- Manufacturer: AnyLeaf
- Measurements: Electrical Conductivity
- Interfaces: UART
- Libraries: anyleaf
- Dependencies: libjpeg-dev, zlib1g-dev, Pillow, python3-scipy, pyusb, Adafruit-extended-bus, anyleaf
- Manufacturer URL: Link
- Datasheet URL: Link

##### OPTIONS

###### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

###### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

###### Conductivity Constant

- Type: Decimal
- Default Value: 1.0
- Description: Conductivity constant K

#### AnyLeaf: AnyLeaf ORP

- Manufacturer: AnyLeaf
- Measurements: Oxidation Reduction Potential
- Interfaces: $I^2C$
- Libraries: anyleaf
- Dependencies: libjpeg-dev, zlib1g-dev, Pillow, python3-scipy, pyusb, Adafruit-extended-bus, anyleaf
- Manufacturer URL: Link
- Datasheet URL: Link

##### OPTIONS

###### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

###### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

###### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Calibrate: Voltage (Internal)

- Type: Decimal
- Default Value: 0.4
- Description: Calibration data: internal voltage

##### Calibrate: ORP (Internal)

- Type: Decimal
- Default Value: 400.0
- Description: Calibration data: internal ORP

#### ACTIONS

##### Calibrate: Buffer ORP (mV)

- Type: Decimal
- Default Value: 400.0
- Description: This is the nominal ORP of the calibration buffer in mV, usually labelled on the bottle.

##### Calibrate

- Type: Button

##### Clear Calibration Slots

- Type: Button

### AnyLeaf: AnyLeaf pH

- Manufacturer: AnyLeaf
- Measurements: Ion concentration
- Interfaces: $I^2C$
- Libraries: anyleaf
- Dependencies: libjpeg-dev, zlib1g-dev, Pillow, python3-scipy, pyusb, Adafruit-extended-bus, anyleaf
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Temperature Compensation Measurement

- Type: Select Measurement
- Selections: Input, Function, Math,
- Description: Select a measurement for temperature compensation

**Temperature Compensation Max Age**

- Type: Integer
- Default Value: 120
- Description: The maximum age (seconds) of the measurement to use for temperature compensation

**Cal data: V1 (internal)**

- Type: Decimal
- Description: Calibration data: Voltage

**Cal data: pH1 (internal)**

- Type: Decimal
- Default Value: 7.0
- Description: Calibration data: pH

**Cal data: T1 (internal)**

- Type: Decimal
- Default Value: 23.0
- Description: Calibration data: Temperature

**Cal data: V2 (internal)**

- Type: Decimal
- Default Value: 0.17
- Description: Calibration data: Voltage

**Cal data: pH2 (internal)**

- Type: Decimal
- Default Value: 4.0
- Description: Calibration data: pH

**Cal data: T2 (internal)**

- Type: Decimal
- Default Value: 23.0
- Description: Calibration data: Temperature

**Cal data: V3 (internal)**

- Type: Decimal
- Description: Calibration data: Voltage

**Cal data: pH3 (internal)**

- Type: Decimal
- Description: Calibration data: pH

**Cal data: T3 (internal)**

- Type: Decimal
- Description: Calibration data: Temperature

**ACTIONS**

**Calibration buffer pH**

- Type: Decimal

- Default Value: 7.0
- Description: This is the nominal pH of the calibration buffer, usually labelled on the bottle.

##### Calibrate, slot 1

- Type: Button

##### Calibrate, slot 2

- Type: Button

##### Calibrate, slot 3

- Type: Button

##### Clear Calibration Slots

- Type: Button

### Atlas Scientific: Atlas CO2

- Manufacturer: Atlas Scientific
- Measurements: CO2
- Interfaces: $I^2C$, UART, FTDI
- Libraries: pylibftdi/fcntl/io/serial
- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link

##### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### FTDI Device

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

##### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### ACTIONS

##### New I2C Address

- Type: Text
- Default Value: 0x69
- Description: The new I2C to set the device to

##### Set I2C Address

- Type: Button

### Atlas Scientific: Atlas Color

- Manufacturer: Atlas Scientific
- Measurements: RGB, CIE, LUX, Proximity
- Interfaces: $I^2C$, UART, FTDI
- Libraries: pylibftdi/fcntl/io/serial
- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### FTDI Device

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

##### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**LED Only For Measure**

- Type: Boolean
- Default Value: True
- Description: Turn the LED on only during the measurement

**LED Percentage**

- Type: Integer
- Default Value: 30
- Description: What percentage of power to supply to the LEDs during measurement

**Gamma Correction**

- Type: Decimal
- Default Value: 1.0
- Description: Gamma correction between 0.01 and 4.99 (default is 1.0)

**ACTIONS**

**The EZO-RGB color sensor is designed to be calibrated to a white object at the maximum brightness the object will be viewed under. In order to get the best results, Atlas Scientific strongly recommends that the sensor is mounted into a fixed location. Holding the sensor in your hand during calibration will decrease performance.**
**1. Embed the EZO-RGB color sensor into its intended use location.**
**2. Set LED brightness to the desired level.**
**3. Place a white object in front of the target object and press the Calibration button.**
**4. A single color reading will be taken and the device will be fully calibrated.**

**Calibrate**

- Type: Button

**The I2C address can be changed. Enter a new address in the 0xYY format (e.g. 0x22, 0x50), then press Set I2C Address. Remember to deactivate and change the I2C address option after setting the new address.**

**New I2C Address**

- Type: Text
- Default Value: 0x70
- Description: The new I2C to set the device to

#### Set I2C Address

- Type: Button

### Atlas Scientific: Atlas DO

- Manufacturer: Atlas Scientific
- Measurements: Dissolved Oxygen
- Interfaces: $I^2C$, UART, FTDI
- Libraries: pylibftdi/fcntl/io/serial
- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

#### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

#### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### FTDI Device

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

#### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### Calibrate: Max Age

- Type: Integer
- Default Value: 120

- Description: The Max Age (seconds) of the measurement to use for calibration

**ACTIONS**

**A one- or two-point calibration can be performed. After exposing the probe to air for 30 seconds until readings stabilize, press Calibrate (Air). If you require accuracy below 1.0 mg/L, you can place the probe in a 0 mg/L solution for 30 to 90 seconds until readings stabilize, then press Calibrate (0 mg/L). You can also clear the currently-saved calibration by pressing Clear Calibration.**

**Calibrate (Air)**

- Type: Button

**Calibrate (0 mg/L)**

- Type: Button

**Clear Calibration**

- Type: Button

**The I2C address can be changed. Enter a new address in the 0xYY format (e.g. 0x22, 0x50), then press Set I2C Address. Remember to deactivate and change the I2C address option after setting the new address.**

**New I2C Address**

- Type: Text
- Default Value: 0x66
- Description: The new I2C to set the device to

**Set I2C Address**

- Type: Button

### Atlas Scientific: Atlas EC

- Manufacturer: Atlas Scientific
- Measurements: Electrical Conductivity
- Interfaces: $I^2C$, UART, FTDI
- Libraries: pylibftdi/fcntl/io/serial
- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link

**OPTIONS**

**$I^2C$ Address**

- Type: Text
- Description: The I2C address of the device

**$I^2C$ Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**FTDI Device**

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

**UART Device**

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**Temperature Compensation: Measurement**

- Type: Select Measurement
- Selections: Input, Function, Math,
- Description: Select a measurement for temperature compensation

**Temperature Compensation: Max Age**

- Type: Integer
- Default Value: 120
- Description: The maximum age (seconds) of the measurement to use for temperature compensation

**ACTIONS**

**New I2C Address**

- Type: Text
- Default Value: 0x64
- Description: The new I2C to set the device to

**Set I2C Address**

- Type: Button

### Atlas Scientific: Atlas Flow Meter

- Manufacturer: Atlas Scientific
- Measurements: Total Volume, Flow Rate
- Interfaces: $I^2C$, UART, FTDI
- Libraries: pylibftdi/fcntl/io/serial
- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link

Set the Measurement Time Base to a value most appropriate for your anticipated flow (it will affect accuracy). This flow rate time base that is set and returned from the sensor will be converted to liters per minute, which is the default unit for this input module. If you desire a different rate to be stored in the database (such as liters per second or hour), then use the Convert to Unit option.

#### OPTIONS

##### I²C Address

- Type: Text
- Description: The I2C address of the device

##### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### FTDI Device

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

##### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Flow Meter Type

- Type: Select
- Options: [**Atlas Scientific 3/8" Flow Meter** | Atlas Scientific 1/4" Flow Meter | Atlas Scientific 1/2" Flow Meter | Atlas Scientific 3/4" Flow Meter | Non-Atlas Scientific Flow Meter] (Default in **bold**)
- Description: Set the type of flow meter used

##### Atlas Meter Time Base

- Type: Select
- Options: [Liters per Second | **Liters per Minute** | Liters per Hour] (Default in **bold**)
- Description: If using an Atlas Scientific flow meter, set the flow rate/time base

##### Internal Resistor

- Type: Select
- Options: [**Use Atlas Scientific Flow Meter** | Disable Internal Resistor | 1 K Ω Pull-Up | 1 K Ω Pull-Down | 10 K Ω Pull-Up | 10 K Ω Pull-Down | 100 K Ω Pull-Up | 100 K Ω Pull-Down] (Default in **bold**)
- Description: Set an internal resistor for the flow meter

##### Custom K Value(s)

- Type: Text
- Description: If using a non-Atlas Scientific flow meter, enter the meter's K value(s). For a single K value, enter '[volume per pulse],[number of pulses]'. For multiple K values (up to 16), enter '[volume at frequency],[frequency in Hz];[volume at frequency],[frequency in Hz];...'. Leave blank to disable.

##### K Value Time Base

- Type: Select
- Options: [**Use Atlas Scientific Flow Meter** | Liters per Second | Liters per Minute | Liters per Hour] (Default in **bold**)
- Description: If using a non-Atlas Scientific flow meter, set the flow rate/time base for the custom K values entered.

##### ACTIONS

**The total volume can be cleared with the following button or with a Function Action.**

##### Clear Total Volume

- Type: Button

**The I2C address can be changed. Enter a new address in the 0xYY format (e.g. 0x22, 0x50), then press Set I2C Address. Remember to deactivate and change the I2C address option after setting the new address.**

##### New I2C Address

- Type: Text
- Default Value: 0x68
- Description: The new I2C to set the device to

##### Set I2C Address

- Type: Button

### Atlas Scientific: Atlas Humidity

- Manufacturer: Atlas Scientific
- Measurements: Humidity/Temperature
- Interfaces: $I^2C$, UART, FTDI
- Libraries: pylibftdi/fcntl/io/serial
- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link

##### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer

- Description: The I2C bus the device is connected to

**FTDI Device**

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

**UART Device**

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**LED Mode**

- Type: Select
- Options: [**Always On** | Always Off | Only On During Measure] (Default in **bold**)
- Description: When to turn the LED on

**ACTIONS**

**New I2C Address**

- Type: Text
- Default Value: 0x6f
- Description: The new I2C to set the device to

**Set I2C Address**

- Type: Button

### Atlas Scientific: Atlas ORP

- Manufacturer: Atlas Scientific
- Measurements: Oxidation Reduction Potential
- Interfaces: $I^2C$, UART, FTDI
- Libraries: pylibftdi/fcntl/io/serial

- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

##### I²C Address

- Type: Text
- Description: The I2C address of the device

##### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### FTDI Device

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

##### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Temperature Compensation: Measurement

- Type: Select Measurement
- Selections: Input, Function, Math,
- Description: Select a measurement for temperature compensation

##### Temperature Compensation: Max Age

- Type: Integer
- Default Value: 120
- Description: The maximum age (seconds) of the measurement to use for temperature compensation

#### ACTIONS

**A one-point calibration can be performed. Enter the solution's mV, set the probe in the solution, then press Calibrate. You can also clear the currently-saved calibration by pressing Clear Calibration.**

##### Calibration Solution mV

- Type: Integer
- Default Value: 225
- Description: The value of the calibration solution, in mV

##### Calibrate

- Type: Button

##### Clear Calibration

- Type: Button

**The I2C address can be changed. Enter a new address in the 0xYY format (e.g. 0x22, 0x50), then press Set I2C Address. Remember to deactivate and change the I2C address option after setting the new address.**

##### New I2C Address

- Type: Text
- Default Value: 0x62
- Description: The new I2C to set the device to

##### Set I2C Address

- Type: Button

### Atlas Scientific: Atlas PT-1000

- Manufacturer: Atlas Scientific
- Measurements: Temperature
- Interfaces: $I^2C$, UART, FTDI
- Libraries: pylibftdi/fcntl/io/serial
- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### FTDI Device

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

##### UART Device

- Type: Text

- Description: The UART device location (e.g. /dev/ttyUSB1)

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**ACTIONS**

**New I2C Address**

- Type: Text
- Default Value: 0x66
- Description: The new I2C to set the device to

**Set I2C Address**

- Type: Button

### Atlas Scientific: Atlas Pressure

- Manufacturer: Atlas Scientific
- Measurements: Pressure
- Interfaces: $I^2C$, UART, FTDI
- Libraries: pylibftdi/fcntl/io/serial
- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link

**OPTIONS**

**$I^2C$ Address**

- Type: Text
- Description: The I2C address of the device

**$I^2C$ Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**FTDI Device**

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

##### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### LED Mode

- Type: Select
- Options: [**Always On** | Always Off | Only On During Measure] (Default in **bold**)
- Description: When to turn the LED on

##### ACTIONS

##### New I2C Address

- Type: Text
- Default Value: 0x6a
- Description: The new I2C to set the device to

##### Set I2C Address

- Type: Button

### Atlas Scientific: Atlas pH

- Manufacturer: Atlas Scientific
- Measurements: Ion Concentration
- Interfaces: $I^2C$, UART, FTDI
- Libraries: pylibftdi/fcntl/io/serial
- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link

Calibration Measurement is an optional setting that provides a temperature measurement (in Celsius) of the water that the pH is being measured from.

#### OPTIONS

##### I²C Address

- Type: Text
- Description: The I2C address of the device

##### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### FTDI Device

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

##### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Temperature Compensation: Measurement

- Type: Select Measurement
- Selections: Input, Function, Math,
- Description: Select a measurement for temperature compensation

##### Temperature Compensation: Max Age

- Type: Integer
- Default Value: 120
- Description: The maximum age (seconds) of the measurement to use for temperature compensation

**ACTIONS**

**Calibration: a one-, two- or three-point calibration can be performed. The first calibration must be the Mid point. The second must be the Low point. And the third must be the High point. You can perform a one-, two- or three-point calibration, but they must be performed in this order. Allow a minute or two after submerging your probe in a calibration solution for the measurements to equilibrate before calibrating to that solution. The EZO pH circuit default temperature compensation is set to 25 °C. If the temperature of the calibration solution is +/- 2 °C from 25 °C, consider setting the temperature compensation first. Note that if you have a Temperature Compensation Measurement selected from the Options, this will overwrite the manual Temperature Compensation set here, so be sure to disable this option if you would like to specify the temperature to compensate with.**

**Compensation Temperature (°C)**

- Type: Decimal
- Default Value: 25.0
- Description: The temperature of the calibration solutions

**Set Temperature Compensation**

- Type: Button

**Clear Calibration**

- Type: Button

**Mid Point pH**

- Type: Decimal
- Default Value: 7.0
- Description: The pH of the mid point calibration solution

**Calibrate Mid**

- Type: Button

**Low Point pH**

- Type: Decimal
- Default Value: 4.0
- Description: The pH of the low point calibration solution

**Calibrate Low**

- Type: Button

**High Point pH**

- Type: Decimal
- Default Value: 10.0
- Description: The pH of the high point calibration solution

**Calibrate High**

- Type: Button

**The I2C address can be changed. Enter a new address in the 0xYY format (e.g. 0x22, 0x50), then press Set I2C Address. Remember to deactivate and change the I2C address option after setting the new address.**

**New I2C Address**

- Type: Text
- Default Value: 0x63
- Description: The new I2C to set the device to

**Set I2C Address**

- Type: Button

**BOSCH: BME280**

- Manufacturer: BOSCH
- Measurements: Pressure/Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: Adafruit_BME280
- Dependencies: Adafruit-GPIO, Adafruit_BME280
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2

**OPTIONS**

**$I^2C$ Address**

- Type: Text
- Description: The I2C address of the device

**$I^2C$ Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**BOSCH: BME280**

- Manufacturer: BOSCH
- Measurements: Pressure/Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: Adafruit_CircuitPython_BME280
- Dependencies: pyusb, Adafruit-extended-bus, adafruit-circuitpython-bme280
- Manufacturer URL: Link

- Datasheet URL: Link
- Product URLs: Link 1, Link 2

#### OPTIONS

##### I²C Address

- Type: Text
- Description: The I2C address of the device

##### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### BOSCH: BME280

- Manufacturer: BOSCH
- Measurements: Pressure/Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: RPi.bme280
- Dependencies: RPi.bme280
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2

#### OPTIONS

##### I²C Address

- Type: Text
- Description: The I2C address of the device

#### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### BOSCH: BME680

- Manufacturer: BOSCH
- Measurements: Temperature/Humidity/Pressure/Gas
- Interfaces: I²C
- Libraries: Adafruit_CircuitPython_BME680
- Dependencies: pyusb, Adafruit-extended-bus, adafruit-circuitpython-bme680
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2

#### OPTIONS

#### I²C Address

- Type: Text
- Description: The I2C address of the device

#### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### Humidity Oversampling

- Type: Select
- Options: [NONE | 1X | **2X** | 4X | 8X | 16X] (Default in **bold**)
- Description: A higher oversampling value means more stable readings with less noise and jitter. However each step of oversampling adds ~2 ms latency, causing a slower response time to fast transients.

#### Temperature Oversampling

- Type: Select
- Options: [NONE | 1X | 2X | 4X | **8X** | 16X] (Default in **bold**)
- Description: A higher oversampling value means more stable readings with less noise and jitter. However each step of oversampling adds ~2 ms latency, causing a slower response time to fast transients.

#### Pressure Oversampling

- Type: Select
- Options: [NONE | 1X | 2X | **4X** | 8X | 16X] (Default in **bold**)
- Description: A higher oversampling value means more stable readings with less noise and jitter. However each step of oversampling adds ~2 ms latency, causing a slower response time to fast transients.

#### IIR Filter Size

- Type: Select
- Options: [0 | 1 | **3** | 7 | 15 | 31 | 63 | 127] (Default in **bold**)
- Description: Optionally remove short term fluctuations from the temperature and pressure readings, increasing their resolution but reducing their bandwidth.

#### Temperature Offset

- Type: Decimal
- Description: The amount to offset the temperature, either negative or positive

#### Sea Level Pressure (ha)

- Type: Decimal
- Default Value: 1013.25
- Description: The pressure at sea level for the sensor location

**BOSCH: BME680**

- Manufacturer: BOSCH
- Measurements: Temperature/Humidity/Pressure/Gas
- Interfaces: $I^2C$
- Libraries: bme680
- Dependencies: bme680, smbus2
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2

**OPTIONS**

**$I^2C$ Address**

- Type: Text
- Description: The I2C address of the device

**$I^2C$ Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**Humidity Oversampling**

- Type: Select
- Options: [NONE | 1X | **2X** | 4X | 8X | 16X] (Default in **bold**)
- Description: A higher oversampling value means more stable readings with less noise and jitter. However each step of oversampling adds ~2 ms latency, causing a slower response time to fast transients.

**Temperature Oversampling**

- Type: Select
- Options: [NONE | 1X | 2X | 4X | **8X** | 16X] (Default in **bold**)

- Description: A higher oversampling value means more stable readings with less noise and jitter. However each step of oversampling adds ~2 ms latency, causing a slower response time to fast transients.

#### Pressure Oversampling

- Type: Select
- Options: [NONE | 1X | 2X | **4X** | 8X | 16X] (Default in **bold**)
- Description: A higher oversampling value means more stable readings with less noise and jitter. However each step of oversampling adds ~2 ms latency, causing a slower response time to fast transients.

#### IIR Filter Size

- Type: Select
- Options: [0 | 1 | **3** | 7 | 15 | 31 | 63 | 127] (Default in **bold**)
- Description: Optionally remove short term fluctuations from the temperature and pressure readings, increasing their resolution but reducing their bandwidth.

#### Gas Heater Temperature (°C)

- Type: Integer
- Default Value: 320
- Description: What temperature to set

#### Gas Heater Duration (ms)

- Type: Integer
- Default Value: 150
- Description: How long of a duration to heat. 20-30 ms are necessary for the heater to reach the intended target temperature.

#### Gas Heater Profile

- Type: Select
- Description: Select one of the 10 configured heating durations/set points

#### Temperature Offset

- Type: Decimal
- Description: The amount to offset the temperature, either negative or positive

### BOSCH: BMP180

- Manufacturer: BOSCH
- Measurements: Pressure/Temperature
- Interfaces: $I^2C$
- Libraries: Adafruit_BMP
- Dependencies: Adafruit-BMP, Adafruit-GPIO
- Datasheet URL: Link

#### OPTIONS

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal

- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### BOSCH: BMP280

- Manufacturer: BOSCH
- Measurements: Pressure/Temperature
- Interfaces: $I^2C$
- Libraries: Adafruit_GPIO
- Dependencies: Adafruit-GPIO
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

**OPTIONS**

**$I^2C$ Address**

- Type: Text
- Description: The I2C address of the device

**$I^2C$ Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal

- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### BOSCH: BMP280

- Manufacturer: BOSCH
- Measurements: Pressure/Temperature
- Interfaces: $I^2C$
- Libraries: bmp280-python
- Dependencies: smbus2, bmp280
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

This is similar to the other BMP280 Input, except it uses a different library, whcih includes the ability to set forced mode.

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### Enable Forced Mode

- Type: Boolean
- Description: Enable heater to evaporate condensation. Turn on heater x seconds every y measurements.

### CO2Meter: K30

- Manufacturer: CO2Meter
- Measurements: CO2
- Interfaces: UART
- Libraries: serial
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

#### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Catnip Electronics: Chirp

- Manufacturer: Catnip Electronics
- Measurements: Light/Moisture/Temperature
- Interfaces: $I^2C$
- Libraries: smbus2
- Dependencies: smbus2
- Manufacturer URL: Link
- Product URL: Link

#### OPTIONS

#### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

**I²C Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Cozir: Cozir CO2

- Manufacturer: Cozir
- Measurements: CO2/Humidity/Temperature
- Interfaces: UART
- Libraries: pierre-haessig/pycozir
- Dependencies: cozir
- Manufacturer URL: Link
- Datasheet URL: Link

**OPTIONS**

**UART Device**

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select

- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Generic: ADS1115: Analog pH/EC

- Manufacturer: Generic
- Measurements: Ion Concentration/Electrical Conductivity
- Interfaces: $I^2C$
- Libraries: Adafruit_CircuitPython_ADS1x15
- Dependencies: pyusb, Adafruit-extended-bus, Adafruit_CircuitPython_ADS1x15

This input relies on an ADS1115 analog-to-digital converter (ADC) to measure pH and/or electrical conductivity (EC) from analog sensors. You can enable or disable either measurement if you want to only connect a pH sensor or an EC sensor by selecting which measurements you want to under Measurements Enabled. Select which channel each sensor is connected to on the ADC. There are default calibration values initially set for the Input. There are also functions to allow you to easily calibrate your sensors with calibration solutions. If you use the Calibrate Slot actions, these values will be calculated and will replace the currently-set values. You can use the Clear Calibration action to delete the database values and return to using the default values. If you delete the Input or create a new Input to use your ADC/sensors with, you will need to recalibrate in order to store new calibration data.

**OPTIONS**

**$I^2C$ Address**

- Type: Text
- Description: The I2C address of the device

**$I^2C$ Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal

- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### ADC Channel: pH

- Type: Select
- Options: [**Channel 0** | Channel 1 | Channel 2 | Channel 3] (Default in **bold**)
- Description: The ADC channel the pH sensor is connected

#### ADC Channel: EC

- Type: Select
- Options: [Channel 0 | **Channel 1** | Channel 2 | Channel 3] (Default in **bold**)
- Description: The ADC channel the EC sensor is connected

#### Temperature Compensation

#### Temperature Compensation: Measurement

- Type: Select Measurement
- Selections: Input, Function, Math,
- Description: Select a measurement for temperature compensation

#### Temperature Compensation: Max Age

- Type: Integer
- Default Value: 120
- Description: The maximum age (seconds) of the measurement to use for temperature compensation

#### pH Calibration Data

#### Cal data: V1 (internal)

- Type: Decimal
- Default Value: 1.5
- Description: Calibration data: Voltage

#### Cal data: pH1 (internal)

- Type: Decimal
- Default Value: 7.0
- Description: Calibration data: pH

#### Cal data: T1 (internal)

- Type: Decimal
- Default Value: 25.0
- Description: Calibration data: Temperature

#### Cal data: V2 (internal)

- Type: Decimal
- Default Value: 2.032
- Description: Calibration data: Voltage

**Cal data: pH2 (internal)**

- Type: Decimal
- Default Value: 4.0
- Description: Calibration data: pH

**Cal data: T2 (internal)**

- Type: Decimal
- Default Value: 25.0
- Description: Calibration data: Temperature

**EC Calibration Data**

**EC cal data: V1 (internal)**

- Type: Decimal
- Default Value: 0.232
- Description: EC calibration data: Voltage

**EC cal data: EC1 (internal)**

- Type: Decimal
- Default Value: 1413.0
- Description: EC calibration data: EC

**EC cal data: T1 (internal)**

- Type: Decimal
- Default Value: 25.0
- Description: EC calibration data: EC

**EC cal data: V2 (internal)**

- Type: Decimal
- Default Value: 2.112
- Description: EC calibration data: Voltage

**EC cal data: EC2 (internal)**

- Type: Decimal
- Default Value: 12880.0
- Description: EC calibration data: EC

**EC cal data: T2 (internal)**

- Type: Decimal
- Default Value: 25.0
- Description: EC calibration data: EC

**ACTIONS**

**pH Calibration Actions: Place your probe in a solution of known pH.**

```
        Set the known pH value in the "Calibration buffer pH" field, and press "Calibrate pH, slot 1".
        Repeat with a second buffer, and press "Calibrate pH, slot 2".
        You don't need to change the values under "Custom Options".
```

**Calibration buffer pH**

- Type: Decimal

- Default Value: 7.0
- Description: This is the nominal pH of the calibration buffer, usually labelled on the bottle.

**Calibrate pH, slot 1**

- Type: Button

**Calibrate pH, slot 2**

- Type: Button

**Clear pH Calibration Slots**

- Type: Button

**EC Calibration Actions: Place your probe in a solution of known EC.**

```
Set the known EC value in the "Calibration standard EC" field, and press "Calibrate EC, slot 1".
Repeat with a second standard, and press "Calibrate EC, slot 2".
You don't need to change the values under "Custom Options".
```

**Calibration standard EC**

- Type: Decimal
- Default Value: 1413.0
- Description: This is the nominal EC of the calibration standard, usually labelled on the bottle.

**Calibrate EC, slot 1**

- Type: Button

**Calibrate EC, slot 2**

- Type: Button

**Clear pH Calibration Slots**

- Type: Button

### Generic: Hall Flow Meter

- Manufacturer: Generic
- Measurements: Flow Rate, Total Volume
- Interfaces: GPIO
- Libraries: pigpio
- Dependencies: pigpio

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### Pulses per Liter

- Type: Decimal
- Default Value: 1.0
- Description: Enter the conversion factor for this meter (pulses to Liter).

#### ACTIONS

#### Clear Total Volume

- Type: Button

### MAXIM: DS1822

- Manufacturer: MAXIM
- Measurements: Temperature
- Interfaces: 1-Wire
- Libraries: w1thermsensor
- Dependencies: w1thermsensor
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### MAXIM: DS1825

- Manufacturer: MAXIM
- Measurements: Temperature
- Interfaces: 1-Wire
- Libraries: w1thermsensor
- Dependencies: w1thermsensor
- Manufacturer URL: Link

- Datasheet URL: Link

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### MAXIM: DS18B20

- Manufacturer: MAXIM
- Measurements: Temperature
- Interfaces: 1-Wire
- Libraries: ow-shell
- Dependencies: ow-shell
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2, Link 3
- Additional URL: Link

Warning: Counterfeit DS18B20 sensors are common and can cause a host of issues. Review the Additional URL for more information about how to determine if your sensor is authentic.

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### MAXIM: DS18B20

- Manufacturer: MAXIM
- Measurements: Temperature
- Interfaces: 1-Wire
- Libraries: w1thermsensor
- Dependencies: w1thermsensor
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2, Link 3
- Additional URL: Link

Warning: Counterfeit DS18B20 sensors are common and can cause a host of issues. Review the Additional URL for more information about how to determine if your sensor is authentic.

#### OPTIONS

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### MAXIM: DS18S20

- Manufacturer: MAXIM
- Measurements: Temperature
- Interfaces: 1-Wire
- Libraries: w1thermsensor
- Dependencies: w1thermsensor
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### MAXIM: DS28EA00

- Manufacturer: MAXIM
- Measurements: Temperature
- Interfaces: 1-Wire
- Libraries: w1thermsensor
- Dependencies: w1thermsensor
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### MAXIM: MAX31850K

- Manufacturer: MAXIM
- Measurements: Temperature

- Interfaces: 1-Wire
- Libraries: w1thermsensor
- Dependencies: w1thermsensor
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### MAXIM: MAX31855

- Manufacturer: MAXIM
- Measurements: Temperature (Object/Die)
- Interfaces: UART
- Libraries: Adafruit_MAX31855
- Dependencies: Adafruit_MAX31855, Adafruit-GPIO
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

##### CS Pin

- Type: Integer
- Description: The GPIO (using BCM numbering) connected to the Cable Select pin

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### MAXIM: MAX31856

- Manufacturer: MAXIM
- Measurements: Temperature (Object/Die)
- Interfaces: UART
- Libraries: RPi.GPIO
- Dependencies: RPi.GPIO
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

#### CS Pin

- Type: Integer
- Description: The GPIO (using BCM numbering) connected to the Cable Select pin

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### MAXIM: MAX31865

- Manufacturer: MAXIM
- Measurements: Temperature
- Interfaces: SPI
- Libraries: Adafruit-CircuitPython-MAX31865
- Dependencies: adafruit-circuitpython-max31865
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

This module was added to allow support for multiple sensors to be connected at the same time, which the original MAX31865 module was not designed for.

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Chip Select Pin

- Type: Integer
- Default Value: 8
- Description: Enter the GPIO Chip Select Pin for your device.

##### Number of wires

- Type: Select
- Options: [**2 Wires** | 3 Wires | 4 Wires] (Default in **bold**)
- Description: Select the number of wires your thermocouple has.

### MAXIM: MAX31865

- Manufacturer: MAXIM
- Measurements: Temperature
- Interfaces: UART
- Libraries: RPi.GPIO
- Dependencies: RPi.GPIO
- Manufacturer URL: Link

- Datasheet URL: Link
- Product URL: Link

Note: This module does not allow for multiple sensors to be connected at the same time. For multi-sensor support, use the MAX31865 CircuitPython Input.

#### OPTIONS

##### CS Pin

- Type: Integer
- Description: The GPIO (using BCM numbering) connected to the Cable Select pin

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Melexis: MLX90614

- Manufacturer: Melexis
- Measurements: Temperature (Ambient/Object)
- Interfaces: $I^2C$
- Libraries: smbus2
- Dependencies: smbus2
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select

- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Microchip: MCP3008

- Manufacturer: Microchip
- Measurements: Voltage (Analog-to-Digital Converter)
- Interfaces: UART
- Libraries: Adafruit_MCP3008
- Dependencies: Adafruit-MCP3008
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

**OPTIONS**

**CS Pin**

- Type: Integer
- Description: The GPIO (using BCM numbering) connected to the Cable Select pin

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal

- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### VREF (volts)

- Type: Decimal
- Default Value: 3.3
- Description: Set the VREF voltage

### Microchip: MCP342x (x=2,3,4,6,7,8)

- Manufacturer: Microchip
- Measurements: Voltage (Analog-to-Digital Converter)
- Interfaces: $I^2C$
- Libraries: MCP342x
- Dependencies: smbus2, MCP342x
- Manufacturer URLs: Link 1, Link 2, Link 3, Link 4, Link 5
- Datasheet URLs: Link 1, Link 2

#### OPTIONS

#### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

#### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean

- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### Microchip: MCP9808

- Manufacturer: Microchip
- Measurements: Temperature
- Interfaces: $I^2C$
- Libraries: Adafruit_MCP9808
- Dependencies: Adafruit-GPIO, Adafruit_MCP9808
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

##### OPTIONS

###### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

###### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

###### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

###### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

###### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

###### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### Multiple Manufacturers: HC-SR04

- Manufacturer: Multiple Manufacturers
- Measurements: Ultrasonic Distance
- Interfaces: GPIO
- Libraries: Adafruit-CircuitPython-HCSR04
- Dependencies: libgpiod-dev, pyusb, adafruit-circuitpython-hcsr04
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

- Additional URL: Link

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**Trigger Pin**

- Type: Integer
- Description: Enter the GPIO Trigger Pin for your device (BCM numbering).

**Echo Pin**

- Type: Integer
- Description: Enter the GPIO Echo Pin for your device (BCM numbering).

### Panasonic: AMG8833

- Manufacturer: Panasonic
- Measurements: 8x8 Temperature Grid
- Interfaces: $I^2C$
- Libraries: Adafruit_AMG88xx/Pillow/colour
- Dependencies: libjpeg-dev, zlib1g-dev, colour, Pillow, Adafruit_AMG88xx

**OPTIONS**

**$I^2C$ Address**

- Type: Text
- Description: The I2C address of the device

**$I^2C$ Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### ROHM: BH1750

- Manufacturer: ROHM
- Measurements: Light
- Interfaces: $I^2C$
- Libraries: smbus2
- Dependencies: smbus2
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

#### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

#### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Raspberry Pi Foundation: Sense HAT

- Manufacturer: Raspberry Pi Foundation
- Measurements: hum/temp/press/compass/magnet/accel/gyro
- Interfaces: $I^2C$
- Libraries: sense-hat
- Dependencies: sense-hat
- Manufacturer URL: Link

This module acquires measurements from the Raspberry Pi Sense HAT sensors, which include the LPS25H, LSM9DS1, and HTS221.

#### OPTIONS

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Ruuvi: RuuviTag

- Manufacturer: Ruuvi
- Measurements: Acceleration/Humidity/Pressure/Temperature
- Interfaces: BT
- Libraries: ruuvitag_sensor
- Dependencies: python3-dev, python3-psutil, bluez, bluez-hcidump, ruuvitag-sensor
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

##### MAC (XX:XX:XX:XX:XX:XX)

- Type: Text
- Description: The MAC address of the Bluetooth device

##### BT Adapter (hci[X])

- Type: Integer
- Description: The adapter of the Bluetooth device

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### STMicroelectronics: VL53L0X

- Manufacturer: STMicroelectronics
- Measurements: Millimeter (Time-of-Flight Distance)
- Interfaces: $I^2C$
- Libraries: VL53L0X_rasp_python
- Dependencies: VL53L0X
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Accuracy

- Type: Select
- Options: [**Good Accuracy (33 ms, 1.2 m range)** | Better Accuracy (66 ms, 1.2 m range) | Best Accuracy (200 ms, 1.2 m range) | Long Range (33 ms, 2 m) | High Speed, Low Accuracy (20 ms, 1.2 m)] (Default in **bold**)
- Description: Set the accuracy. A longer measurement duration yields a more accurate measurement.

##### ACTIONS

##### New I2C Address

- Type: Text
- Default Value: 0x52
- Description: The new I2C to set the device to

##### Set I2C Address

- Type: Button

### STMicroelectronics: VL53L1X

- Manufacturer: STMicroelectronics
- Measurements: Millimeter (Time-of-Flight Distance)
- Interfaces: $I^2C$
- Libraries: VL53L1X
- Dependencies: smbus2, vl53l1x
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2

Notes when setting a custom timing budget: A higher timing budget results in greater measurement accuracy, but also a higher power consumption. The inter measurement period must be >= the timing budget, otherwise it will be double the expected value.

#### OPTIONS

##### I²C Address

- Type: Text
- Description: The I2C address of the device

##### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Range

- Type: Select
- Options: [**Short Range** | Medium Range | Long Range | Custom Timing Budget] (Default in **bold**)
- Description: Select a range or select to set a custom Timing Budget and Inter Measurement Period.

##### Timing Budget (microseconds)

- Type: Integer
- Default Value: 66000
- Description: Set the timing budget. Must be less than or equal to the Inter Measurement Period.

##### Inter Measurement Period (milliseconds)

- Type: Integer
- Default Value: 70
- Description: Set the Inter Measurement Period

### Seeedstudio: DHT11/22

- Manufacturer: Seeedstudio
- Measurements: Humidity/Temperature
- Interfaces: GROVE

- Libraries: grovepi
- Dependencies: libatlas-base-dev, grovepi
- Manufacturer URLs: Link 1, Link 2

Enter the Grove Pi+ GPIO pin connected to the sensor and select the sensor type.

**OPTIONS**

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Sensor Type**

- Type: Select
- Options: [**DHT11 (Blue)** | DHT22 (White)] (Default in **bold**)
- Description: Sensor type

### Sensirion: SCD30

- Manufacturer: Sensirion
- Measurements: CO2/Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: Adafruit-CircuitPython-SCD30
- Dependencies: pyusb, Adafruit-extended-bus, adafruit-circuitPython-scd30
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2

**OPTIONS**

**$I^2C$ Address**

- Type: Text
- Description: The I2C address of the device

**$I^2C$ Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal

- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Sensirion: SCD30

- Manufacturer: Sensirion
- Measurements: CO2/Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: scd30_i2c
- Dependencies: scd30-i2c
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URLs: Link 1, Link 2

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Sensirion: SHT1x/7x

- Manufacturer: Sensirion
- Measurements: Humidity/Temperature
- Interfaces: GPIO
- Libraries: sht_sensor

- Dependencies: sht-sensor
- Manufacturer URLs: Link 1, Link 2

#### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Sensirion: SHT2x

- Manufacturer: Sensirion
- Measurements: Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: smbus2
- Dependencies: smbus2
- Manufacturer URL: Link

#### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal

- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Sensirion: SHT31-D

- Manufacturer: Sensirion
- Measurements: Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: Adafruit_CircuitPython_SHT31
- Dependencies: pyusb, Adafruit-extended-bus, adafruit-circuitpython-sht31d
- Manufacturer URL: Link

##### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Sensirion: SHT3x (30, 31, 35)

- Manufacturer: Sensirion
- Measurements: Humidity/Temperature

- Interfaces: I$^2$C
- Libraries: Adafruit_SHT31
- Dependencies: Adafruit-GPIO, Adafruit-SHT31
- Manufacturer URL: Link

#### OPTIONS

##### I$^2$C Address

- Type: Text
- Description: The I2C address of the device

##### I$^2$C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Enable Heater

- Type: Boolean
- Description: Enable heater to evaporate condensation. Turn on heater x seconds every y measurements.

##### Heater On Seconds

- Type: Decimal
- Default Value: 1.0
- Description: How long to turn the heater on (seconds).

##### Heater On Period

- Type: Integer
- Default Value: 10
- Description: After how many measurements to turn the heater on. This will repeat.

### Sensirion: SHT4X

- Manufacturer: Sensirion
- Measurements: Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: Adafruit_CircuitPython_SHT4X
- Dependencies: pyusb, Adafruit-extended-bus, adafruit_circuitpython_sht4x
- Manufacturer URL: Link

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Sensorion: SHT31 Smart Gadget

- Manufacturer: Sensorion
- Measurements: Humidity/Temperature
- Interfaces: BT
- Libraries: bluepy
- Dependencies: pi-bluetooth, libglib2.0-dev, bluepy
- Manufacturer URL: Link

#### OPTIONS

##### MAC (XX:XX:XX:XX:XX:XX)

- Type: Text
- Description: The MAC address of the Bluetooth device

##### BT Adapter (hci[X])

- Type: Integer
- Description: The adapter of the Bluetooth device

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Download Stored Data

- Type: Boolean
- Default Value: True
- Description: Download the data logged to the device.

##### Set Logging Interval

- Type: Integer
- Default Value: 600
- Description: Set the logging interval (seconds) the device will store measurements on its internal memory.

### Sonoff: TH16/10 (Tasmota firmware) with AM2301

- Manufacturer: Sonoff
- Measurements: Humidity/Temperature
- Libraries: requests
- Dependencies: requests
- Manufacturer URL: Link

**OPTIONS**

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**IP Address**

- Type: Text
- Default Value: 192.168.0.100
- Description: The IP address of the device

### Sonoff: TH16/10 (Tasmota firmware) with DS18B20

- Manufacturer: Sonoff
- Measurements: Temperature
- Libraries: requests
- Dependencies: requests
- Manufacturer URL: Link

**OPTIONS**

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal

- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### IP Address

- Type: Text
- Default Value: 192.168.0.100
- Description: The IP address of the device

### TE Connectivity: HTU21D

- Manufacturer: TE Connectivity
- Measurements: Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: pigpio
- Dependencies: pigpio
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Tasmota: Tasmota Outlet Energy Monitor (HTTP)

- Manufacturer: Tasmota
- Measurements: Total Energy, Amps, Watts
- Interfaces: HTTP
- Libraries: requests
- Manufacturer URL: Link
- Product URL: Link

This input queries the energy usage information from a WiFi outlet that is running the tasmota firmware. There are many WiFi outlets that support tasmota, and many of of those have energy monitoring capabilities. When used with an MQTT Output, you can both control your tasmota outlets as well as mionitor their energy usage.

#### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Host

- Type: Text
- Default Value: 192.168.0.50
- Description: Host address or IP

### Texas Instruments: ADS1015

- Manufacturer: Texas Instruments
- Measurements: Voltage (Analog-to-Digital Converter)
- Interfaces: $I^2C$
- Libraries: Adafruit_CircuitPython

- Dependencies: pyusb, Adafruit-extended-bus, Adafruit_CircuitPython_ADS1x15

**OPTIONS**

**I²C Address**

- Type: Text
- Description: The I2C address of the device

**I²C Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**Measurements to Average**

- Type: Integer
- Default Value: 5
- Description: The number of times to measure each channel. An average of the measurements will be stored.

### Texas Instruments: ADS1115

- Manufacturer: Texas Instruments
- Measurements: Voltage (Analog-to-Digital Converter)
- Interfaces: I²C
- Libraries: Adafruit_CircuitPython_ADS1x15
- Dependencies: pyusb, Adafruit-extended-bus, Adafruit_CircuitPython_ADS1x15

**OPTIONS**

**I²C Address**

- Type: Text
- Description: The I2C address of the device

#### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### Measurements to Average

- Type: Integer
- Default Value: 5
- Description: The number of times to measure each channel. An average of the measurements will be stored.

### Texas Instruments: ADS1256

- Manufacturer: Texas Instruments
- Measurements: Voltage (Waveshare, Analog-to-Digital Converter)
- Interfaces: UART
- Libraries: wiringpi, kizniche/PiPyADC-py3
- Dependencies: wiringpi, pipyadc_py3

#### OPTIONS

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**Calibration**

- Type: Select
- Description: Set the calibration method to perform during Input activation

### Texas Instruments: ADS1x15

- Manufacturer: Texas Instruments
- Measurements: Voltage (Analog-to-Digital Converter)
- Interfaces: $I^2C$
- Libraries: Adafruit_ADS1x15 [DEPRECATED]
- Dependencies: Adafruit-GPIO, Adafruit-ADS1x15

The Adafruit_ADS1x15 is deprecated. It's advised to use The Circuit Python ADS1x15 Input.

**OPTIONS**

**$I^2C$ Address**

- Type: Text
- Description: The I2C address of the device

**$I^2C$ Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean

- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### Measurements to Average

- Type: Integer
- Default Value: 5
- Description: The number of times to measure each channel. An average of the measurements will be stored.

### Texas Instruments: HDC1000

- Manufacturer: Texas Instruments
- Measurements: Humidity/Temperature
- Interfaces: $I^2C$
- Libraries: fcntl/io
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

#### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

#### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Texas Instruments: INA219x

- Manufacturer: Texas Instruments
- Measurements: Electrical Current (DC)

- Interfaces: $I^2C$
- Libraries: Adafruit_CircuitPython
- Dependencies: adafruit-circuitpython-ina219, Adafruit-extended-bus
- Manufacturer URL: Link
- Datasheet URL: Link

**OPTIONS**

**$I^2C$ Address**

- Type: Text
- Description: The I2C address of the device

**$I^2C$ Bus**

- Type: Integer
- Description: The I2C bus the device is connected to

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**Measurements to Average**

- Type: Integer
- Default Value: 5
- Description: The number of times to measure. An average of the measurements will be stored.

**Calibration Range**

- Type: Select
- Options: [**32V @ 2A max (default)** | 32V @ 1A max | 16V @ 400mA max | 16V @ 5A max] (Default in **bold**)
- Description: Set the device calibration range

**Bus Voltage Range**

- Type: Select
- Options: [(0x00) - 16V | **(0x01) - 32V (default)**] (Default in **bold**)
- Description: Set the bus voltage range

##### Bus ADC Resolution

- Type: Select
- Options: [(0x00) - 9 Bit / 1 Sample | (0x01) - 10 Bit / 1 Sample | (0x02) - 11 Bit / 1 Sample | **(0x03) - 12 Bit / 1 Sample (default)** | (0x09) - 12 Bit / 2 Samples | (0x0A) - 12 Bit / 4 Samples | (0x0B) - 12 Bit / 8 Samples | (0x0C) - 12 Bit / 16 Samples | (0x0D) - 12 Bit / 32 Samples | (0x0E) - 12 Bit / 64 Samples | (0x0F) - 12 Bit / 128 Samples] (Default in **bold**)
- Description: Set the Bus ADC Resolution.

##### Shunt ADC Resolution

- Type: Select
- Options: [(0x00) - 9 Bit / 1 Sample | (0x01) - 10 Bit / 1 Sample | (0x02) - 11 Bit / 1 Sample | **(0x03) - 12 Bit / 1 Sample (default)** | (0x09) - 12 Bit / 2 Samples | (0x0A) - 12 Bit / 4 Samples | (0x0B) - 12 Bit / 8 Samples | (0x0C) - 12 Bit / 16 Samples | (0x0D) - 12 Bit / 32 Samples | (0x0E) - 12 Bit / 64 Samples | (0x0F) - 12 Bit / 128 Samples] (Default in **bold**)
- Description: Set the Shunt ADC Resolution.

### Texas Instruments: TMP006

- Manufacturer: Texas Instruments
- Measurements: Temperature (Object/Die)
- Interfaces: $I^2C$
- Libraries: Adafruit_TMP
- Dependencies: Adafruit-TMP
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Weather: OpenWeatherMap (City, Current)

- Manufacturer: Weather
- Measurements: Humidity/Temperature/Pressure/Wind
- Interfaces: Mycodo
- Additional URL: Link

Obtain a free API key at openweathermap.org. If the city you enter does not return measurements, try another city. Note: the free API subscription is limited to 60 calls per minute

#### OPTIONS

#### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

#### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

#### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

#### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

#### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

#### API Key

- Type: Text
- Description: The API Key for this service's API

#### City

- Type: Text
- Description: The city to acquire the weather data

### Weather: OpenWeatherMap (Lat/Lon, Current/Future)

- Manufacturer: Weather
- Measurements: Humidity/Temperature/Pressure/Wind
- Interfaces: Mycodo
- Additional URL: Link

Obtain a free API key at openweathermap.org. Notes: The free API subscription is limited to 60 calls per minute. If a Day (Future) time is selected, Minimum and Maximum temperatures are available as measurements.

**OPTIONS**

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**API Key**

- Type: Text
- Description: The API Key for this service's API

**Latitude (decimal)**

- Type: Decimal
- Default Value: 33.441792
- Description: The latitude to acquire weather data

**Longitude (decimal)**

- Type: Decimal
- Default Value: -94.037689
- Description: The longitude to acquire weather data

**Time**

- Type: Select
- Options: [**Current (Present)** | 1 Day (Future) | 2 Day (Future) | 3 Day (Future) | 4 Day (Future) | 5 Day (Future) | 6 Day (Future) | 7 Day (Future) | 1 Hour (Future) | 2 Hours (Future) | 3 Hours (Future) | 4 Hours (Future) | 5 Hours (Future) | 6 Hours (Future) | 7 Hours (Future) | 8 Hours (Future) | 9 Hours (Future) | 10 Hours (Future) | 11 Hours (Future) | 12 Hours (Future) | 13 Hours (Future) | 14 Hours (Future) | 15 Hours (Future) | 16 Hours (Future) | 17 Hours (Future) | 18 Hours (Future) | 19 Hours (Future) | 20 Hours (Future) | 21 Hours (Future) | 22 Hours (Future) | 23 Hours (Future) | 24 Hours (Future) | 25 Hours (Future) | 26 Hours (Future) | 27 Hours (Future) | 28 Hours (Future) | 29 Hours (Future) | 30 Hours (Future) | 31 Hours (Future) | 32 Hours (Future) | 33 Hours (Future) | 34 Hours (Future) | 35 Hours (Future) | 36 Hours (Future) | 37 Hours (Future) | 38 Hours (Future) | 39 Hours (Future) | 40 Hours (Future) | 41 Hours (Future) | 42 Hours (Future) | 43 Hours (Future) | 44 Hours (Future) | 45 Hours (Future) | 46 Hours (Future) | 47 Hours (Future) | 48 Hours (Future)] (Default in **bold**)

- Description: Select the time for the current or forecast weather

### Winsen: MH-Z16

- Manufacturer: Winsen
- Measurements: CO2
- Interfaces: UART, $I^2C$
- Libraries: smbus2/serial
- Dependencies: smbus2
- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Winsen: MH-Z19

- Manufacturer: Winsen
- Measurements: CO2
- Interfaces: UART
- Libraries: serial
- Datasheet URL: Link

This is the version of the sensor that does not include the ability to conduct automatic baseline correction (ABC). See the B version of the sensor if you wish to use ABC.

#### OPTIONS

##### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Measurement Range

- Type: Select
- Options: [0 - 1000 ppmv | 0 - 2000 ppmv | 0 - 3000 ppmv | **0 - 5000 ppmv**] (Default in **bold**)
- Description: Set the measuring range of the sensor

#### ACTIONS

##### Calibrate Zero Point

- Type: Button

##### Span Point (ppmv)

- Type: Integer
- Default Value: 1500
- Description: The ppmv concentration for a span point calibration

##### Calibrate Span Point

- Type: Button

### Winsen: MH-Z19B

- Manufacturer: Winsen
- Measurements: CO2
- Interfaces: UART
- Libraries: serial
- Manufacturer URL: Link
- Datasheet URL: Link

This is the B version of the sensor that includes the ability to conduct automatic baseline correction (ABC).

**OPTIONS**

**UART Device**

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**Automatic Baseline Correction**

- Type: Boolean
- Description: Enable automatic baseline correction (ABC)

**Measurement Range**

- Type: Select
- Options: [0 - 1000 ppmv | 0 - 2000 ppmv | 0 - 3000 ppmv | **0 - 5000 ppmv**] (Default in **bold**)
- Description: Set the measuring range of the sensor

**ACTIONS**

**Calibrate Zero Point**

- Type: Button

**Span Point (ppmv)**

- Type: Integer
- Default Value: 1500
- Description: The ppmv concentration for a span point calibration

**Calibrate Span Point**

- Type: Button

### Winsen: ZH03B

- Manufacturer: Winsen
- Measurements: Particulates
- Interfaces: UART
- Libraries: serial

- Manufacturer URL: Link
- Datasheet URL: Link

#### OPTIONS

##### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

##### Fan Off After Measure

- Type: Boolean
- Description: Turn the fan on only during the measurement

##### Fan On Duration

- Type: Decimal
- Default Value: 50.0
- Description: How long to turn the fan on (seconds) before acquiring measurements

##### Number of Measurements

- Type: Integer
- Default Value: 3
- Description: How many measurements to acquire. If more than 1 are acquired that are less than 1001, the average of the measurements will be stored.

### Xiaomi: Miflora

- Manufacturer: Xiaomi
- Measurements: EC/Light/Moisture/Temperature
- Interfaces: BT
- Libraries: miflora

- Dependencies: libglib2.0-dev, miflora, bluepy

#### OPTIONS

##### MAC (XX:XX:XX:XX:XX:XX)

- Type: Text
- Description: The MAC address of the Bluetooth device

##### BT Adapter (hci[X])

- Type: Integer
- Description: The adapter of the Bluetooth device

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

##### Pre Output

- Type: Select
- Description: Turn the selected output on before taking every measurement

##### Pre Out Duration

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

##### Pre During Measure

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

### Xiaomi: Mijia LYWSD03MMC (ATC and non-ATC modes)

- Manufacturer: Xiaomi
- Measurements: Battery/Humidity/Temperature
- Interfaces: BT
- Libraries: bluepy/bluez
- Dependencies: bluez, bluetooth, libbluetooth-dev, bluepy, pybluez

More information about ATC mode can be found at https://github.com/JsBergbau/MiTemperature2

#### OPTIONS

##### MAC (XX:XX:XX:XX:XX:XX)

- Type: Text
- Description: The MAC address of the Bluetooth device

##### BT Adapter (hci[X])

- Type: Integer
- Description: The adapter of the Bluetooth device

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Description: The duration (seconds) between measurements or actions

**Pre Output**

- Type: Select
- Description: Turn the selected output on before taking every measurement

**Pre Out Duration**

- Type: Decimal
- Description: If a Pre Output is selected, set the duration (seconds) to turn the Pre Output on for before every measurement is acquired.

**Pre During Measure**

- Type: Boolean
- Description: Check to turn the output off after (opposed to before) the measurement is complete

**Enable ATC Mode**

- Type: Boolean
- Description: Enable sensor ATC mode

# 5.3 Supported Outputs

Supported Outputs are listed below.

## 5.3.1 Built-In Outputs (System)

**MQTT Publish: On/Off**

- Manufacturer: Mycodo
- Interfaces: Mycodo
- Output Types: On/Off
- Libraries: paho-mqtt
- Dependencies: paho-mqtt
- Additional URL: Link

Publish "on" or "off" (or any other strings of your choosing) to an MQTT server.

**OPTIONS**

**CHANNEL OPTIONS**

**Hostname**

- Type: Text
- Default Value: localhost
- Description: The hostname of the MQTT server

**Port**

- Type: Integer
- Default Value: 1883
- Description: The port of the MQTT server

**Topic**

- Type: Text
- Default Value: paho/test/single
- Description: The topic to publish with

**Keep Alive**

- Type: Integer
- Default Value: 60
- Description: The keepalive timeout value for the client. Set to 0 to disable.

**Client ID**

- Type: Text
- Default Value: mycodo_mqtt_client
- Description: Unique client ID for connecting to the MQTT server

**On Payload**

- Type: Text
- Default Value: on
- Description: The payload to send when turned on

#### Off Payload

- Type: Text
- Default Value: off
- Description: The payload to send when turned off

#### Startup State

- Type: Select
- Description: Set the state when Mycodo starts

#### Shutdown State

- Type: Select
- Description: Set the state when Mycodo shuts down

#### Force Command

- Type: Boolean
- Description: Always send the commad if instructed, regardless of the current state

#### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

#### Use Login

- Type: Boolean
- Description: Send login credentials

#### Username

- Type: Text
- Default Value: user
- Description: Username for connecting to the server

#### Password

- Type: Text
- Description: Password for connecting to the server. Leave blank to disable.

### MQTT Publish: Value

- Manufacturer: Mycodo
- Interfaces: Mycodo
- Output Types: Value
- Libraries: paho-mqtt
- Dependencies: paho-mqtt
- Additional URL: Link

Publish a value to an MQTT server.

#### OPTIONS

#### CHANNEL OPTIONS

#### Hostname

- Type: Text
- Default Value: localhost

- Description: The hostname of the MQTT server

**Port**

- Type: Integer
- Default Value: 1883
- Description: The port of the MQTT server

**Topic**

- Type: Text
- Default Value: paho/test/single
- Description: The topic to publish with

**Keep Alive**

- Type: Integer
- Default Value: 60
- Description: The keepalive timeout value for the client. Set to 0 to disable.

**Client ID**

- Type: Text
- Default Value: mycodo_mqtt_client
- Description: Unique client ID for connecting to the MQTT server

**Off Value**

- Type: Integer
- Description: The value to send when an Off command is given

**Use Login**

- Type: Boolean
- Description: Send login credentials

**Username**

- Type: Text
- Default Value: user
- Description: Username for connecting to the server

**Password**

- Type: Text
- Description: Password for connecting to the server.

## 5.3.2 Built-In Outputs (Devices)

**DC Motor Controller: L298N**

- Manufacturer: STMicroelectronics
- Interfaces: GPIO
- Output Types: Volume, On/Off
- Libraries: RPi.GPIO
- Dependencies: RPi.GPIO
- Additional URL: Link

The L298N can control 2 DC motors. If these motors control peristaltic pumps, set the Flow Rate and the output can can be instructed to dispense volumes in addition to being turned on for durations.

#### OPTIONS

#### CHANNEL OPTIONS

##### Name

- Type: Text
- Description: A name to distinguish this from others

##### Input Pin 1

- Type: Integer
- Description: The Input Pin 1 of the controller (BCM numbering)

##### Input Pin 2

- Type: Integer
- Description: The Input Pin 2 of the controller (BCM numbering)

##### Use Enable Pin

- Type: Boolean
- Default Value: True
- Description: Enable the use of the Enable Pin

##### Enable Pin

- Type: Integer
- Description: The Enable pin of the controller (BCM numbering)

##### Enable Pin Duty Cycle

- Type: Integer
- Default Value: 50
- Description: The duty cycle to apply to the Enable Pin (percent, 1 - 100)

##### Direction

- Type: Select
- Options: [**Forward** | Backward] (Default in **bold**)
- Description: The direction to turn the motor

##### Volume Rate (ml/min)

- Type: Decimal
- Default Value: 150.0
- Description: If a pump, the measured flow rate (ml/min) at the set Duty Cycle

### Digital Potentiometer: DS3502

- Manufacturer: Maxim Integrated
- Interfaces: $I^2C$
- Output Types: Value
- Dependencies: pyusb, Adafruit_Extended_Bus, adafruit-circuitpython-ds3502
- Manufacturer URL: Link
- Datasheet URL: Link

- Product URL: Link

The DS3502 can generate a 0 - 10k Ohm resistance with 7-bit precision. This equates to 128 possible steps. A value, in Ohms, is passed to this output controller and the step value is calculated and passed to the device. Select whether to round up or down to the nearest step.

#### OPTIONS

##### I²C Address

- Type: Text
- Description: The I2C address of the device

##### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### Round Step

- Type: Select
- Options: [**Up** | Down] (Default in **bold**)
- Description: Round direction to the nearest step value

### Digital-to-Analog Converter: MCP4728

- Manufacturer: MICROCHIP
- Interfaces: I²C
- Output Types: Value
- Dependencies: pyusb, adafruit-extended-bus, adafruit-circuitpython-mcp4728
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

#### OPTIONS

##### I²C Address

- Type: Text
- Description: The I2C address of the device

##### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

##### VREF (volts)

- Type: Decimal
- Default Value: 4.096
- Description: Set the VREF voltage

#### CHANNEL OPTIONS

##### Name

- Type: Text
- Description: A name to distinguish this from others

#### VREF

- Type: Select
- Options: [**Internal** | VDD] (Default in **bold**)
- Description: Select the channel VREF

#### Gain

- Type: Select
- Options: [**1X** | 2X] (Default in **bold**)
- Description: Select the channel Gain

#### Start State

- Type: Select
- Options: [**Previously-Saved State** | Specified Value] (Default in **bold**)
- Description: Select the channel start state

#### Start Value (volts)

- Type: Decimal
- Description: If Specified Value is selected, set the start state value

#### Shutdown State

- Type: Select
- Options: [**Previously-Saved Value** | Specified Value] (Default in **bold**)
- Description: Select the channel shutdown state

#### Shutdown Value (volts)

- Type: Decimal
- Description: If Specified Value is selected, set the shutdown state value

### GPIO: On/Off

- Interfaces: GPIO
- Output Types: On/Off
- Libraries: RPi.GPIO
- Dependencies: RPi.GPIO

The specified GPIO pin will be set HIGH (3.3 volts) or LOW (0 volts) when turned on or off, depending on the On State option.

#### OPTIONS

#### CHANNEL OPTIONS

#### GPIO Pin (BCM)

- Type: Integer
- Description: The pin to control the state of

#### Startup State

- Type: Select
- Description: Set the state when Mycodo starts

#### Shutdown State

- Type: Select
- Description: Set the state when Mycodo shuts down

#### On State

- Type: Select
- Options: [**HIGH** | LOW] (Default in **bold**)
- Description: The state of the GPIO that corresponds to an On state

#### Trigger Functions at Startup

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

#### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

### GPIO: PWM

- Interfaces: GPIO
- Output Types: PWM
- Libraries: pigpio
- Dependencies: pigpio

See the PWM section of the manual for PWM information and determining which pins may be used for each library option.

#### OPTIONS

#### CHANNEL OPTIONS

#### GPIO Pin (BCM)

- Type: Integer
- Description: The pin to control the state of

#### Startup State

- Type: Select
- Description: Set the state when Mycodo starts

#### Startup Value

- Type: Decimal
- Description: The value when Mycodo starts

#### Shutdown State

- Type: Select
- Description: Set the state when Mycodo shuts down

#### Shutdown Value

- Type: Decimal
- Description: The value when Mycodo shuts down

#### Library

- Type: Select
- Options: [**Any Pin, <= 40 kHz** | Hardware Pin, <= 30 MHz] (Default in **bold**)
- Description: Which method to produce the PWM signal (hardware pins can produce higher frequencies)

#### Frequency (Hertz)

- Type: Integer
- Default Value: 22000
- Description: The Herts to output the PWM signal (0 - 70,000)

#### Invert Signal

- Type: Boolean
- Description: Invert the PWM signal

#### Trigger Functions at Startup

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

#### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

### Grove I2C Motor Driver (Board v1.3) (Test Module 01)

- Manufacturer: Grove
- Interfaces: $I^2C$
- Output Types: Volume, On/Off
- Libraries: smbus2
- Dependencies: smbus2
- Manufacturer URL: Link

Controls the Grove I2C Motor Driver Board (v1.3). Both motors will turn at the same time. This output can also dispense volumes of fluid if the motors are attached to peristaltic pumps.

#### OPTIONS

#### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

#### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### CHANNEL OPTIONS

#### Name

- Type: Text
- Description: A name to distinguish this from others

#### Motor Speed (0 - 100)

- Type: Integer
- Default Value: 100
- Description: The motor output that determines the speed

#### Flow Rate Method

- Type: Select

- Options: [**Fastest Flow Rate** | Specify Flow Rate] (Default in **bold**)
- Description: The flow rate to use when pumping a volume

##### Desired Flow Rate (ml/min)

- Type: Decimal
- Default Value: 10.0
- Description: Desired flow rate in ml/minute when Specify Flow Rate set

##### Fastest Rate (ml/min)

- Type: Decimal
- Default Value: 100.0
- Description: The fastest rate that the pump can dispense (ml/min)

### Grove I2C Motor Driver (TB6612FNG, Board v1.0)

- Manufacturer: Grove
- Interfaces: $I^2C$
- Output Types: Volume, On/Off
- Libraries: smbus2
- Dependencies: smbus2
- Manufacturer URL: Link

Controls the Grove I2C Motor Driver Board (v1.3). Both motors will turn at the same time. This output can also dispense volumes of fluid if the motors are attached to peristaltic pumps.

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### CHANNEL OPTIONS

##### Name

- Type: Text
- Description: A name to distinguish this from others

##### Motor Speed (0 - 255)

- Type: Integer
- Default Value: 255
- Description: The motor output that determines the speed

##### Flow Rate Method

- Type: Select
- Options: [**Fastest Flow Rate** | Specify Flow Rate] (Default in **bold**)
- Description: The flow rate to use when pumping a volume

##### Desired Flow Rate (ml/min)

- Type: Decimal
- Default Value: 10.0
- Description: Desired flow rate in ml/minute when Specify Flow Rate set

##### Fastest Rate (ml/min)

- Type: Decimal
- Default Value: 100.0
- Description: The fastest rate that the pump can dispense (ml/min)

##### Minimum On (sec/min)

- Type: Decimal
- Default Value: 1.0
- Description: The minimum duration (seconds) the pump turns on for every 60 second period (only used for Specify Flow Rate mode).

#### ACTIONS

##### New I2C Address

- Type: Text
- Default Value: 0x14
- Description: The new I2C to set the sensor to

##### Set I2C Address

- Type: Button

### Grove Multichannel Relay (4- or 8-Channel board)

- Manufacturer: Grove
- Interfaces: $I^2C$
- Output Types: On/Off
- Libraries: smbus2
- Dependencies: smbus2
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

Controls the 4 or 8 channel Grove multichannel relay board.

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### CHANNEL OPTIONS

##### Name

- Type: Text
- Description: A name to distinguish this from others

##### Startup State

- Type: Select
- Description: Set the state of the relay when Mycodo starts

##### Shutdown State

- Type: Select
- Description: Set the state of the relay when Mycodo shuts down

##### On State

- Type: Select
- Options: [**HIGH** | LOW] (Default in **bold**)
- Description: The state of the GPIO that corresponds to an On state

##### Trigger Functions at Startup

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

##### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

### I/O Expander: PCF8574 (8 Channels): On/Off

- Manufacturer: Texas Instruments
- Interfaces: $I^2C$
- Output Types: On/Off
- Libraries: smbus2
- Dependencies: smbus2
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

Controls the 8 channels of the PCF8574.

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

##### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### CHANNEL OPTIONS

##### Name

- Type: Text
- Description: A name to distinguish this from others

##### Startup State

- Type: Select
- Description: Set the state of the GPIO when Mycodo starts

##### Shutdown State

- Type: Select
- Description: Set the state of the GPIO when Mycodo shuts down

##### On State

- Type: Select
- Options: [**HIGH** | LOW] (Default in **bold**)
- Description: The state of the GPIO that corresponds to an On state

##### Trigger Functions at Startup

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

##### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

### KP303 Kasa Smart WiFi Power Strip

- Manufacturer: TP-Link
- Interfaces: Mycodo
- Output Types: On/Off
- Dependencies: python-kasa
- Manufacturer URL: Link

This output controls the 3 outlets of the Kasa KP303 Smart WiFi Power Strip.

#### OPTIONS

##### Host

- Type: Text
- Default Value: 192.168.0.50
- Description: Host address or IP

##### Status Update (Sec)

- Type: Integer
- Default Value: 60
- Description: The period (seconds) between checking if connected and output states.

#### CHANNEL OPTIONS

##### Name

- Type: Text

- Default Value: Outlet Name
- Description: A name to distinguish this from others

#### Startup State

- Type: Select
- Description: Set the state when Mycodo starts

#### Shutdown State

- Type: Select
- Description: Set the state when Mycodo shuts down

#### Trigger Functions at Startup

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

#### Force Command

- Type: Boolean
- Description: Always send the command if instructed, regardless of the current state

#### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

### LED Controller: PCA9685 (16 channels): PWM

- Manufacturer: NXP Semiconductors
- Interfaces: $I^2C$
- Output Types: PWM
- Libraries: adafruit-pca9685
- Dependencies: adafruit-pca9685
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

The PCA9685 can output a PWM signal to 16 channels at a frequency between 40 and 1600 Hz.

#### OPTIONS

#### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

#### $I^2C$ Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### Frequency (Hertz)

- Type: Integer
- Default Value: 1600
- Description: The Herts to output the PWM signal (40 - 1600)

#### CHANNEL OPTIONS

##### Name

- Type: Text
- Description: A name to distinguish this from others

##### Startup State

- Type: Select
- Description: Set the state when Mycodo starts

##### Startup Value

- Type: Decimal
- Description: The value when Mycodo starts

##### Shutdown State

- Type: Select
- Description: Set the state when Mycodo shuts down

##### Shutdown Value

- Type: Decimal
- Description: The value when Mycodo shuts down

##### Invert Signal

- Type: Boolean
- Description: Invert the PWM signal

##### Trigger Functions at Startup

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

##### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

### Peristaltic Pump: Atlas Scientific

- Manufacturer: Atlas Scientific
- Interfaces: $I^2C$, UART, FTDI
- Output Types: Volume, On/Off
- Dependencies: pylibftdi
- Manufacturer URL: Link
- Datasheet URL: Link
- Product URL: Link

Atlas Scientific peristaltic pumps can be set to dispense at their maximum rate or a rate can be specified. Their minimum flow rate is 0.5 ml/min and their maximum is 105 ml/min.

#### OPTIONS

##### $I^2C$ Address

- Type: Text
- Description: The I2C address of the device

#### I²C Bus

- Type: Integer
- Description: The I2C bus the device is connected to

#### FTDI Device

- Type: Text
- Description: The FTDI device connected to the input/output/etc.

#### UART Device

- Type: Text
- Description: The UART device location (e.g. /dev/ttyUSB1)

#### CHANNEL OPTIONS

#### Flow Rate Method

- Type: Select
- Options: [**Fastest Flow Rate** | Specify Flow Rate] (Default in **bold**)
- Description: The flow rate to use when pumping a volume

#### Desired Flow Rate (ml/min)

- Type: Decimal
- Default Value: 10.0
- Description: Desired flow rate in ml/minute when Specify Flow Rate set

#### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

#### ACTIONS

#### New I2C Address

- Type: Text
- Default Value: 0x67
- Description: The new I2C to set the device to

#### Set I2C Address

- Type: Button

### Peristaltic Pump: Generic

- Interfaces: GPIO
- Output Types: Volume, On/Off
- Libraries: RPi.GPIO
- Dependencies: RPi.GPIO

This output turns a GPIO pin HIGH and LOW to control power to a generic peristaltic pump. The peristaltic pump can then be turned on for a duration or, after determining the pump's maximum flow rate, instructed to dispense a specific volume at the maximum rate or at a specified rate.

#### OPTIONS

#### CHANNEL OPTIONS

##### GPIO Pin (BCM)

- Type: Integer
- Description: The pin to control the state of

##### On State

- Type: Select
- Options: [**HIGH** | LOW] (Default in **bold**)
- Description: The state of the GPIO that corresponds to an On state

##### Fastest Rate (ml/min)

- Type: Decimal
- Default Value: 150.0
- Description: The fastest rate that the pump can dispense (ml/min)

##### Minimum On (sec/min)

- Type: Decimal
- Default Value: 1.0
- Description: The minimum duration (seconds) the pump should be turned on for every 60 second period

##### Flow Rate Method

- Type: Select
- Options: [**Fastest Flow Rate** | Specify Flow Rate] (Default in **bold**)
- Description: The flow rate to use when pumping a volume

##### Desired Flow Rate (ml/min)

- Type: Decimal
- Default Value: 10.0
- Description: Desired flow rate in ml/minute when Specify Flow Rate set

##### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

### Python Code: On/Off

- Interfaces: Python
- Output Types: On/Off

Python 3 code will be executed when this output is turned on or off.

#### OPTIONS

#### CHANNEL OPTIONS

##### On Command

- Description: Python code to execute when the output is instructed to turn on

##### Off Command

- Description: Python code to execute when the output is instructed to turn off

**Startup State**

- Type: Select
- Description: Set the state when Mycodo starts

**Shutdown State**

- Type: Select
- Description: Set the state when Mycodo shuts down

**Trigger Functions at Startup**

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

**Force Command**

- Type: Boolean
- Description: Always send the command if instructed, regardless of the current state

**Current (Amps)**

- Type: Decimal
- Description: The current draw of the device being controlled

### Python Code: PWM

- Interfaces: Python
- Output Types: PWM

Python 3 code will be executed when this output is turned on or off. The "duty_cycle" object is a float value that represents the duty cycle that has been set.

**OPTIONS**

**CHANNEL OPTIONS**

**Bash Command**

- Description: Command to execute to set the PWM duty cycle (%)

**User**

- Type: Text
- Default Value: mycodo
- Description: The user to execute the command

**Startup State**

- Type: Select
- Description: Set the state when Mycodo starts

**Startup Value**

- Type: Decimal
- Description: The value when Mycodo starts

**Shutdown State**

- Type: Select
- Description: Set the state when Mycodo shuts down

#### Shutdown Value

- Type: Decimal
- Description: The value when Mycodo shuts down

#### Invert Signal

- Type: Boolean
- Description: Invert the PWM signal

#### Trigger Functions at Startup

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

#### Force Command

- Type: Boolean
- Description: Always send the commad if instructed, regardless of the current state

#### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

### Shell Script: On/Off

- Interfaces: Shell
- Output Types: On/Off
- Libraries: subprocess.Popen

Commands will be executed in the Linux shell by the specified user when this output is turned on or off.

#### OPTIONS

#### CHANNEL OPTIONS

#### On Command

- Type: Text
- Default Value: /home/pi/script_on_off.sh on
- Description: Command to execute when the output is instructed to turn on

#### Off Command

- Type: Text
- Default Value: /home/pi/script_on_off.sh off
- Description: Command to execute when the output is instructed to turn off

#### User

- Type: Text
- Default Value: mycodo
- Description: The user to execute the command

#### Startup State

- Type: Select
- Description: Set the state when Mycodo starts

#### Shutdown State

- Type: Select
- Description: Set the state when Mycodo shuts down

#### Trigger Functions at Startup

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

#### Force Command

- Type: Boolean
- Description: Always send the commad if instructed, regardless of the current state

#### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

### Shell Script: PWM

- Interfaces: Shell
- Output Types: PWM
- Libraries: subprocess.Popen

Commands will be executed in the Linux shell by the specified user when the duty cycle is set for this output. The string "((duty_cycle))" in the command will be replaced with the duty cycle being set prior to execution.

#### OPTIONS

#### CHANNEL OPTIONS

#### Bash Command

- Type: Text
- Default Value: /home/pi/script_pwm.sh ((duty_cycle))
- Description: Command to execute to set the PWM duty cycle (%)

#### User

- Type: Text
- Default Value: mycodo
- Description: The user to execute the command

#### Startup State

- Type: Select
- Description: Set the state when Mycodo starts

#### Startup Value

- Type: Decimal
- Description: The value when Mycodo starts

#### Shutdown State

- Type: Select
- Description: Set the state when Mycodo shuts down

#### Shutdown Value

- Type: Decimal

- Description: The value when Mycodo shuts down

##### Invert Signal

- Type: Boolean
- Description: Invert the PWM signal

##### Trigger Functions at Startup

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

##### Force Command

- Type: Boolean
- Description: Always send the commad if instructed, regardless of the current state

##### Current (Amps)

- Type: Decimal
- Description: The current draw of the device being controlled

### Stepper Motor: Bipolar, Generic

- Interfaces: GPIO
- Output Types: Value
- Dependencies: RPi.GPIO
- Manufacturer URLs: Link 1, Link 2
- Datasheet URLs: Link 1, Link 2
- Product URLs: Link 1, Link 2

This is a generic module for bipolar stepper motor drivers such as the DRV8825, A4988, and others. The value passed to the output is the number of steps. A positive value turns clockwise and a negative value turns counter-clockwise.

#### OPTIONS

#### CHANNEL OPTIONS

**If the Direction or Enable pins are not used, make sure you pull the appropriate pins on your driver high or low to set the proper direction and enable the stepper motor to be energized. Note: For Enable Mode, always having the motor energized will use more energy and produce more heat.**

##### Step Pin

- Type: Integer
- Description: The Step pin of the controller (BCM numbering)

##### Full Step Delay

- Type: Decimal
- Default Value: 0.005
- Description: The Full Step Delay of the controller

##### Direction Pin

- Type: Integer
- Description: The Direction pin of the controller (BCM numbering). Set to None to disable.

##### Enable Pin

- Type: Integer
- Description: The Enable pin of the controller (BCM numbering). Set to None to disable.

#### Enable Mode

- Type: Select
- Options: [**Only When Turning** | Always] (Default in **bold**)
- Description: Choose when to pull the enable pin high to energize the motor.

#### Enable at Shutdown

- Type: Select
- Options: [Enable | **Disable**] (Default in **bold**)
- Description: Choose whether the enable pin in pulled high (Enable) or low (Disable) when Mycodo shuts down.

#### If using a Step Resolution other than Full, and all three Mode Pins are set, they will be set high (1) or how (0) according to the values in parentheses to the right of the selected Step Resolution, e.g. (Mode Pin 1, Mode Pin 2, Mode Pin 3).

#### Step Resolution

- Type: Select
- Options: [**Full (modes 0, 0, 0)** | Half (modes 1, 0, 0) | 1/4 (modes 0, 1, 0) | 1/8 (modes 1, 1, 0) | 1/16 (modes 0, 0, 1) | 1/32 (modes 1, 0, 1)] (Default in **bold**)
- Description: The Step Resolution of the controller

#### Mode Pin 1

- Type: Integer
- Description: The Mode Pin 1 of the controller (BCM numbering). Set to None to disable.

#### Mode Pin 2

- Type: Integer
- Description: The Mode Pin 2 of the controller (BCM numbering). Set to None to disable.

#### Mode Pin 3

- Type: Integer
- Description: The Mode Pin 3 of the controller (BCM numbering). Set to None to disable.

### Stepper Motor: Unipolar, ULN2003

- Manufacturer: STMicroelectronics
- Interfaces: GPIO
- Output Types: Value
- Dependencies: RPi.GPIO, rpimotorlib
- Manufacturer URL: Link
- Datasheet URLs: Link 1, Link 2

This is a module for the ULN2003 driver.

#### OPTIONS

#### CHANNEL OPTIONS

#### Notes about connecting the ULN2003...

#### Pin IN1

- Type: Integer
- Default Value: 18
- Description: The pin (BCM numbering) connected to IN1 of the ULN2003

#### Pin IN2

- Type: Integer
- Default Value: 23
- Description: The pin (BCM numbering) connected to IN2 of the ULN2003

#### Pin IN3

- Type: Integer
- Default Value: 24
- Description: The pin (BCM numbering) connected to IN3 of the ULN2003

#### Pin IN4

- Type: Integer
- Default Value: 25
- Description: The pin (BCM numbering) connected to IN4 of the ULN2003

#### Step Delay

- Type: Decimal
- Default Value: 0.001
- Description: The Step Delay of the controller

#### Notes about step resolution...

#### Step Resolution

- Type: Select
- Options: [**Full** | Half | Wave] (Default in **bold**)
- Description: The Step Resolution of the controller

### Wireless: 315/433 MHz

- Interfaces: GPIO
- Output Types: On/Off
- Libraries: rpi-rf
- Dependencies: RPi.GPIO, rpi_rf

This output uses a 315 or 433 MHz transmitter to turn wireless power outlets on or off. Run ~/Mycodo/mycodo/devices/wireless_rpi_rf.py with a receiver to discover the codes produced from your remote.

#### OPTIONS

#### CHANNEL OPTIONS

#### GPIO Pin (BCM)

- Type: Integer
- Description: The pin to control the state of

#### On Command

- Type: Text
- Default Value: 22559
- Description: Command to execute when the output is instructed to turn on

#### Off Command

- Type: Text

- Default Value: 22558
- Description: Command to execute when the output is instructed to turn off

**Protocol**

- Type: Select
- Options: [**1** | 2 | 3 | 4 | 5] (Default in **bold**)
- Description: Wireless protocol

**Pulse Length**

- Type: Integer
- Default Value: 189
- Description: Wireless pulse length

**Startup State**

- Type: Select
- Description: Set the state when Mycodo starts

**Shutdown State**

- Type: Select
- Description: Set the state when Mycodo shuts down

**Trigger Functions at Startup**

- Type: Boolean
- Description: Whether to trigger functions when the output switches at startup

**Force Command**

- Type: Boolean
- Description: Always send the commad if instructed, regardless of the current state

**Current (Amps)**

- Type: Decimal
- Description: The current draw of the device being controlled

# 5.4 Supported Functions

Supported Functions are listed below.

## 5.4.1 Built-In Functions

**Average (Last, Multiple)**

This function acquires the last measurement of those that are selected, averages them, then stores the resulting value as the selected measurement and unit.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Start Offset**

- Type: Integer
- Default Value: 10
- Description: The duration (seconds) to wait before the first operation

**Measurement Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the measurement

**Measurement**

- Description: Measurement to replace "x" in the equation

**Average (Past, Single)**

This function acquires the past measurements (within Max Age) for the selected measurement, averages them, then stores the resulting value as the selected measurement and unit.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Start Offset**

- Type: Integer
- Default Value: 10
- Description: The duration (seconds) to wait before the first operation

**Measurement**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement to replace "x" in the equation

#### Measurement Max Age

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the measurement

### Backup to Remote Host (rsync)

- Dependencies: rsync

This function will use rsync to back up assets on this system to a remote system. Your remote system needs to have an SSH server running and rsync installed. This system will need rsync installed and be able to access your remote system via SSH keyfile (login without a password). You can do this by creating an SSH key on this system running Mycodo with "ssh-keygen" (leave the password field empty), then run "ssh-copy-id -i ~/.ssh/id_rsa.pub pi@REMOTE_HOST_IP" to transfer your public SSH key to your remote system (changing pi and REMOTE_HOST_IP to the appropriate user and host of your remote system). You can test if this worked by trying to connect to your remote system with "ssh pi@REMOTE_HOST_IP" and you should log in without being asked for a password. Be careful not to set the Period too low, which could cause the function to begin running before the previous operation(s) complete. Therefore, it is recommended to set a relatively long Period (greater than 10 minutes). The default Period is 15 days. Note that the Period will reset if the system or the Mycodo daemon restarts and the Function will run, generating new settings and measurement archives that will be synced. There are two common ways to use this Function: 1) A short period (1 hour), only have Backup Camera Directories enabled, and use the Backup Settings Now and Backup Measurements Now buttons manually to perform a backup, and 2) A long period (15 days), only have Backup Settings and Backup Measurements enabled. You can even create two of these Functions with one set up to perform long-Period settings and measurement backups and the other set up to perform short-Period camera backups.

#### OPTIONS

#### Period (seconds)

- Type: Decimal
- Default Value: 1296000
- Description: The duration (seconds) between measurements or actions

#### Start Offset

- Type: Integer
- Default Value: 300
- Description: The duration (seconds) to wait before the first operation

#### Local User

- Type: Text
- Default Value: pi
- Description: The user on this system that will run rsync

#### Remote User

- Type: Text
- Default Value: pi
- Description: The user to log in to the remote host

#### Remote Host

- Type: Text
- Default Value: 192.168.0.50
- Description: The IP or host address to send the backup to

**Remote Backup Path**

- Type: Text
- Default Value: /home/pi/backup_mycodo_zeph
- Description: The path to backup to on the remote host

**Rsync Timeout**

- Type: Integer
- Default Value: 3600
- Description: How long to allow rsync to complete (seconds)

**Backup Settings Export File**

- Type: Boolean
- Default Value: True
- Description: Create and backup exported settings file

**Remove Local Settings Backups**

- Type: Boolean
- Description: Remove local settings backups after successful transfer to remote host

**Backup Measurements**

- Type: Boolean
- Default Value: True
- Description: Backup all influxdb measurements

**Remove Local Measurements Backups**

- Type: Boolean
- Description: Remove local measurements backups after successful transfer to remote host

**Backup Camera Directories**

- Type: Boolean
- Default Value: True
- Description: Backup all camera directories

**Remove Local Camera Images**

- Type: Boolean
- Description: Remove local camera images after successful transfer to remote host

**ACTIONS**

**Backup of settings are only created if the Mycodo version or database versions change. This is due to this Function running periodically- if it created a new backup every Period, there would soon be many identical backups. Therefore, if you want to induce the backup of settings, measurements, or camera directories and sync them to your remote system, use the buttons below.**

**Backup Settings Now**

- Type: Button

**Backup Measurements Now**

- Type: Button

**Backup Camera Directories Now**

- Type: Button

### Bang-Bang Hysteretic (On/Off) (Raise/Lower)

A simple bang-bang control for controlling one output from one input. Select an input, an output, enter a setpoint and a hysteresis, and select a direction. The output will turn on when the input is below (lower = setpoint - hysteresis) and turn off when the input is above (higher = setpoint + hysteresis). This is the behavior when Raise is selected, such as when heating. Lower direction has the opposite behavior - it will try to turn the output on in order to drive the input lower.

#### OPTIONS

##### Measurement

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Select a measurement the selected output will affect

##### Output

- Description: Select an output to control that will affect the measurement

##### Setpoint

- Type: Decimal
- Default Value: 50
- Description: The desired setpoint

##### Hysteresis

- Type: Decimal
- Default Value: 1
- Description: The amount above and below the setpoint that defines the control band

##### Direction

- Type: Select
- Options: [**Raise** | Lower] (Default in **bold**)
- Description: Raise means the measurement will increase when the control is on (heating). Lower means the measurement will decrease when the output is on (cooling)

##### Period (seconds)

- Type: Decimal
- Default Value: 5
- Description: The duration (seconds) between measurements or actions

### Bang-Bang Hysteretic (On/Off) (Raise/Lower/Both)

A simple bang-bang control for controlling one output from one input. Select an input, an output, enter a setpoint and a hysteresis, and select a direction. The output will turn on when the input is below (lower = setpoint - hysteresis) and turn off when the input is above (higher = setpoint + hysteresis). This is the behavior when Raise is selected, such as when heating. Lower direction has the opposite behavior - it will try to turn the output on in order to drive the input lower. The Both option will raise and lower.

#### OPTIONS

##### Measurement

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Select a measurement the selected output will affect

##### Output (Raise)

- Description: Select an output to control that will raise the measurement

##### Output (Lower)

- Description: Select an output to control that will lower the measurement

##### Setpoint

- Type: Decimal
- Default Value: 50
- Description: The desired setpoint

##### Hysteresis

- Type: Decimal
- Default Value: 1
- Description: The amount above and below the setpoint that defines the control band

##### Direction

- Type: Select
- Options: [Raise | Lower | **Both**] (Default in **bold**)
- Description: Raise means the measurement will increase when the control is on (heating). Lower means the measurement will decrease when the output is on (cooling)

##### Period (seconds)

- Type: Decimal
- Default Value: 5
- Description: The duration (seconds) between measurements or actions

### Bang-Bang Hysteretic (PWM) (Raise/Lower/Both)

A simple bang-bang control for controlling one PWM output from one input. Select an input, a PWM output, enter a setpoint and a hysteresis, and select a direction. The output will turn on when the input is below below (lower = setpoint - hysteresis) and turn off when the input is above (higher = setpoint + hysteresis). This is the behavior when Raise is selected, such as when heating. Lower direction has the opposite behavior - it will try to turn the output on in order to drive the input lower. The Both option will raise and lower.

#### OPTIONS

##### Measurement

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Select a measurement the selected output will affect

##### Output

- Description: Select an output to control that will affect the measurement

##### Setpoint

- Type: Decimal
- Default Value: 50
- Description: The desired setpoint

##### Hysteresis

- Type: Decimal

- Default Value: 1
- Description: The amount above and below the setpoint that defines the control band

**Direction**

- Type: Select
- Options: [Raise | Lower | **Both**] (Default in **bold**)
- Description: Raise means the measurement will increase when the control is on (heating). Lower means the measurement will decrease when the output is on (cooling)

**Period (seconds)**

- Type: Decimal
- Default Value: 5
- Description: The duration (seconds) between measurements or actions

**Duty Cycle (increase)**

- Type: Decimal
- Default Value: 90
- Description: The duty cycle to increase the measurement

**Duty Cycle (maintain)**

- Type: Decimal
- Default Value: 55
- Description: The duty cycle to maintain the measurement

**Duty Cycle (decrease)**

- Type: Decimal
- Default Value: 20
- Description: The duty cycle to decrease the measurement

**Duty Cycle (shutdown)**

- Type: Decimal
- Description: The duty cycle to set when the function shuts down

### Difference

This function acquires 2 measurements, calculates the difference, and stores the resulting value as the selected measurement and unit.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Measurement A**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement A

**Measurement A Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of Measurement A

**Measurement B**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement B

**Measurement B Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of Measurement B

**Reverse Order**

- Type: Boolean
- Description: Reverse the order in the calculation

**Absolute Difference**

- Type: Boolean
- Description: Return the absolute value of the difference

### Display: Generic LCD 16x2 (I2C)

This Function outputs to a generic 16x2 LCD display via I2C. Since this display can show 2 lines at a time, channels are added in sets of 2 when Number of Line Sets is modified. Every Period, the LCD will refresh and display the next set of lines. Therefore, the first 2 lines that are displayed are channels 0 and 1, then 2 and 3, and so on. After all channels have been displayed, it will cycle back to the beginning.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 10
- Description: The duration (seconds) between measurements or actions

**I2C Address**

- Type: Text
- Default Value: 0x20
- Description: The I2C address of the device

**I2C Bus**

- Type: Integer
- Default Value: 1
- Description: The I2C bus the device is connected to

**Number of Line Sets**

- Type: Integer
- Default Value: 1
- Description: How many sets of lines to cycle on the LCD

#### CHANNEL OPTIONS

##### Line Display Type

- Type: Select
- Description: What to display on the line

##### Measurement

- Type: Select Measurement
- Selections: Input, Math, Function, Output, PID,
- Description: Measurement to display on the line

##### Measurement Max Age

- Type: Decimal
- Default Value: 360
- Description: The maximum allowed age of the measurement

##### Measurement Decimal

- Type: Integer
- Default Value: 1
- Description: The number of digits after the decimal

##### Text

- Type: Text
- Default Value: Text
- Description: Text to display

### Display: Generic LCD 20x4 (I2C)

This Function outputs to a generic 20x4 LCD display via I2C. Since this display can show 4 lines at a time, channels are added in sets of 4 when Number of Line Sets is modified. Every Period, the LCD will refresh and display the next set of lines. Therefore, the first 4 lines that are displayed are channels 0, 1, 2, and 3, then 4, 5, 6, and 7, and so on. After all channels have been displayed, it will cycle back to the beginning.

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Default Value: 10
- Description: The duration (seconds) between measurements or actions

##### I2C Address

- Type: Text
- Default Value: 0x20
- Description: The I2C address of the device

##### I2C Bus

- Type: Integer
- Default Value: 1
- Description: The I2C bus the device is connected to

##### Number of Line Sets

- Type: Integer

- Default Value: 1
- Description: How many sets of lines to cycle on the LCD

**CHANNEL OPTIONS**

**Line Display Type**

- Type: Select
- Description: What to display on the line

**Measurement**

- Type: Select Measurement
- Selections: Input, Math, Function, Output, PID,
- Description: Measurement to display on the line

**Measurement Max Age**

- Type: Decimal
- Default Value: 360
- Description: The maximum allowed age of the measurement

**Measurement Decimal**

- Type: Integer
- Default Value: 1
- Description: The number of digits after the decimal

**Text**

- Type: Text
- Default Value: Text
- Description: Text to display

### Display: Grove LCD 16x2 (I2C)

This Function outputs to the Grove 16x2 LCD display via I2C. Since this display can show 2 lines at a time, channels are added in sets of 2 when Number of Line Sets is modified. Every Period, the LCD will refresh and display the next set of lines. Therefore, the first 2 lines that are displayed are channels 0 and 1, then 2 and 3, and so on. After all channels have been displayed, it will cycle back to the beginning.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 10
- Description: The duration (seconds) between measurements or actions

**I2C Address**

- Type: Text
- Default Value: 0x3e
- Description: The I2C address of the device

**I2C Bus**

- Type: Integer
- Default Value: 1
- Description: The I2C bus the device is connected to

#### Backlight I2C Address

- Type: Text
- Default Value: 0x62
- Description: I2C address to control the backlight

#### Number of Line Sets

- Type: Integer
- Default Value: 1
- Description: How many sets of lines to cycle on the LCD

#### Backlight Red (0 - 255)

- Type: Integer
- Default Value: 255
- Description: Set the red color value of the backlight on startup.

#### Backlight Green (0 - 255)

- Type: Integer
- Default Value: 255
- Description: Set the green color value of the backlight on startup.

#### Backlight Blue (0 - 255)

- Type: Integer
- Default Value: 255
- Description: Set the blue color value of the backlight on startup.

### CHANNEL OPTIONS

#### Line Display Type

- Type: Select
- Description: What to display on the line

#### Measurement

- Type: Select Measurement
- Selections: Input, Math, Function, Output, PID,
- Description: Measurement to display on the line

#### Measurement Max Age

- Type: Decimal
- Default Value: 360
- Description: The maximum allowed age of the measurement

#### Measurement Decimal

- Type: Integer
- Default Value: 1
- Description: The number of digits after the decimal

#### Text

- Type: Text
- Default Value: Text
- Description: Text to display

**Display: SSD1306 OLED 128x32 (I2C)**

- Dependencies: libjpeg-dev, Pillow, pyusb, adafruit-extended-bus, adafruit-circuitpython-framebuf, Adafruit-Circuitpython-SSD1306

This Function outputs to a 128x32 SSD1306 OLED display via I2C. Since this display can show 8 lines at a time, channels are added in sets of 8 when Number of Line Sets is modified. Every Period, the LCD will refresh and display the next 8 lines. Therefore, the first 8 lines that are displayed are channels 0 - 7, then 8 - 15, and so on. After all channels have been displayed, it will cycle back to the beginning.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 10
- Description: The duration (seconds) between measurements or actions

**I2C Address**

- Type: Text
- Default Value: 0x3c
- Description: The I2C address of the device

**I2C Bus**

- Type: Integer
- Default Value: 1
- Description: The I2C bus the device is connected to

**Number of Line Sets**

- Type: Integer
- Default Value: 1
- Description: How many sets of lines to cycle on the LCD

**Reset Pin**

- Type: Integer
- Default Value: 17
- Description: The pin (BCM numbering) connected to RST of the display

**CHANNEL OPTIONS**

**Line Display Type**

- Type: Select
- Description: What to display on the line

**Measurement**

- Type: Select Measurement
- Selections: Input, Math, Function, Output, PID,
- Description: Measurement to display on the line

**Measurement Max Age**

- Type: Decimal
- Default Value: 360
- Description: The maximum allowed age of the measurement

#### Measurement Decimal

- Type: Integer
- Default Value: 1
- Description: The number of digits after the decimal

#### Text

- Type: Text
- Default Value: Text
- Description: Text to display

### Display: SSD1306 OLED 128x32 (SPI)

- Dependencies: libjpeg-dev, Pillow, pyusb, adafruit-extended-bus, adafruit-circuitpython-framebuf, Adafruit-Circuitpython-SSD1306

This Function outputs to a 128x32 SSD1306 OLED display via SPI. Since this display can show 8 lines at a time, channels are added in sets of 8 when Number of Line Sets is modified. Every Period, the LCD will refresh and display the next 8 lines. Therefore, the first 8 lines that are displayed are channels 0 - 7, then 8 - 15, and so on. After all channels have been displayed, it will cycle back to the beginning.

#### OPTIONS

#### Period (seconds)

- Type: Decimal
- Default Value: 10
- Description: The duration (seconds) between measurements or actions

#### Number of Line Sets

- Type: Integer
- Default Value: 1
- Description: How many sets of lines to cycle on the LCD

#### SPI Device

- Type: Integer
- Description: The SPI device

#### SPI Bus

- Type: Integer
- Description: The SPI bus

#### DC Pin

- Type: Integer
- Default Value: 16
- Description: The pin (BCM numbering) connected to DC of the display

#### Reset Pin

- Type: Integer
- Default Value: 19
- Description: The pin (BCM numbering) connected to RST of the display

#### CS Pin

- Type: Integer

- Default Value: 17
- Description: The pin (BCM numbering) connected to CS of the display

**CHANNEL OPTIONS**

**Line Display Type**

- Type: Select
- Description: What to display on the line

**Measurement**

- Type: Select Measurement
- Selections: Input, Math, Function, Output, PID,
- Description: Measurement to display on the line

**Measurement Max Age**

- Type: Decimal
- Default Value: 360
- Description: The maximum allowed age of the measurement

**Measurement Decimal**

- Type: Integer
- Default Value: 1
- Description: The number of digits after the decimal

**Text**

- Type: Text
- Default Value: Text
- Description: Text to display

### Display: SSD1306 OLED 128x64 (I2C)

- Dependencies: libjpeg-dev, Pillow, pyusb, adafruit-extended-bus, adafruit-circuitpython-framebuf, Adafruit-Circuitpython-SSD1306

This Function outputs to a 128x64 SSD1306 OLED display via I2C. Since this display can show 8 lines at a time, channels are added in sets of 8 when Number of Line Sets is modified. Every Period, the LCD will refresh and display the next 8 lines. Therefore, the first 8 lines that are displayed are channels 0 - 7, then 8 - 15, and so on. After all channels have been displayed, it will cycle back to the beginning.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 10
- Description: The duration (seconds) between measurements or actions

**I2C Address**

- Type: Text
- Default Value: 0x3c
- Description: The I2C address of the device

**I2C Bus**

- Type: Integer

- Default Value: 1
- Description: The I2C bus the device is connected to

**Number of Line Sets**

- Type: Integer
- Default Value: 1
- Description: How many sets of lines to cycle on the LCD

**Reset Pin**

- Type: Integer
- Default Value: 17
- Description: The pin (BCM numbering) connected to RST of the display

**CHANNEL OPTIONS**

**Line Display Type**

- Type: Select
- Description: What to display on the line

**Measurement**

- Type: Select Measurement
- Selections: Input, Math, Function, Output, PID,
- Description: Measurement to display on the line

**Measurement Max Age**

- Type: Decimal
- Default Value: 360
- Description: The maximum allowed age of the measurement

**Measurement Decimal**

- Type: Integer
- Default Value: 1
- Description: The number of digits after the decimal

**Text**

- Type: Text
- Default Value: Text
- Description: Text to display

### Display: SSD1306 OLED 128x64 (SPI)

- Dependencies: libjpeg-dev, Pillow, pyusb, adafruit-extended-bus, adafruit-circuitpython-framebuf, Adafruit-Circuitpython-SSD1306

This Function outputs to a 128x64 SSD1306 OLED display via SPI. Since this display can show 8 lines at a time, channels are added in sets of 8 when Number of Line Sets is modified. Every Period, the LCD will refresh and display the next 8 lines. Therefore, the first 8 lines that are displayed are channels 0 - 7, then 8 - 15, and so on. After all channels have been displayed, it will cycle back to the beginning.

**OPTIONS**

**Period (seconds)**

- Type: Decimal

- Default Value: 10
- Description: The duration (seconds) between measurements or actions

**Number of Line Sets**

- Type: Integer
- Default Value: 1
- Description: How many sets of lines to cycle on the LCD

**SPI Device**

- Type: Integer
- Description: The SPI device

**SPI Bus**

- Type: Integer
- Description: The SPI bus

**DC Pin**

- Type: Integer
- Default Value: 16
- Description: The pin (BCM numbering) connected to DC of the display

**Reset Pin**

- Type: Integer
- Default Value: 19
- Description: The pin (BCM numbering) connected to RST of the display

**CS Pin**

- Type: Integer
- Default Value: 17
- Description: The pin (BCM numbering) connected to CS of the display

**CHANNEL OPTIONS**

**Line Display Type**

- Type: Select
- Description: What to display on the line

**Measurement**

- Type: Select Measurement
- Selections: Input, Math, Function, Output, PID,
- Description: Measurement to display on the line

**Measurement Max Age**

- Type: Decimal
- Default Value: 360
- Description: The maximum allowed age of the measurement

**Measurement Decimal**

- Type: Integer
- Default Value: 1

- Description: The number of digits after the decimal

**Text**

- Type: Text
- Default Value: Text
- Description: Text to display

### Display: SSD1309 OLED 128x64 (I2C)

- Dependencies: pyusb, luma.oled, Pillow, libjpeg-dev, zlib1g-dev, libfreetype6-dev, liblcms2-dev, libopenjp2-7, libtiff5

This Function outputs to a 128x64 SSD1309 OLED display via I2C. Since this display can show 8 lines at a time, channels are added in sets of 8 when Number of Line Sets is modified. Every Period, the LCD will refresh and display the next 8 lines. Therefore, the first 8 lines that are displayed are channels 0 - 7, then 8 - 15, and so on. After all channels have been displayed, it will cycle back to the beginning.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 10
- Description: The duration (seconds) between measurements or actions

**I2C Address**

- Type: Text
- Default Value: 0x3c
- Description: The I2C address of the device

**I2C Bus**

- Type: Integer
- Default Value: 1
- Description: The I2C bus the device is connected to

**Number of Line Sets**

- Type: Integer
- Default Value: 1
- Description: How many sets of lines to cycle on the LCD

**Reset Pin**

- Type: Integer
- Default Value: 17
- Description: The pin (BCM numbering) connected to RST of the display

**CHANNEL OPTIONS**

**Line Display Type**

- Type: Select
- Description: What to display on the line

**Measurement**

- Type: Select Measurement
- Selections: Input, Math, Function, Output, PID,

- Description: Measurement to display on the line

**Measurement Max Age**

- Type: Decimal
- Default Value: 360
- Description: The maximum allowed age of the measurement

**Measurement Decimal**

- Type: Integer
- Default Value: 1
- Description: The number of digits after the decimal

**Text**

- Type: Text
- Default Value: Text
- Description: Text to display

### Equation (Multi-Measure)

This function acquires two measurements and uses them within a user-set equation and stores the resulting value as the selected measurement and unit.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Measurement A**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement to replace a

**Measurement A Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of measurement a

**Measurement B**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement to replace b

**Measurement B Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of measurement b

**Equation**

- Type: Text

- Default Value: a*(2+b)
- Description: Equation using measurements a and b

### Equation (Single-Measure)

This function acquires a measurement and uses it within a user-set equation and stores the resulting value as the selected measurement and unit.

#### OPTIONS

##### Period (seconds)

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

##### Measurement

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement to replace "x" in the equation

##### Measurement Max Age

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the measurement

##### Equation

- Type: Text
- Default Value: x*5+2
- Description: Equation using the measurement

### Humidity (Wet/Dry-Bulb)

This function calculates the humidity based on wet and dry bulb temperature measurements.

#### OPTIONS

##### Measurements Enabled

- Type: Multi-Select
- Description: The measurements to record

##### Period (seconds)

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

##### Start Offset

- Type: Integer
- Default Value: 10
- Description: The duration (seconds) to wait before the first operation

##### Dry Bulb Temperature

- Type: Select Measurement

- Selections: Input, Math, Function,
- Description: Dry Bulb temperature measurement

**Dry Bulb Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the Dry Bulb measurement

**Wet Bulb Temperature**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Wet Bulb temperature measurement

**Wet Bulb Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the Wet Bulb measurement

**Pressure**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Pressure measurement

**Pressure Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the Pressure measurement

### PID Autotune

This function will attempt to perform a PID controller autotune. That is, an output will be powered and the response measured from a sensor several times to calculate the P, I, and D gains. Updates about the operation will be sent to the Daemon log. If the autotune successfully completes, a summary will be sent to the Daemon log as well. Currently, only raising a Measurement is supported, but lowering should be possible with some modification to the function controller code. It is recommended to create a graph on a dashboard with the Measurement and Output to monitor that the Output is successfully raising the Measurement beyond the Setpoint. Note: Autotune is an experimental feature, it is not well-developed, and it has a high likelihood of failing to generate PID gains. Do not rely on it for accurately tuning your PID controller.

**OPTIONS**

**Measurement**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Select a measurement the selected output will affect

**Output**

- Description: Select an output to modulate that will affect the measurement

**Period**

- Type: Integer
- Default Value: 30

- Description: The period between powering the output

**Setpoint**

- Type: Decimal
- Default Value: 50
- Description: A value sufficiently far from the current measured value that the output is capable of pushing the measurement toward

**Noise Band**

- Type: Decimal
- Default Value: 0.5
- Description: The amount above the setpoint the measurement must reach

**Outstep**

- Type: Decimal
- Default Value: 10
- Description: How many seconds the output will turn on every Period

**Currently, only autotuning to raise a condition (measurement) is supported.**

**Direction**

- Type: Select
- Options: [**Raise**] (Default in **bold**)
- Description: The direction the Output will push the Measurement

### Redundancy

This function stores the first available measurement. This is useful if you have multiple sensors that you want to serve as backups in case one stops working, you can set them up in the order of importance. This function will check if a measurement exits, starting with the first measurement. If it doesn't, the next is checked, until a measurement is found. Once a measurement is found, it is stored in the database with the user-set measurement and unit. The output of this function can be used as an input throughout Mycodo. If you need more than 3 measurements to be checked, you can string multiple Redundancy Functions by creating a second Function and setting the first Function's output as the second Function's input.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Measurement A**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement to replace a

**Measurement A Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of measurement a

**Measurement B**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement to replace b

**Measurement B Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of measurement b

**Measurement C**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement to replace C

**Measurement C Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of measurement C

### Statistics (Last, Multiple)

This function acquires multiple measurements, calculates statistics, and stores the resulting values as the selected unit.

**OPTIONS**

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Measurement Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the measurements

**Measurement**

- Description: Measurements to perform statistics on

**Halt on Missing Measurement**

- Type: Boolean
- Description: Don't calculate statistics if >= 1 measurement is not found within Max Age

### Statistics (Past, Single)

This function acquires multiple values from a single measurement, calculates statistics, and stores the resulting values as the selected unit.

**OPTIONS**

**Measurements Enabled**

- Type: Multi-Select
- Description: The measurements to record

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Measurement Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the measurements

**Measurement**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement to perform statistics on

### Sum (Last, Multiple)

This function acquires the last measurement of those that are selected, sums them, then stores the resulting value as the selected measurement and unit.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Start Offset**

- Type: Integer
- Default Value: 10
- Description: The duration (seconds) to wait before the first operation

**Measurement Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the measurement

**Measurement**

- Description: Measurement to replace "x" in the equation

### Sum (Past, Single)

This function acquires the past measurements (within Max Age) for the selected measurement, sums them, then stores the resulting value as the selected measurement and unit.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Start Offset**

- Type: Integer
- Default Value: 10
- Description: The duration (seconds) to wait before the first operation

**Measurement**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement to replace "x" in the equation

**Measurement Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the measurement

### Vapor Pressure Deficit

This function calculates the vapor pressure deficit based on leaf temperature and humidity.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Start Offset**

- Type: Integer
- Default Value: 10
- Description: The duration (seconds) to wait before the first operation

**Temperature**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Temperature measurement

**Temperature Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the Temperature measurement

**Humidity**

- Type: Select Measurement
- Selections: Input, Math, Function,

- Description: Humidity measurement

**Humidity Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of the Humidity measurement

### Verification

This function acquires 2 measurements, calculates the difference, and if the difference is not larger than the set threshold, the Measurement A value is stored. This enables verifying one sensor's measurement with another sensor's measurement. Only when they are both in agreement is a measurement stored. This stored measurement can be used in functions such as Conditional Statements that will notify the user if no measurement is avilable to indicate there may be an issue with a sensor.

**OPTIONS**

**Period (seconds)**

- Type: Decimal
- Default Value: 60
- Description: The duration (seconds) between measurements or actions

**Measurement A**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement A

**Measurement A Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of Measurement A

**Measurement B**

- Type: Select Measurement
- Selections: Input, Math, Function,
- Description: Measurement B

**Measurement B Max Age**

- Type: Integer
- Default Value: 360
- Description: The maximum allowed age of Measurement B

**Maximum Difference**

- Type: Decimal
- Default Value: 10.0
- Description: The maximum allowed difference between the measurements

# 5.5 Supported Widgets

Supported Widget devices are listed below.

## 5.5.1 Built-In Widgets

**Camera**

Displays a camera image or stream.

**Function Status**

Displays the status of a Function (if supported).

**Gauge (Angular)**

Displays an angular gauge. Be sure to set the Maximum option to the last Stop High value for the gauge to display properly.

**Gauge (Solid)**

Displays a solid gauge. Be sure to set the Maximum option to the last Stop value for the gauge to display properly.

**Graph (Synchronous)**

Displays a synchronous graph (all data is downloaded for the selected period on the x-axis).

**Indicator**

Displays a red or green circular image based on a measurement value. Useful for showing if an Output is on or off.

**Measurement**

Displays a measurement value and timestamp.

**Output**

Displays and allows control of an output.

**Output (PWM Slider)**

Displays and allows control of a PWM output using a slider.

**PID Controller**

Displays and allows control of a PID Controller.

**Python Code**

Executes Python code and displays the output within the widget.

**Spacer**

A simple widget to use as a spacer, which includes the ability to set text in its contents.

## 5.6 I2C Multiplexers

All devices that connected to the Raspberry Pi by the I2C bus need to have a unique address in order to communicate. Some inputs may have the same address (such as the AM2315), which prevents more than one from being connected at the same time. Others may provide the ability to change the address, however the address range may be limited, which limits by how many you can use at the same time. I2C multiplexers are extremely clever and useful in these scenarios because they allow multiple sensors with the same I2C address to be connected.

For instance, the TCA9548A/PCA9548A: I2C Multiplexer has 8 selectable addresses, so 8 multiplexers can be connected to one Raspberry Pi. Each multiplexer has 8 channels, allowing up to 8 devices/sensors with the same address to be connected to each multiplexer. 8 multiplexers x 8 channels = 64 devices/sensors with the same I2C address.

Multiplexers can be set up by loading a kernel driver to handle the communication, producing a new I2C bus device for each multiplexer channel. To enable the driver for the TCA9548A/PCA9548A, visit GPIO-pca9548 to get the code and latest install instructions. If successfully set up, there will be 8 new I2C buses on the `[Gear Icon] -> System Information` page.

The driver for the TCA9545A can be found at https://github.com/camrex/i2c-mux-pca9545a and other drivers are available elsewhere. See the manufacturer or user forums for details. Some multiplexers I've tested are below.

- TCA9548A/PCA9548A: I2C Multiplexer link (I2C): 8 selectable addresses, 8 channels
- TCA9545A: I2C Bus Multiplexer link (I2C): The linked Grove board creates 4 new I2C buses, each with their own selectable voltage, either 3.3 or 5.0 volts.

## 5.7 Analog-To-Digital Converters

An analog-to-digital converter (ADC) allows the measurement of an analog voltage.

> **Note**
>
> A voltage divider may be necessary to convert your source voltage to an acceptable range for the ADC.

- ADS1x15: Analog-to-digital converter link
- ADS1256: Analog-to-digital converter link
- MCP3008: Analog-to-digital converter link
- MCP342x: Analog-to-digital converter link

# 5.8 Interfaces

## 5.8.1 I2C Information

The I2C interface should be enabled with `raspi-config` or from the `[Gear Icon] -> Configure -> Raspberry Pi` page.

## 5.8.2 1-Wire Information

The 1-Wire interface should be enabled with `raspi-config` or from the `[Gear Icon] -> Configure -> Raspberry Pi` page.

## 5.8.3 UART Information

This documentation provides specific installation procedures for configuring UART with the Raspberry Pi version 1 or 2.

Because the UART is handled differently higher after the Raspberry Pi 2 (due to the addition of bluetooth), there are a different set of instructions. If installing Mycodo on a Raspberry Pi 3 or above, you only need to perform these steps to configure UART:

Run raspi-config

```
sudo raspi-config
```

Go to `Advanced Options -> Serial` and disable. Then edit `/boot/config.txt`

```
sudo nano /boot/config.txt
```

Find the line "enable_uart=0" and change it to "enable_uart=1", then reboot.

## 5.9 Dependencies

Page: `[Gear Icon] -> Dependencies`

The dependency page allows viewing of dependency information and the ability to initiate their installation.

# 5.10 Device Notes

This information may not be current, so always reference and follow manufacturer recommendations for operating their devices.

## 5.10.1 Edge Detection

The detection of a changing signal, for instance a simple switch completing a circuit, requires the use of edge detection. By detecting a rising edge (LOW to HIGH), a falling edge (HIGH to LOW), or both, actions or events can be triggered. The GPIO chosen to detect the signal should be equipped with an appropriate resistor that either pulls the GPIO up [to 5-volts] or down [to ground]. The option to enable the internal pull-up or pull-down resistors is not available for safety reasons. Use your own resistor to pull the GPIO high or low.

Examples of devices that can be used with edge detection: simple switches and buttons, PIR motion sensors, reed switches, hall effect sensors, float switches, and more.

## 5.10.2 LCD Displays

There are only a few number fo LCDs that are supported. 16x2 and 20x4 character LCD displays with I2C backpacks and the 128x32 / 128x64 OLED displays are supported. The below image is the type of device with the I2C backpack that should be compatible.


## 5.10.3 Raspberry Pi

The Raspberry Pi has an integrated temperature sensor on the BCM2835 SoC that measure the temperature of the CPU/GPU. This is the easiest sensor to set up in Mycodo, as it is immediately available to be used.

### 5.10.4 AM2315

From @Theoi-Meteoroi on GitHub:

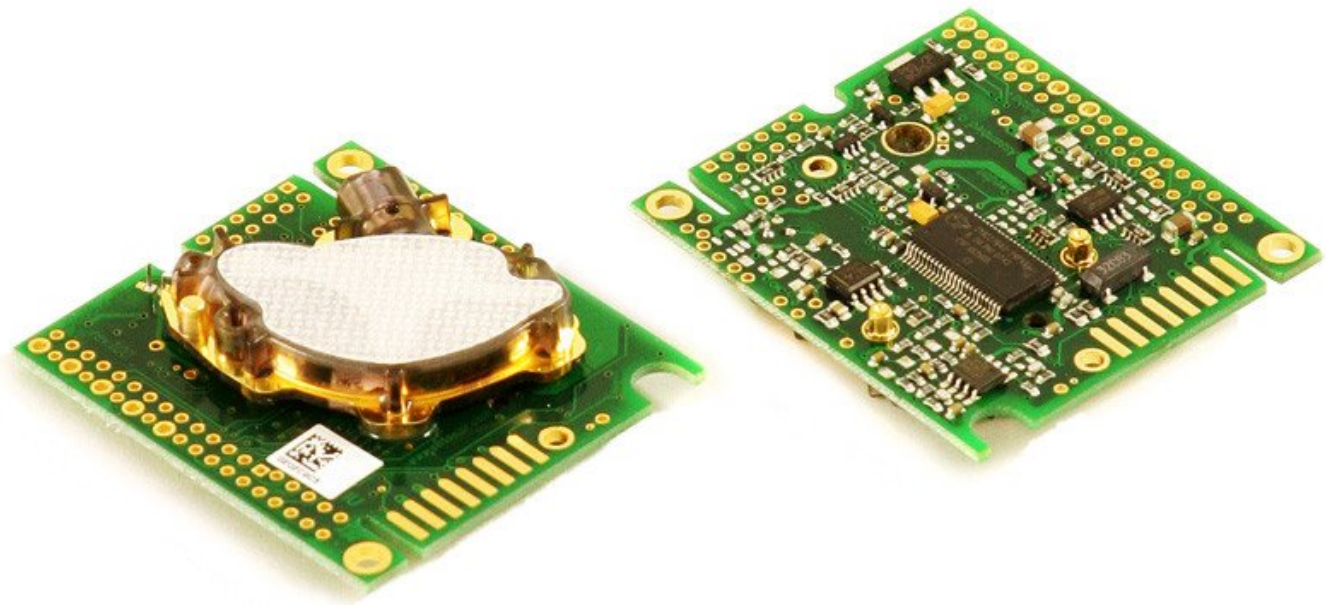
I figured out why this [AM2315] sensor is unreliable with Rpi3 hardware I2C. It is among a number of I2C devices that really hates the BCM2835 clock stretching blunder (hardware bug: raspberrypi/linux#254). The wakeup attempts fail, consistently. I checked the bitstream with a sniffer, and see that the sensor may respond once out of 20 or so tries (or not at all) but only with a single byte returned. The solution is to use a software implementation of the I2C bus. You need to add pull-up resistors (4.7k is dandy) to 3.3v and install the i2c_gpio device overlay. Seems to work fine now, will run for a few days, but the CRC failures are gone and I get good readings, every time. And no twiddling the power for the sensor is required.

To enable software I2C, add the following line to your `/boot/config.txt`

```
dtoverlay=i2c-gpio,i2c_gpio_sda=23,i2c_gpio_scl=24,i2c_gpio_delay_us=4
```

After rebooting, a new I2C bus at /dev/i2c-3 should exist with SDA on pin 23 (BCM) and SCL on pin 24 (BCM). Make sure you add the appropriate pull-up resistors before connecting any devices.

### 5.10.5 K-30



Be very careful when connecting the K-30, as there is no reverse-voltage protection and improper connections could destroy your sensor.

Wiring instructions for the Raspberry Pi can be found here.

### 5.10.6 USB Device Persistence Across Reboots

From (#547) Theoi-Meteoroi on Github:

Using USB devices, such as USB-to-serial interfaces (CP210x) to connect a sensor, while convenient, poses an issue if there are multiple devices when the system reboots. After a reboot, there is no guarantee the device will persist with the same name. For instance, if Sensor A is /dev/ttyUSB0 and Sensor B is /dev/ttyUSB1, after a reboot Sensor A may be /dev/ttyUSB1 and Sensor B may be /dev/ttyUSB0. This will cause Mycodo to query the wrong device for a measurement, potentially causing a mis-measurement, or worse, an incorrect measurement because the response is not from the correct sensor (I've seen my temperature sensor read 700+ degrees celsius because of this!). Follow the instructions below to alleviate this issue.

I use udev to create a persistent device name ('/dev/dust-sensor') that will be linked to the /dev/ttyUSBn that is chosen at device arrival in the kernel. The only requirement is some attribute returned from the USB device that is unique. The common

circumstance is that none of the attributes are unique and you get stuck with just VID and PID, which is ok as long as you don't have any other adapters that report the same VID and PID. If you have multiple adapters with the same VID and PID, then hopefully they have some unique attribute. This command will walk the attributes. Run on each USB device and then compare differences to possibly find some attribute to use.

`udevadm info --name=/dev/ttyUSB0 --attribute-walk`

I ended up using the serial number on the ZH03B to program the USB adapter serial field. This way guarantees unique serial numbers rather than me trying to remember what was the last serial number I used to increment by 1.

When you plug a USB device in it can be enumerated to different device names by the operating system. To fix this problem for this sensor on linux, I changed attributes that make the connection unique.

First - find the VID and PID for the USB device:

```
pi@raspberry:~ $ lsusb
Bus 001 Device 008: ID 10c4:ea60 Cygnal Integrated Products, Inc. CP210x UART Bridge / myAVR mySmartUSB light
Bus 001 Device 003: ID 0424:ec00 Standard Microsystems Corp. SMSC9512/9514 Fast Ethernet Adapter
Bus 001 Device 002: ID 0424:9514 Standard Microsystems Corp. SMC9514 Hub
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
```

In this case the Vendor ID is 10c4 The Product ID is ea60

> **Note**
>
> If you have multiple devices and you find your IDs to be the same, you can change IDs with the Simplicity Studio Xpress Configurator tool (discussed starting on page 6 of the AN721: USBXpress Device Configuration and Programming Guide).

Since I changed the serial number field - this will be unique.

```
pi@raspberry:~ $ udevadm info --name=/dev/ttyUSB0 --attribute-walk | grep serial
SUBSYSTEMS=="usb-serial"
ATTRS{serial}=="ZH03B180904"
ATTRS{serial}=="3f980000.usb"
```

Now I have an attribute to tell udev what to do. I create a file in /etc/udev/rules.d with a name like "99-dustsensor.rules". In that file I tell udev what device name to create when it sees this device plugged in:

`SUBSYSTEM=="tty", ATTRS{idVendor}=="10c4", ATTRS{idProduct}=="ea60", ATTRS{serial}=="ZH03B180904" SYMLINK+="dust-sensor"`

To test the new rule:

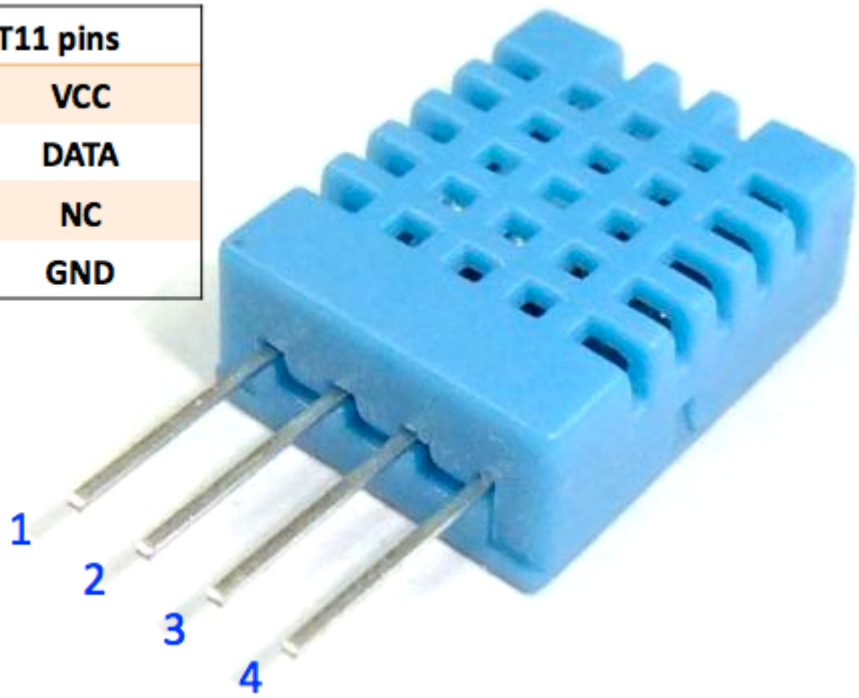
```
pi@raspberry:/dev $ sudo udevadm trigger
pi@raspberry:/dev $ ls -al dust-sensor
lrwxrwxrwx 1 root root 7 Oct 6 21:04 dust-sensor -> ttyUSB0
```

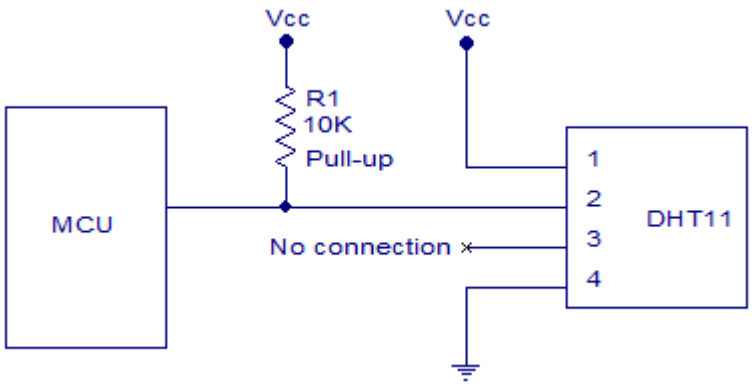
Now, every time the dust sensor is plugged in, it shows up at /dev/dust-sensor

## 5.10.7 Diagrams

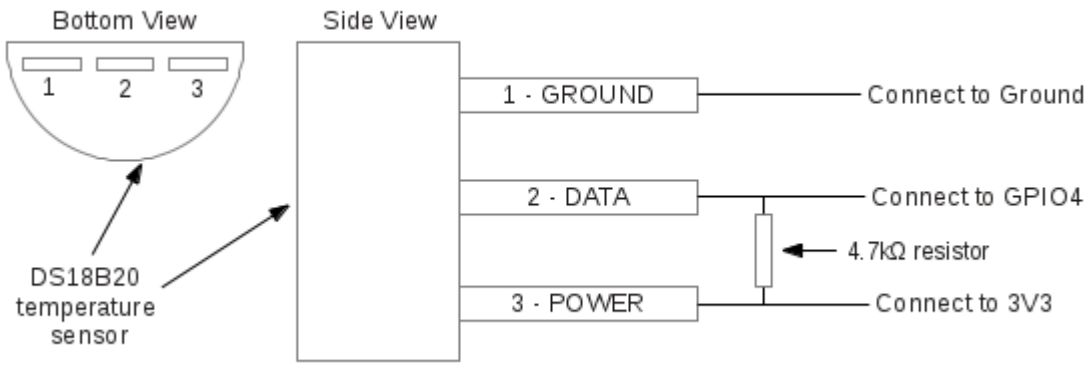
**DHT11 Diagrams**

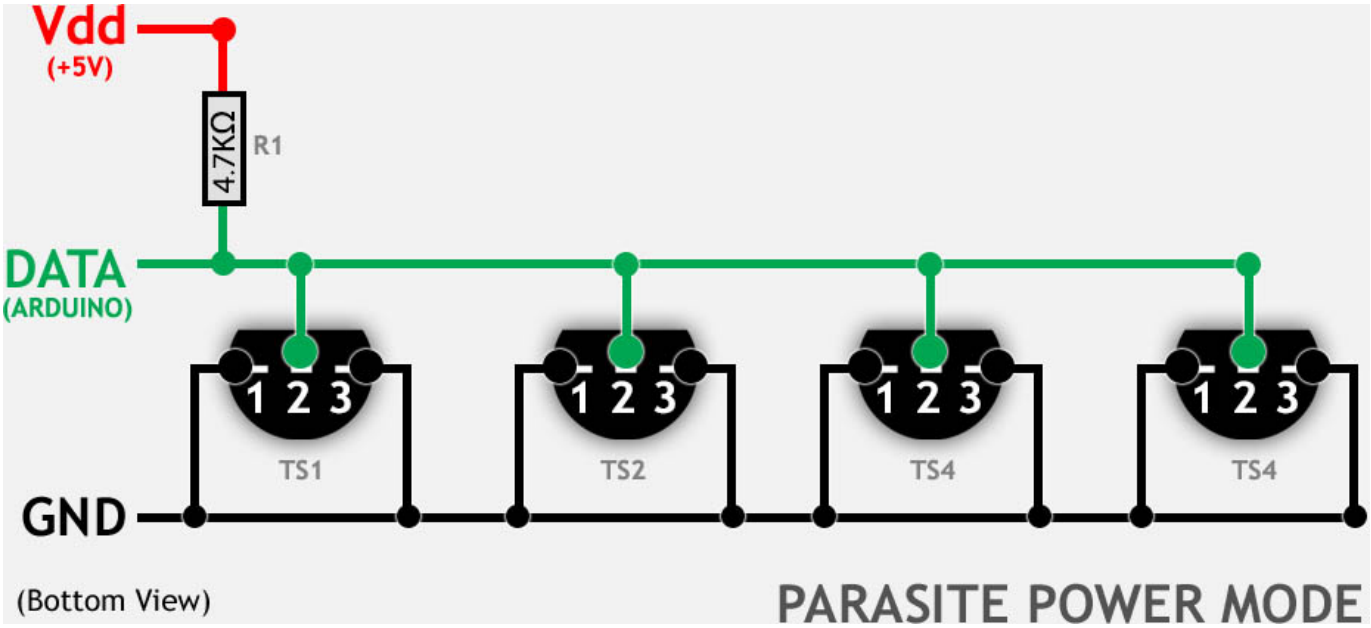
| DHT11 pins | |
|---|---|
| 1 | VCC |
| 2 | DATA |
| 3 | NC |
| 4 | GND |

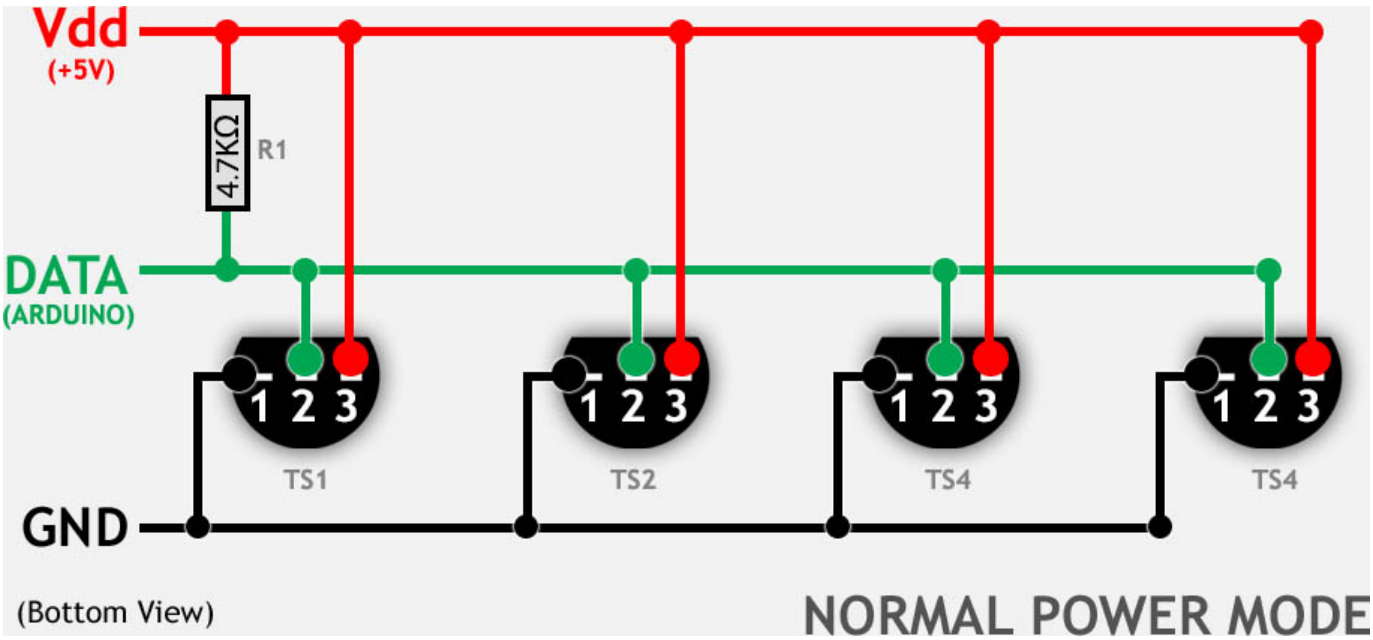



**DS18B20 Diagrams**

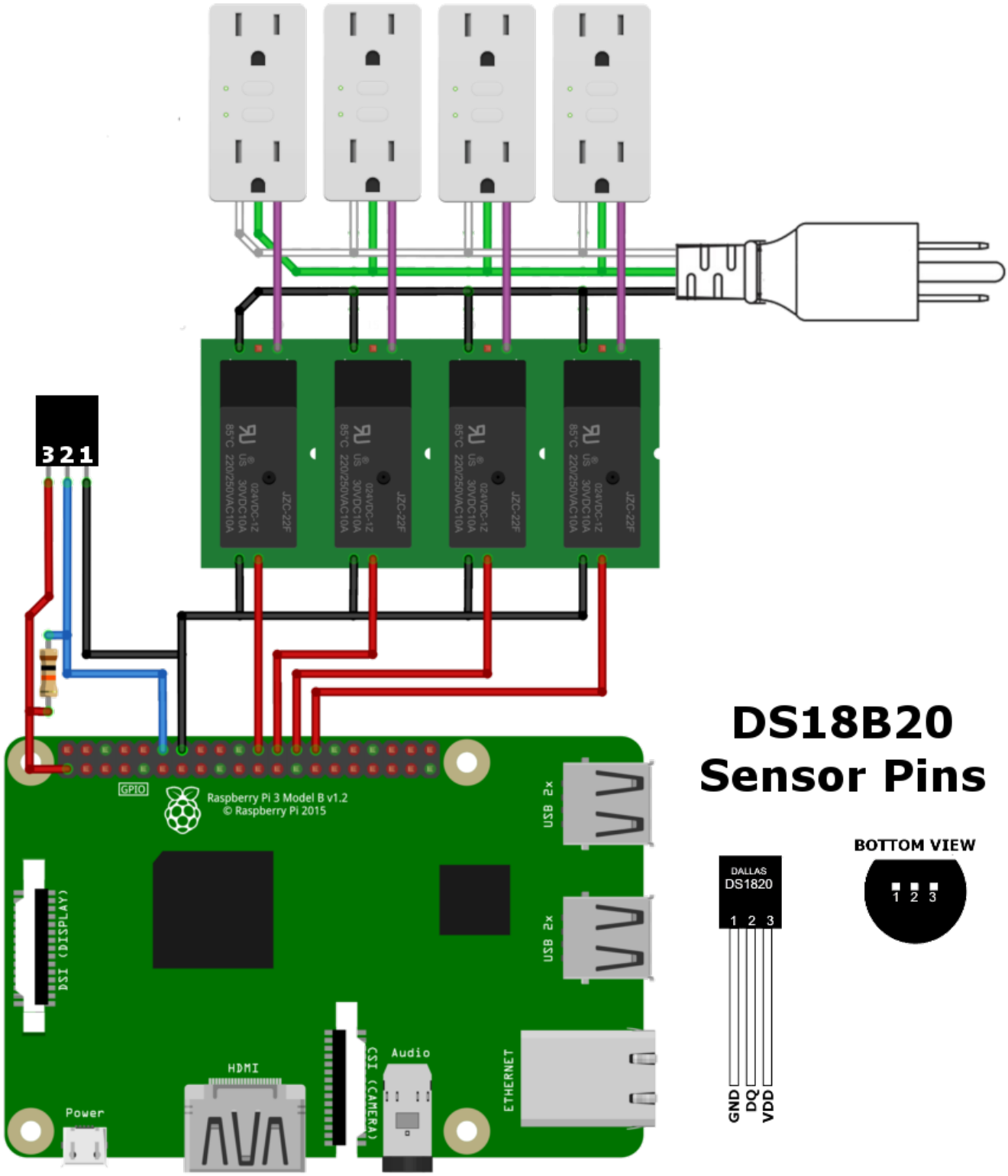




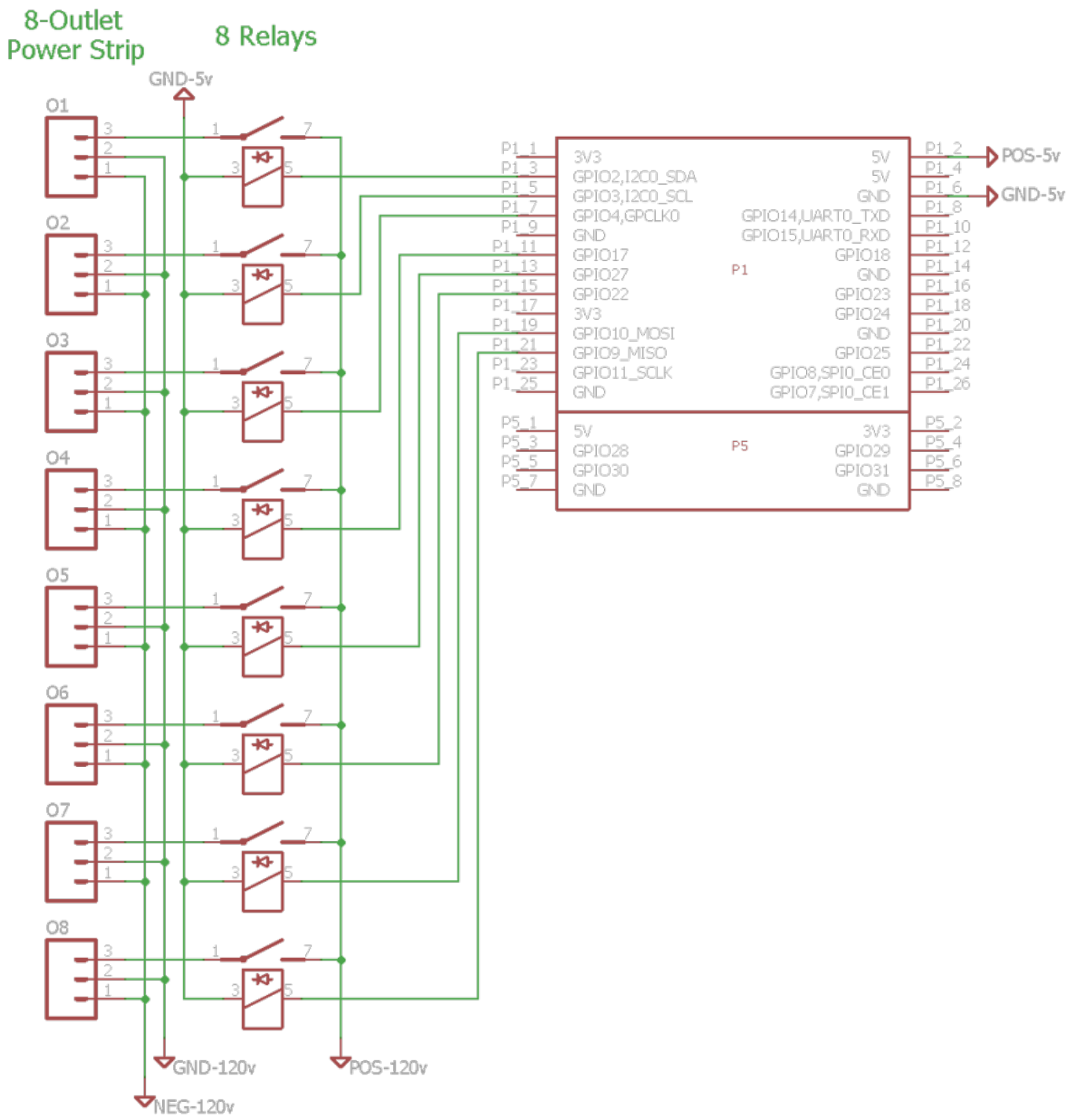



## Raspberry Pi and Relay Diagrams

### RASPBERRY PI, 4 RELAYS, 4 OUTLETS, 1 DS18B20 SENSOR



**RASPBERRY PI, 8 RELAYS, 8 OUTLETS**



# 6. System

## 6.1 System Information

Page: `[Gear Icon] -> System Information`

This page serves to provide information about the Mycodo frontend and backend as well as the linux system it's running on. Several commands and their output are listed to give the user information about how their system is running.

| Command | Description |
| --- | --- |
| Mycodo Version | The current version of Mycodo, reported by the configuration file. |
| Python Version | The version of python currently running the web user interface. |
| Database Version | The current version of the settings database. If the current version is different from what it should be, an error will appear indicating the issue and a link to find out more information about the issue. |
| Daemon Status | This will be a green "Running" or a red "Stopped". Additionally, the Mycodo version and hostname text at the top-left of the screen May be Green, Yellow, or Red to indicate the status. Green = daemon running, yellow = unable to connect, and red = daemon not running. |
| ... | Several other status indicators and commands are listed to provide information about the health of the system. Use these in addition to others to investigate software or hardware issues. |

# 6.2 System Configuration

Page: `[Gear Icon] -> Configure`

The settings menu, accessed by selecting the gear icon in the top-right, then the Configure link, is a general area for various system-wide configuration options.

## 6.2.1 General Settings

Page: `[Gear Icon] -> Configure -> General`

| Setting | Description |
|---|---|
| Language | Set the language that will be displayed in the web user interface. |
| Force HTTPS | Require web browsers to use SSL/HTTPS. Any request to http:// will be redirected to https://. |
| Hide success alerts | Hide all success alert boxes that appear at the top of the page. |
| Hide info alerts | Hide all info alert boxes that appear at the top of the page. |
| Hide warning alerts | Hide all warning alert boxes that appear at the top of the page. |
| Opt-out of statistics | Turn off sending anonymous usage statistics. Please consider that this helps the development to leave on. |
| Check for Updates | Automatically check for updates every 2 days and notify through the web interface. If there is a new update, the Configure (Gear Icon) as well as the Upgrade menu will turn the color red. |

## 6.2.2 Energy Usage Settings

Page: `[Gear Icon] -> Configure -> General`

In order to calculate accurate energy usage statistics, a few characteristics of your electrical system needs to be know. These variables should describe the characteristics of the electrical system being used by the relays to operate electrical devices.

> **Note**
>
> If not using a current sensor, proper energy usage calculations will rely on the correct current draw to be set for each output (see Output Settings).

| Setting | Description |
|---|---|
| Max Amps | Set the maximum allowed amperage to be switched on at any given time. If a output that's instructed to turn on will cause the sum of active devices to exceed this amount, the output will not be allowed to turn on, to prevent any damage that may result from exceeding current limits. |
| Voltage | Alternating current (AC) voltage that is switched by the outputs. This is usually 120 or 240. |
| Cost per kWh | This is how much you pay per kWh. |
| Currency Unit | This is the unit used for the currency that pays for electricity. |
| Day of Month | This is the day of the month (1-30) that the electricity meter is read (which will correspond to the electrical bill). |
| Generate Usage/Cost Report | These options define when an Energy Usage Report will be generated. Currently these Only support the Output Duration calculation method. For more information about the methods, see Energy Usage. |

## 6.2.3 Controller Settings

Page: `[Gear Icon] -> Configure -> Custom Functions`

Controller modules may be imported and used within Mycodo. These modules must follow a specific format. See Custom Functions for more details.

## 6.2.4 Input Settings

Page: `[Gear Icon] -> Configure -> Custom Inputs`

Input modules may be imported and used within Mycodo. These modules must follow a specific format. See Custom Inputs for more details.

| Setting | Description |
|---|---|
| Import Input Module | Select your input module file, then click this button to begin the import. |

## 6.2.5 Output Settings

Page: `[Gear Icon] -> Configure -> Custom Outputs`

Output modules may be imported and used within Mycodo. These modules must follow a specific format. See Custom Outputs for more details.

| Setting | Description |
|---|---|
| Import Output Module | Select your output module file, then click this button to begin the import. |

## 6.2.6 Measurement Settings

Page: `[Gear Icon] -> Configure -> Measurements`

New measurements, units, and conversions can be created that can extend functionality of Mycodo beyond the built-in types and equations. Be sure to create units before measurements, as units need to be selected when creating a measurement. A measurement can be created that already exists, allowing additional units to be added to a pre-existing measurement. For

example, the measurement 'altitude' already exists, however if you wanted to add the unit 'fathom', first create the unit 'fathom', then create the measurement 'altitude' with the 'fathom' unit selected. It is okay to create a custom measurement for a measurement that already exist (this is how new units for a currently-installed measurement is added).

| Setting | Description |
|---|---|
| Measurement ID | ID for the measurement to use in the measurements_dict of input modules (e.g. "length", "width", "speed"). |
| Measurement Name | Common name for the measurement (e.g. "Length", "Weight", "Speed"). |
| Measurement Units | Select all the units that are associated with the measurement. |
| Unit ID | ID for the unit to use in the measurements_dict of input modules (e.g. "K", "g", "m"). |
| Unit Name | Common name for the unit (e.g. "Kilogram", "Meter"). |
| Unit Abbreviation | Abbreviation for the unit (e.g. "kg", "m"). |
| Convert From Unit | The unit that will be converted from. |
| Convert To Unit | The unit that will be converted to. |
| Equation | The equation used to convert one unit to another. The lowercase letter "x" must be included in the equation (e.g. "x/1000+20", "250*(x/3)"). This "x" will be replaced with the actual measurement being converted. |

## 6.2.7 Users

Page: `[Gear Icon] -> Configure -> Users`

Mycodo requires at least one Admin user for the login system to be enabled. If there isn't an Admin user, the web server will redirect to an Admin Creation Form. This is the first page you see when starting Mycodo for the first time. After an Admin user has been created, additional users may be created from the User Settings page.

| Setting | Description |
|---|---|
| Username | Choose a user name that is between 2 and 64 characters. The user name is case insensitive (all user names are converted to lower-case). |
| Email | The email associated with the new account. |
| Password/ Repeat | Choose a password that is between 6 and 64 characters and only contains letters, numbers, and symbols. |
| Keypad Code | Set an optional numeric code that is at least 4 digits for logging in using a keypad. |
| Role | Roles are a way of imposing access restrictions on users, to either allow or deny actions. See the table below for explanations of the four default Roles. |
| Theme | The web user interface theme to apply, including colors, themes, and other design elements. |

**Roles**

Roles define the permissions of each user. There are 4 default roles that determine if a user can view or edit particular areas of Mycodo. Four roles are provided by default, but custom roles may be created.

| Role | Admin | Editor | Monitor | Guest |
|---|---|---|---|---|
| Edit Users | X | | | |
| Edit Controllers | X | X | | |
| Edit Settings | X | X | | |
| View Settings | X | X | X | |
| View Camera | X | X | X | |
| View Stats | X | X | X | |
| View Logs | X | X | X | |

The `Edit Controllers` permission protects the editing of Conditionals, Graphs, LCDs, Methods, PIDs, Outputs, and Inputs.

The `View Stats` permission protects the viewing of usage statistics and the System Information and Energy Usage pages.

## 6.2.8 Pi Settings

Page: `[Gear Icon] -> Configure -> Raspberry Pi`

Pi settings configure parts of the linux system that Mycodo runs on.

pigpiod is required if you wish to use PWM Outputs, as well as PWM, RPM, DHT22, DHT11, HTU21D Inputs.

| Setting | Description |
|---|---|
| Enable/ Disable Feature | These are system interfaces that can be enabled and disabled from the web UI via the `raspi-config` command. |
| pigpiod Sample Rate | This is the sample rate the pigpiod service will operate at. The lower number enables faster PWM frequencies, but may significantly increase processor load on the Pi Zeros. pigpiod may als be disabled completely if it's not required (see note, above). |

## 6.2.9 Alert Settings

Page: `[Gear Icon] -> Configure -> Alerts`

Alert settings set up the credentials for sending email notifications.

| Setting | Description |
|---|---|
| SMTP Host | The SMTP server to use to send emails from. |
| SMTP Port | Port to communicate with the SMTP server (465 for SSL, 587 for TSL). |
| Enable SSL | Check to enable SSL, uncheck to enable TSL. |
| SMTP User | The user name to send the email from. This can be just a name or the entire email address. |
| SMTP Password | The password for the user. |
| From Email | What the from email address be set as. This should be the actual email address for this user. |
| Max emails (per hour) | Set the maximum number of emails that can be sent per hour. If more notifications are triggered within the hour and this number has been reached, the notifications will be discarded. |
| Send Test Email | Test the email configuration by sending a test email. |

## 6.2.10 Camera Settings

Page: `[Gear Icon] -> Configure -> Camera`

Many cameras can be used simultaneously with Mycodo. Each camera needs to be set up in the camera settings, then may be used throughout the software.

> **Note**
>
> Not every option (such as Hue or White Balance) may be able to be used with your particular camera, due to manufacturer differences in hardware and software.

| Setting | Description |
|---|---|
| Type | Select whether the camera is a Raspberry Pi Camera or a USB camera. |
| Library | Select which library to use to communicate with the camera. The Raspberry Pi Camera uses picamera, and USB cameras should be set to fswebcam. |
| Device | The device to use to connect to the camera. fswebcam is the only library that uses this option. |
| Output | This output will turn on during the capture of any still image (which includes timelapses). |
| Output Duration | Turn output on for this duration of time before the image is captured. |
| Rotate Image | The number of degrees to rotate the image. |
| ... | Image Width, Image Height, Brightness, Contrast, Exposure, Gain, Hue, Saturation, White Balance. These options are self-explanatory. Not all options will work with all cameras. |
| Pre Command | A command to execute (as user 'root') before a still image is captured. |
| Post Command | A command to execute (as user 'root') after a still image is captured. |
| Flip horizontally | Flip, or mirror, the image horizontally. |
| Flip vertically | Flip, or mirror, the image vertically. |

## 6.2.11 Diagnostic Settings

Page: `[Gear Icon] -> Configure -> Diagnostics`

Sometimes issues arise in the system as a result of incompatible configurations, either the result of a misconfigured part of the system (Input, Output, etc.) or an update that didn't properly handle a database upgrade, or other unforeseen issue. Sometimes it is necessary to perform diagnostic actions that can determine the cause of the issue or fix the issue itself. The options below are meant to alleviate issues, such as a misconfigured dashboard element causing an error on the `Data -> Dashboard` page, which may cause an inability to access the `Data -> Dashboard` page to correct the issue. Deleting all Dashboard Elements may be the most economical method to enable access to the `Data -> Dashboard` page again, at the cost of having to readd all the Dashboard Elements that were once there.

| Setting | Description |
| --- | --- |
| Delete All Dashboard Elements | Delete all saved Dashboard Elements from the Dashboard. |
| Delete All Notes and Note Tags | Delete all notes and note tags. |

# 6.3 Upgrade/Backup/Restore

## 6.3.1 Upgrading

Page: `[Gear Icon] -> Upgrade`

If you already have Mycodo installed, you can perform an upgrade to the latest Mycodo Release by either using the Upgrade option in the web interface (recommended) or by issuing the following command in a terminal. A log of the upgrade process is created at `/var/log/mycodo/mycodoupgrade.log` and is also available from the `[Gear Icon] -> Mycodo Logs` page.

```
sudo mycodo-commands upgrade-mycodo
```

## 6.3.2 Backup-Restore

Page: `[Gear Icon] -> Backup Restore`

A backup is made to /var/Mycodo-backups when the system is upgraded or instructed to do so from the web interface on the `[Gear Icon] -> Backup Restore` page.

If you need to restore a backup, this can be done on the `[Gear Icon] -> Backup Restore` page (recommended). Find the backup you would like restored and press the Restore button beside it. If you're unable to access the web interface, a restore can also be initialized through the command line. Use the following command to initialize a restore. The [backup_location] must be the full path to the backup to be restored (e.g. "/var/Mycodo-backups/Mycodo-backup-2018-03-11_21-19-15-5.6.4/" without quotes).

```
sudo mycodo-commands backup-restore [backup_location]
```

## 6.4 Export/Import

Page: `More -> Export Import`

Measurements that fall within the selected date/time frame may be exported as CSV with their corresponding timestamps.

Additionally, the entire measurement database (influxdb) may be exported as a ZIP archive backup. This ZIP may be imported back in any Mycodo system to restore these measurements.

> **Note**
>
> Measurements are associated with specific IDs that correspond to the Inputs/Outputs/etc. of your specific system. If you import measurements without also importing the associated Inputs/Outputs/etc., you will not see these measurements (e.g. on Dashboard Graphs). Therefore, it is recommended to export both Measurements and Settings at the same time so when you import them at a later time, you will have the devices associated with the measurements available on the system you're importing to.

> **Note**
>
> Importing measurement data will not destroy old data and will be added to the current measurement data.

Mycodo settings may be exported as a ZIP file containing the Mycodo settings database (sqlite) and any custom Inputs, Outputs, Functions, and Widgets. This ZIP file may be used to restore these to another Mycodo install, as long as the Mycodo and database versions being imported are equal or less than the system you are installing them to. Additionally, you can only import to a system with the same major version number (the first number in the version format x.x.x). For instance, you can export settings from Mycodo 8.5.0 and import them into Mycodo 8.8.0, however you can not import them into Mycodo 8.2.0 (earlier version with same major version number), 7.0.0 (not the same major version number), or 9.0.0 (not the same major version number).

> **Warning**
>
> An import will override the current settings and custom controller data (i.e. destroying it). It is advised to make a Mycodo backup prior to attempting an import.

## 6.5 Mycodo Client

The Mycodo client is a command-line tool used to communicate with the daemon.

```
pi@raspberry:~ $ mycodo-client --help
usage: mycodo-client [-h] [-c] [--activatecontroller CONTROLLER ID]
                     [--deactivatecontroller CONTROLLER ID] [--ramuse] [-t]
                     [--trigger_action ACTIONID]
                     [--trigger_all_actions FUNCTIONID]
                     [--input_force_measurements INPUTID]
                     [--lcd_backlight_on LCDID] [--lcd_backlight_off LCDID]
                     [--lcd_reset LCDID] [--get_measurement ID UNIT CHANNEL]
                     [--output_state OUTPUTID]
                     [--output_currently_on OUTPUTID] [--outputoff OUTPUTID]
                     [--outputon OUTPUTID] [--duration SECONDS]
                     [--dutycycle DUTYCYCLE] [--pid_pause ID] [--pid_hold ID]
                     [--pid_resume ID] [--pid_get_setpoint ID]
                     [--pid_get_error ID] [--pid_get_integrator ID]
                     [--pid_get_derivator ID] [--pid_get_kp ID]
                     [--pid_get_ki ID] [--pid_get_kd ID]
                     [--pid_set_setpoint ID SETPOINT]
                     [--pid_set_integrator ID INTEGRATOR]
                     [--pid_set_derivator ID DERIVATOR] [--pid_set_kp ID KP]
                     [--pid_set_ki ID KI] [--pid_set_kd ID KD]

Client for Mycodo daemon.

optional arguments:
  -h, --help            show this help message and exit
  -c, --checkdaemon     Check if all active daemon controllers are running
  --activatecontroller CONTROLLER ID
                        Activate controller. Options: Conditional, LCD, Math,
                        PID, Input
  --deactivatecontroller CONTROLLER ID
                        Deactivate controller. Options: Conditional, LCD,
                        Math, PID, Input
  --ramuse              Return the amount of ram used by the Mycodo daemon
  -t, --terminate       Terminate the daemon
  --trigger_action ACTIONID
                        Trigger action with Action ID
  --trigger_all_actions FUNCTIONID
                        Trigger all actions belonging to Function with ID
  --input_force_measurements INPUTID
                        Force acquiring measurements for Input ID
  --lcd_backlight_on LCDID
                        Turn on LCD backlight with LCD ID
  --lcd_backlight_off LCDID
                        Turn off LCD backlight with LCD ID
  --lcd_reset LCDID     Reset LCD with LCD ID
  --get_measurement ID UNIT CHANNEL
                        Get the last measurement
  --output_state OUTPUTID
                        State of output with output ID
  --output_currently_on OUTPUTID
                        How many seconds an output has currently been active
                        for
  --outputoff OUTPUTID  Turn off output with output ID
  --outputon OUTPUTID   Turn on output with output ID
  --duration SECONDS    Turn on output for a duration of time (seconds)
  --dutycycle DUTYCYCLE
                        Turn on PWM output for a duty cycle (%)
  --pid_pause ID        Pause PID controller.
  --pid_hold ID         Hold PID controller.
  --pid_resume ID       Resume PID controller.
  --pid_get_setpoint ID
                        Get the setpoint value of the PID controller.
  --pid_get_error ID    Get the error value of the PID controller.
  --pid_get_integrator ID
                        Get the integrator value of the PID controller.
  --pid_get_derivator ID
                        Get the derivator value of the PID controller.
  --pid_get_kp ID       Get the Kp gain of the PID controller.
  --pid_get_ki ID       Get the Ki gain of the PID controller.
  --pid_get_kd ID       Get the Kd gain of the PID controller.
  --pid_set_setpoint ID SETPOINT
                        Set the setpoint value of the PID controller.
  --pid_set_integrator ID INTEGRATOR
                        Set the integrator value of the PID controller.
  --pid_set_derivator ID DERIVATOR
                        Set the derivator value of the PID controller.
  --pid_set_kp ID KP    Set the Kp gain of the PID controller.
  --pid_set_ki ID KI    Set the Ki gain of the PID controller.
  --pid_set_kd ID KD    Set the Kd gain of the PID controller.
```

# 6.6 API

## 6.6.1 REST API

As of version 8, Mycodo has a REST API (See API Endpoint Documentation).

An API is an application programming interface - in short, it's a set of rules that lets programs talk to each other, exposing data and functionality across the internet in a consistent format.

REST stands for Representational State Transfer. This is an architectural pattern that describes how distributed systems can expose a consistent interface. When people use the term 'REST API,' they are generally referring to an API accessed via HTTP protocol at a predefined set of URLs. These URLs represent various resources - any information or content accessed at that location, which can be returned as JSON, HTML, audio files, or images. Often, resources have one or more methods that can be performed on them over HTTP, like GET, POST, PUT and DELETE.

### Authentication

An API Key can be generated from the User Settings page ( `[Gear Icon] -> Configure -> Users` ). This is stored as a 128-bit bytes object in the database, but will be presented to the user as a base64-encoded string. This can be used to access HTTPS endpoints.

Mycodo supports several authentication methods. All API requests must be made over HTTPS. Calls made over plain HTTP will fail. API requests without authentication will fail.

### Bash Examples

`curl` can be used, but you must either use `-k` to allow the use of an unsigned SSL certificate, or use your own certificate and domain.

```
curl -k -v -X GET "https://127.0.0.1/api/settings/users" -H "authorization: Basic 0scjVcxRGi0XczregANBRXG3VMMro+oolPYdauadLblaNThd79bzFPITJjYneU1yK/
Ikc9ahHXmll9JiKZO9+hogKoIp2Q8a2cMFBGevgJSd5jYVYz5D83dFE5+OBvvKKaN1U5TvPOXXcj3lkjvPzgxOnEF0CZUsKfU3MA3cFEs=" -H "accept: application/vnd.mycodo.v1+json"
```

```
curl -k -v -x GET "https://127.0.0.1/api/settings/users -H "X-API-KEY: 0scjVcxRGi0XczregANBRXG3VMMro+oolPYdauadLblaNThd79bzFPITJjYneU1yK/
Ikc9ahHXmll9JiKZO9+hogKoIp2Q8a2cMFBGevgJSd5jYVYz5D83dFE5+OBvvKKaN1U5TvPOXXcj3lkjvPzgxOnEF0CZUsKfU3MA3cFEs=" -H "accept: application/vnd.mycodo.v1+json"
```

```
curl -k -v -x GET "https://127.0.0.1/api/settings/users?api_key=0scjVcxRGi0XczregANBRXG3VMMro+oolPYdauadLblaNThd79bzFPITJjYneU1yK/
Ikc9ahHXmll9JiKZO9+hogKoIp2Q8a2cMFBGevgJSd5jYVYz5D83dFE5+OBvvKKaN1U5TvPOXXcj3lkjvPzgxOnEF0CZUsKfU3MA3cFEs=" -H "accept: application/vnd.mycodo.v1+json"
```

### Python Example (GET)

```
import json
import requests

ip_address = '127.0.0.1'
api_key = 'YOUR_API_KEY'
endpoint = 'settings/inputs'
url = 'https://{ip}/api/{ep}'.format(ip=ip_address, ep=endpoint)
headers = {'Accept': 'application/vnd.mycodo.v1+json',
           'X-API-KEY': api_key}
response = requests.get(url, headers=headers, verify=False)
print("Response Status: {}".format(response.status_code))
print("Response Headers: {}".format(response.headers))
response_dict = json.loads(response.text)
print("Response Dictionary: {}".format(response_dict))
```

### Python Example (POST)

```
import json
import requests
import urllib3

urllib3.disable_warnings(urllib3.exceptions.InsecureRequestWarning)

ip_address = '127.0.0.1'
api_key = 'YOUR_API_KEY'
endpoint = 'outputs/3f5a4806-c830-432d-b329-7821da8336e4'
```

```
url = 'https://{ip}/api/{ep}'.format(ip=ip_address, ep=endpoint)
data = {"state": True}  # Turn Output On
headers = {'Accept': 'application/vnd.mycodo.v1+json',
           'X-API-KEY': api_key}
response = requests.post(url, json=data, headers=headers, verify=False)
print("Response Status: {}".format(response.status_code))
print("Response Headers: {}".format(response.headers))
response_dict = json.loads(response.text)
print("Response Dictionary: {}".format(response_dict))
```

#### Errors

Mycodo uses conventional HTTP response codes to indicate the success or failure of an API request. In general: Codes in the 2xx range indicate success. Codes in the 4xx range indicate an error that failed given the information provided (e.g., a required parameter was omitted, a charge failed, etc.). Codes in the 5xx range indicate an error with Mycodo's servers (these are rare).

Some 4xx errors that could be handled programmatically (e.g., a card is declined) include an error code that briefly explains the error reported.

#### Endpoints

A vendor-specific content type header must be included to determine which API version to use. For version 1, this is "application/vnd.mycodo.v1+json", as can be seen in the examples, above.

Visit https://{RASPBERRY_PI_IP_ADDRESS}/api for documentation of the current API endpoints of your Mycodo install.

Documentation for the latest API version is also available in HTML format: `Mycodo API Docs <https://kizniche.github.io/Mycodo/mycodo-api.html>`__

### 6.6.2 Daemon Control Object

#### DaemonControl()

**class mycodo_client.DaemonControl** (*pyro_uri='PYRO:mycodo.pyro_server@127.0.0.1:9090'*, *pyro_timeout=None*)

The mycodo client object implements a way to communicate with a mycodo daemon and query information from the influxdb database.

Example usage:

```
from mycodo.mycodo_client import DaemonControl
control = DaemonControl()
control.terminate_daemon()
```

Parameters:

- **pyro_uri** - the Pyro5 uri to use to connect to the daemon.
- **pyro_timeout** - the Pyro5 timeout period.

#### controller_activate()

**controller_activate** (*controller_id*)

Activates a controller.

Parameters:

- **controller_type** - the type of controller being activated. Options are: "Function", "LCD", "Input", "Math", "Output", "PID", "Trigger", or "Function".
- **controller_id** - the unique ID of the controller to activate.

#### controller_deactivate()

**controller_deactivate** (*controller_id*)

Deactivates a controller.

Parameters:

- **controller_type** - the type of controller being deactivated. Options are: "Conditional", "LCD", "Input", "Math", "Output", "PID", "Trigger", or "Function".
- **controller_id** - the unique ID of the controller to deactivate.

#### get_condition_measurement()

**get_condition_measurement** (*condition_id*)

Gets the measurement from a Condition of a Conditional Controller.

Parameters:

- **condition_id** - The unique ID of the controller.

#### get_condition_measurement_dict()

**get_condition_measurement_dict** (*condition_id*)

Gets the measurement dictionary from a Condition of a Conditional Controller.

Parameters:

- **condition_id** - The unique ID of the controller.

#### input_force_measurements()

**input_force_measurements** (*input_id*)

Induce an Input to conduct a measurement.

Parameters:

- **input_id** - The unique ID of the controller.

#### lcd_backlight()

**lcd_backlight** (*lcd_id, state*)

Turn the backlight of an LCD on or off, if the LCD supports that functionality.

Parameters:

- **lcd_id** - The unique ID of the controller.
- **state** - The state of the LCD backlight. Options are: False for off, True for on.

#### lcd_flash()

**lcd_flash** (*lcd_id, state*)

Cause the LCD backlight to start or stop flashing, if the LCD supports that functionality.

Parameters:

- **lcd_id** - The unique ID of the controller.
- **state** - The state of the LCD flashing. Options are: False for off, True for on.

#### lcd_reset()

**lcd_reset** (*lcd_id*)

Reset an LCD to it's default startup state. This can be used to clear the screen, fix display issues, or turn off flashing.

Parameters:

- **lcd_id** - The unique ID of the controller.

#### output_off()

**output_off** (*output_id, trigger_conditionals=True*)

Turn an Output off.

Parameters:

- **output_id** - The unique ID of the Output.
- **trigger_conditionals** - Whether to trigger controllers that may be monitoring Outputs for state changes.

#### output_on()

**output_on** (*output_id, output_type='sec', amount=0.0, min_off=0.0, trigger_conditionals=True*)

Turn an Output on.

Parameters:

- **output_id** - The unique ID of the Output.
- **output_type** - The type of output to send to the output module (e.g. "sec", "pwm", "vol").
- **amount** - The amount to send to the output module.
- **min_off** - How long to keep the Output off after turning on, if on for a duration.
- **trigger_conditionals** - Whether to trigger controllers that may be monitoring Outputs for state changes.

#### output_on_off()

**output_on_off** (*output_id, state, output_type='sec', amount=0.0,*)

Turn an Output on or off.

Parameters:

- **output_id** - The unique ID of the Output.
- **state** - The state to turn the Output. Options are: "on", "off"
- **output_type** - The type of output to send to the output module (e.g. "sec", "pwm", "vol").
- **amount** - The amount to send to the output module.

#### output_sec_currently_on()

**output_sec_currently_on** (*output_id*)

Get how many seconds an Output has been on.

Parameters:

- **output_id** - The unique ID of the Output.

**output_setup()**

**output_setup** (*action, output_id*)

Set up an Output (i.e. load/reload settings from database, initialize any pins/classes, etc.).

Parameters:

- **action** - What action to instruct for the Output. Options are: "Add", "Delete", or "Modify".
- **output_id** - The unique ID of the Output.

**output_state()**

**output_state** (*output_id*)

Gets the state of an Output. Returns "on" or "off" or duty cycle value.

Parameters:

- **output_id** - The unique ID of the Output.

**pid_get()**

**pid_get** (*pid_id, setting*)

Get a parameter of a PID controller.

Parameters:

- **pid_id** - The unique ID of the controller.
- **setting** - Which option to get. Options are: "setpoint", "error", "integrator", "derivator", "kp", "ki", or "kd".

**pid_hold()**

**pid_hold** (*pid_id*)

Set a PID Controller to Hold.

Parameters:

- **pid_id** - The unique ID of the controller.

**pid_mod()**

**pid_mod** (*pid_id*)

Refresh/Initialize the variables of a running PID controller.

Parameters:

- **pid_id** - The unique ID of the controller.

**pid_pause()**

**pid_pause** (*pid_id*)

Set a PID Controller to Pause.

Parameters:

- **pid_id** - The unique ID of the controller.

#### pid_resume()

**pid_resume** (*pid_id*)

Set a PID Controller to Resume.

Parameters:

- **pid_id** - The unique ID of the controller.

#### pid_set()

**pid_set** (*pid_id, setting, value*)

Set a parameter of a running PID controller.

Parameters:

- **pid_id** - The unique ID of the controller.
- **setting** - Which option to set. Options are: "setpoint", "method", "integrator", "derivator", "kp", "ki", or "kd".
- **value** - The value to set.

#### refresh_daemon_camera_settings()

**refresh_daemon_camera_settings** ()

Refresh the camera settings stored in the running daemon from the database values.

#### refresh_daemon_conditional_settings()

**refresh_daemon_conditional_settings** (*unique_id*)

Refresh the Conditional Controller settings of a running Conditional Controller.

Parameters:

- **unique_id** - The unique ID of the controller.

#### refresh_daemon_misc_settings()

**refresh_daemon_misc_settings** ()

Refresh the miscellaneous settings stored in the running daemon from the database values.

#### refresh_daemon_trigger_settings()

**refresh_daemon_trigger_settings** (*unique_id*)

Refresh the Trigger Controller settings of a running Trigger Controller.

Parameters:

- **unique_id** - The unique ID of the controller.

#### send_email()

**send_email** (*recipients, message, subject*)

Send an email with the credentials configured for alert notifications.

Parameters:

- **recipients** - The email address (string) or addresses (list of strings) to send the email.
- **message** - The body of the email.
- **subject** - The subject of the email.

#### terminate_daemon()

**terminate_daemon** ()

Instruct the daemon to shut down.

#### trigger_action()

**trigger_action** (*action_id, message='', single_action=True, debug=False*)

Instruct a Function Action to be executed.

Parameters:

- **action_id** - The unique ID of the Function Action.
- **message** - A message to send with the action that may be used by the action.
- **single_action** - True if only executing a single action.
- **debug** - Whether to show debug logging messages.

#### trigger_all_actions()

**trigger_all_actions** (*function_id, message='', debug=False*)

Instruct all Function Actions of a Function Controller to be executed sequentially.

Parameters:

- **function_id** - The unique ID of the controller.
- **message** - A message to send with the action that may be used by the action.
- **debug** - Whether to show debug logging messages.

# 7. Troubleshooting

## 7.1 Daemon Not Running

- Check the Logs: From the `[Gear Icon] -> Mycodo Logs` page, check the Daemon Log for any errors. If the issue began after an upgrade, also check the Upgrade Log for indications of an issue.
- Determine if the Daemon is Running: Execute `ps aux | grep '/var/mycodo-root/env/bin/python /var/mycodo-root/mycodo/mycodo_daemon.py'` in a terminal and look for an entry to be returned. If nothing is returned, the daemon is not running.
- Daemon Lock File: If the daemon is not running, make sure the daemon lock file is deleted at `/var/lock/mycodo.pid`. The daemon cannot start if the lock file is present.
- If a solution could not be found after investigating the above suggestions, submit a New Mycodo Issue on github.

## 7.2 Incorrect Database Version

- Check the `[Gear Icon] -> System Information` page or select the mycodo logo in the top-left.
- An incorrect database version error means the version stored in the Mycodo settings database ( `~/Mycodo/databases/mycodo.db` ) is not correct for the latest version of Mycodo, determined in the Mycodo config file ( `~/Mycodo/mycodo/config.py` ).
- This can be caused by an error in the upgrade process from an older database version to a newer version, or from a database that did not upgrade during the Mycodo upgrade process.
- Check the Upgrade Log for any issues that may have occurred. The log is located at `/var/log/mycodo/mycodoupgrade.log` but may also be accessed from the web UI (if you're able to): select `[Gear Icon] -> Mycodo Logs -> Upgrade Log`.
- Sometimes issues may not immediately present themselves. It is not uncommon to be experiencing a database issue that was actually introduced several Mycodo versions ago, before the latest upgrade.
- Because of the nature of how many versions the database can be in, correcting a database issue may be very difficult. It may be much easier to delete your database and let Mycodo generate a new one.
- Use the following commands to rename your database and restart the web UI. If both commands are successful, refresh your web UI page in your browser in order to generate a new database and create a new Admin user.

```
mv ~/Mycodo/databases/mycodo.db ~/Mycodo/databases/mycodo.db.backup
sudo service mycodoflask restart
```

## 7.3 More

Check out the Diagnosing Mycodo Issues Wiki Page on github for more information about diagnosing issues.

# 8. Translations

Mycodo has been translated to several languages. By default, the language of the browser will determine which language is used, but may be overridden in the General Settings, on the `[Gear Icon] -> Configure -> General` page. If you find an issue and would like to correct a translation or would like to add another language, this can be done at https://translate.kylegabriel.com.

Also check out the Translations section of the Wiki for details on working with translation files manually.