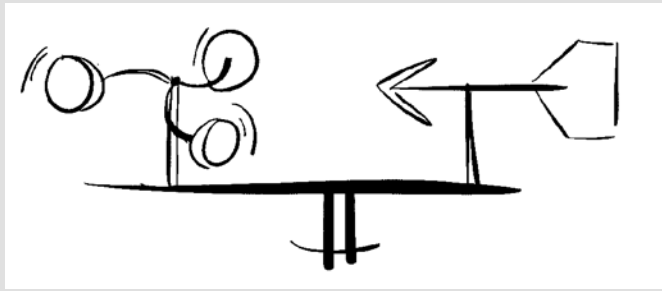# SwitchDoc Labs



The **Weather Board** is an interface board for connecting a full featured, customizable Weather Station board for Raspberry Pi and Arduino projects.  It contains a built in I2C BMP280 Barometer/Temperature sensor includes a DS3231 RTC/EEPROM and contains interfaces for the following:

- SwitchDoc Labs WeatherRack Anemometer/Wind Vane/Rain Bucket (also supports SparkFun and ArgentData weather sensors)
- Embedded Adventures I2C Lightning Detector MOD-1016 board
- Adafruit HTU21D-F Temperature/Humidity breakout board
- Adafruit 32KB FRAM /ADS1015
- SwitchDoc Labs  Grove ADS1116 16 Bit ADC Board

Features and Benefits:

- Provides an excellent interface for a Weather Station hookup to Raspberry Pi or Arduino
- Supports Grove Connectors
- Includes Arduino and Raspberry Pi Software
- Supports SwitchDoc Labs WeatherRack Wind Vane / Anemometer / Rain Bucket
- Control Panel available on RasPiConnect
- Contains I2C BMP280 Barometer/Temperature
- Includes DS3231 RTC/EEPROM
- Directly powers Raspberry Pi / Arduino
- Works with Raspberry Pi (3.3V) GPIO and Arduino (5.0V) GPIO
- Works with 3.3V and 5.0V I2C bus
- Supports I2C Lightning Detector MOD-1016
- Supports I2C HTU21D-F Humidity Sensor
- Supports I2C 32KB FRAM
- Supports I2C ADS1015 4 Channel A/D
- Supports I2C Grove AM2315 Temp/Hum
- Low Cost
- Full Test Code Supplied
- Quantity Discounts Available
- Immediate Availability

## Introduction



The **Weather Board** is a weather station controller board designed to interface to Arduino and Raspberry Pi computers.  It is an interface board developed by SwitchDoc Labs to allow the user to easily build a fully functioned Weather Station while allowing customization of functions.

The Weather Board is derived from Project Curacao. Generation 1 of this board was deployed and tested on the island nation of Curacao before Generation 2 was released to production.  We then added support for Grove Connectors

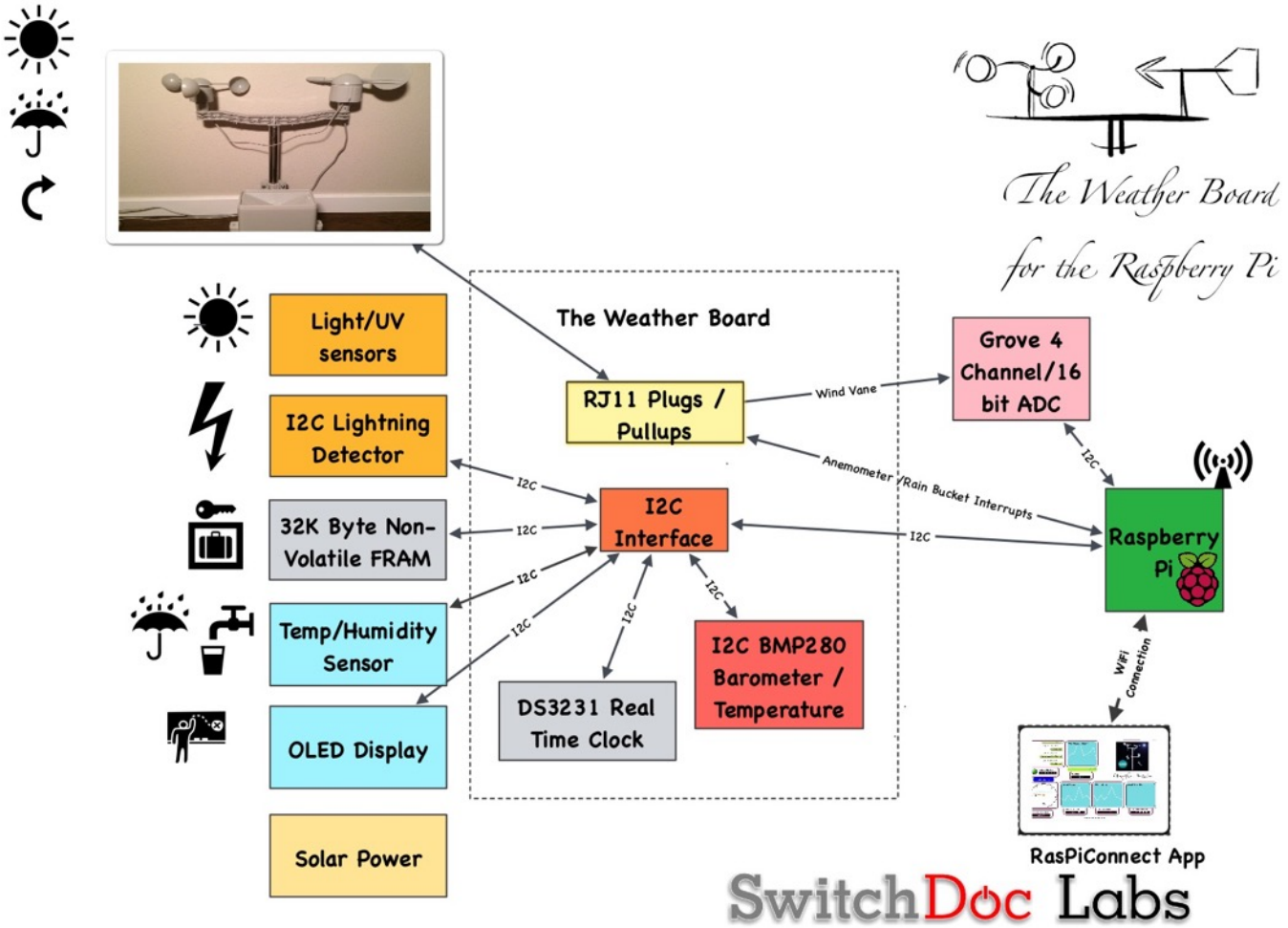Combine the Weather Board with a SunAir or
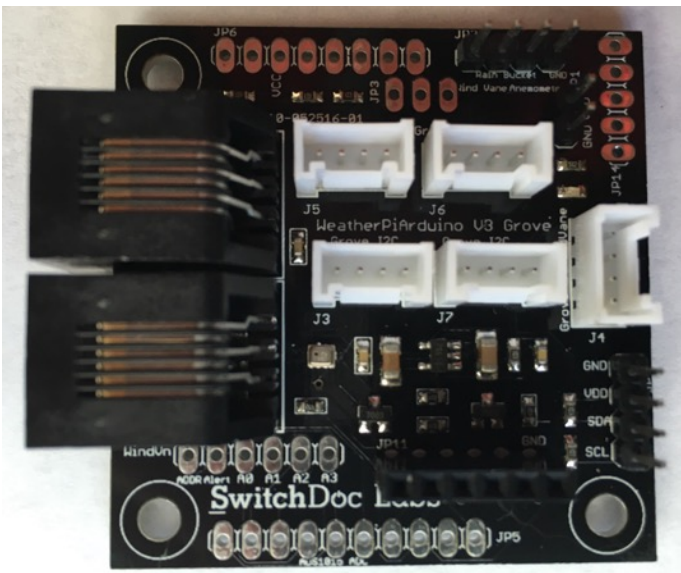
# SwitchDoc Labs

SunAirPlus board to create a solar powered weather station.

Additional code and examples on www.switchdoc.com on the Weather Board Product Page

## Block Diagram

# SwitchDoc Labs

# Theory of Operation

## Software

Software and drivers for the WeatherPiArdunio boards (including optional boards) for the Raspberry Pi and the Arduino can be located on the SwitchDoc Labs Weather Board product page (www.switchdoc.com).

## RJ11 Plugs / Pullups

The RJ11 Plugs on the Weather Board are designed to hook into inexpensive Anemometers, Wind Vanes and Rain Buckets.  These plugs are wired to directly support the plugs coming from:

- SwitchDoc Labs WeatherRack (http://www.switchdoc.com/weatherrack-weather-sensors/).  Available on the SwitchDoc Store and on Amazon.

- ArgentData (http://www.argentdata.com)

- SparkFun (http://www.sparkfun.com)

## I2C Interface

The I2C interface has two parts.  J3 and J7  provide Grove I2C connectors (3.3V or 5V) and JP4 provides a pinheaded I2C interface.
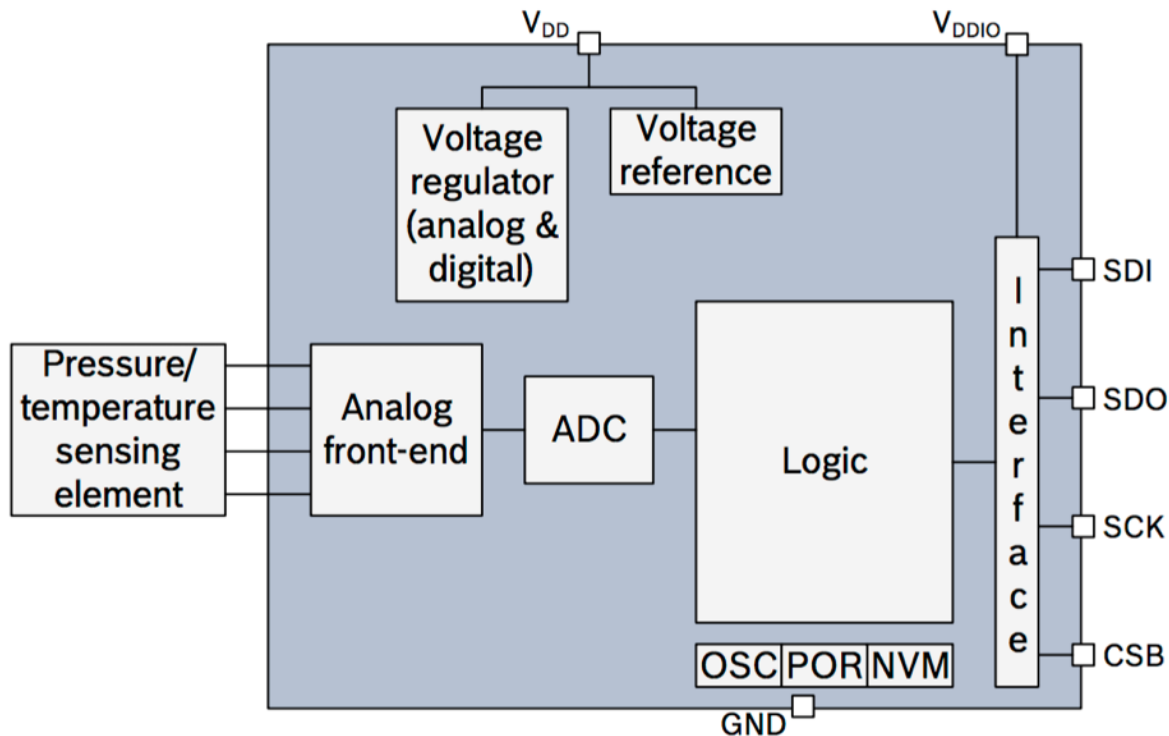
## BMP280 Barometer / Temperature

The WeatherPlus board has an on board BMP280 Barometer / Temperature sensor connected to the I2C bus from the computer.    The BMP280 is the function compatible successor of the BMP085 and BMP180.

With a low altitude noise of merely 0.25m at fast conversion time, the BMP280 offers superior performance.  The BMP280 is based on piezo-resistive technology for EMC robustness, high accuracy and linearity as well as long term stability.  The BMP280 consists of a piezo-resistive sensor, an analog to digital converter and a control unit with EEPROM and a serial I2C interface. The BMP280 delivers the uncompensated value of pressure and Temperature.  Pressure data is 16 to 19 bits and temperature data is 16 bits.  The resolution of the barometer is 0.16Pa and the temperature sensor is 0.01C.

The specifications for this device is on the SwitchDoc Labs Weather Board product page.

# SwitchDoc Labs



The BMP280 as shown above is a high precision I2C Barometer / Temperature sensor.   Older WeatherPlus board (before revision 0011-021916-01) have the BMP180, the previous member of this family.

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## DS3231/EEPROM Real Time Clock

The SwitchDoc Labs DS3231/EEPROM combination is included with the Weather Board board.  It is plugged in by the user into JP11, taking care to having the battery facing the top of the board.

The DS3231 is a low-cost, extremely accurate $I^2C$ real- time clock (RTC) with an integrated temperature-compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate timekeeping when main power to the device is interrupted. The integration of the crystal resonator enhances the long-term accuracy of the device.

# SwitchDoc Labs

The RTC maintains seconds, minutes, hours, day, date, month, and year information. The date at the end of the month is automatically adjusted for months with fewer than 31 days, including corrections for leap year. The clock operates in either the 24-hour or 12-hour format with an AM/PM indicator. Two programmable time-of- day alarms and a programmable square-wave output are provided. Address and data are transferred serially through the I2C bidirectional bus.

A precision temperature-compensated voltage reference and comparator circuit monitors the status of VDD to detect power failures, to provide a reset output, and to automatically switch to the backup supply (battery
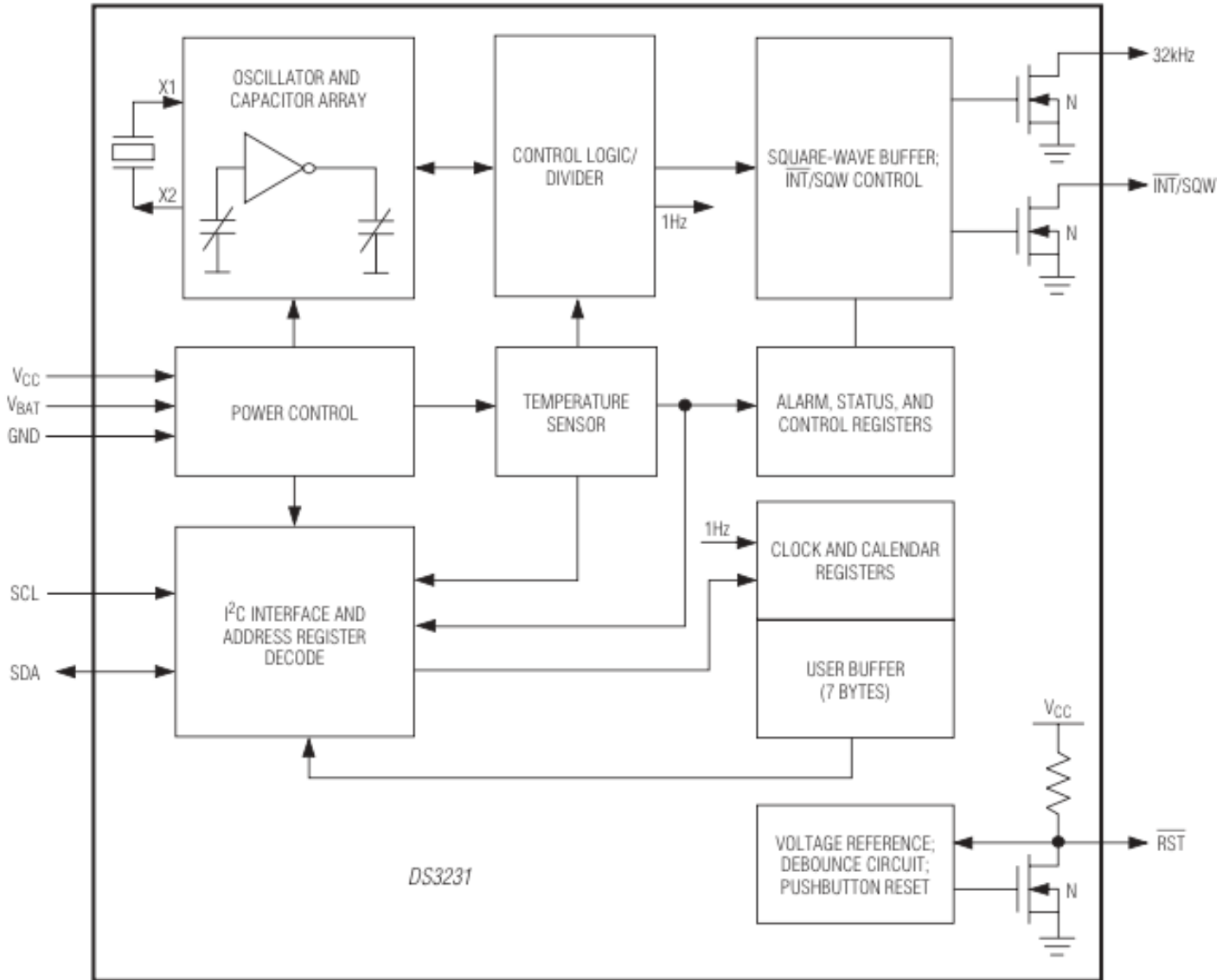
included) when necessary. Additionally, the RST pin is monitored as a pushbutton input for generating a µP reset.

The specifications for this device is on the SwitchDoc Labs Weather Board product page.

AT24C32 32KB EEPROM

The AT24C32 provides 32,768 bits of serial electrically erasable and programmable read only memory (EEPROM) organized as 4096 words of 8 bits each.   The EEPROM drivers are included in the SwitchDoc driver software.
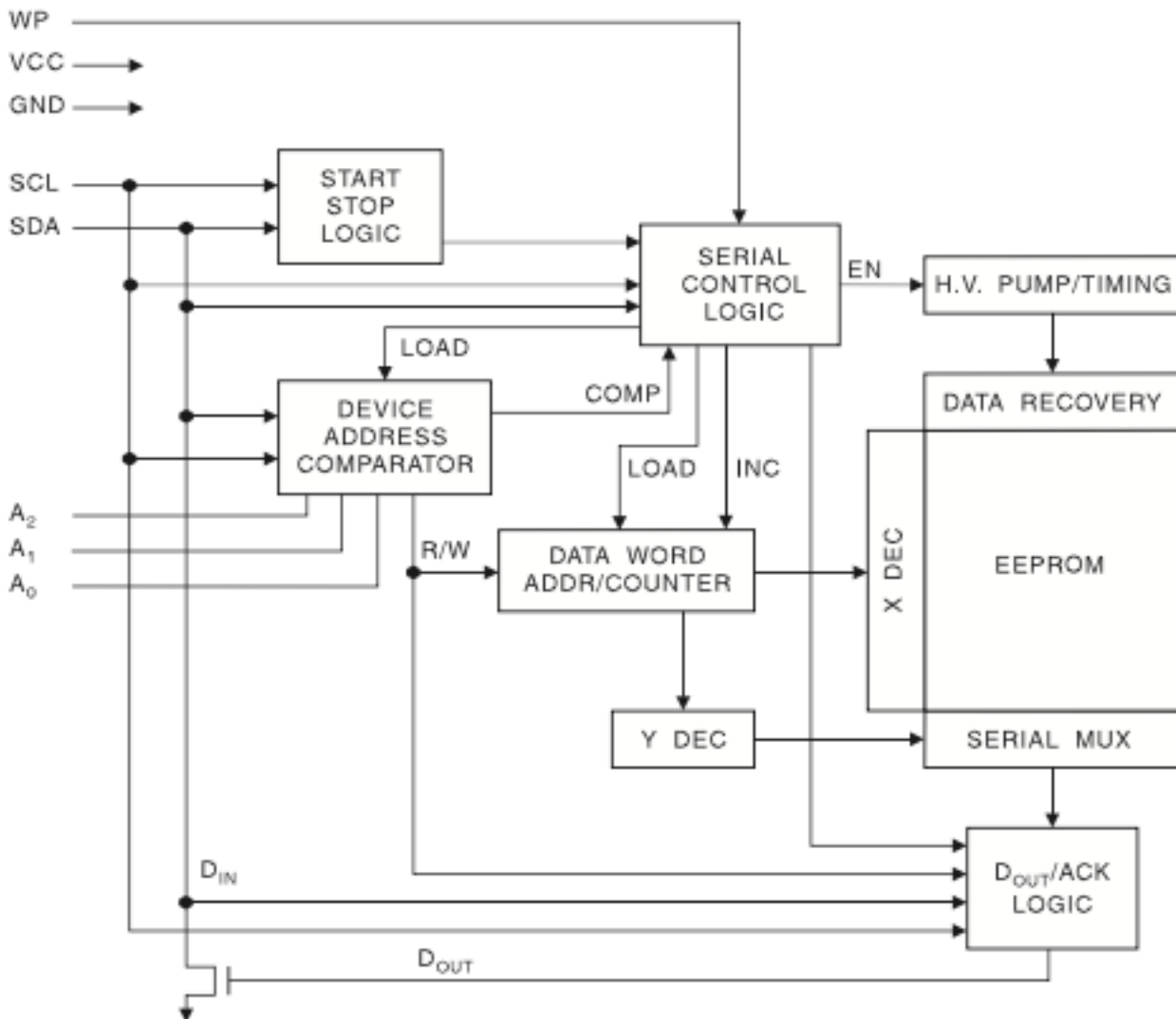
## SwitchDoc Labs

## Weather Board Sensor Compatibility

The anemometer and rain bucket pins are pulled to VDD (3.3V or 5V) via a 10K Ohm pullup resistor. These are intended to connect to interrupt inputs on the host computer. Note: You need to change a constant in the WeatherRack software drivers according to the VDD voltage, or you will not get the correct wind direction.

From SDL_Pi_WeatherRack on github.com/switchdoclabs:

```
# For 5V, use 1.0.  For 3.3V use 0.66

ADJUST30R5 = 0.66

PowerVoltage = 3.3
```

The standard Anemometer in these devices measures wind speed by closing a contact as a magnet moves past a switch. One contact closure a second indicates 1.492 MPH (2.4 km/h). If you use a different anemometer, this constant can be changed in software.

The tipping bucket Rain Gauge used in the SwitchDoc Labs WeatherRack, the SparkFun Weather Sensor and the ArgentData Sensors. The standard rain gauge used in these devices makes one momentary contact closure that can be recorded with a micro controller interrupt input. Each contact closure of the standard unit indicates 0.011 inch (0.2794 mm). If you use a different tipping rain gauge you can adjust these values in software.

 The Wind vane has 8 switches, each connected to a different resistor. The Weather Board measures the resistance value of the resistor by measuring the voltage on a resistor divider (with 10K Ohm onboard resistor). With an Arduino, it is measured either with the optional ADS1015 or the internal A/D converters. In the case of a Raspberry Pi measuring this voltage requires an external A/D converter such as the optional ADS1015. See the SwitchDoc Labs WeatherRack Product Specification for more information on the Wind Vane.

See the SwitchDoc Labs drivers provided on www.switchdoc.com.

Note that most RJ11 cables only have 4 wires instead of the six allowed by the plug.

The specifications for this device is on the SwitchDoc Labs Weather Board product page.

# SwitchDoc Labs

## Default I2C Addresses

The default I2C addresses for the on board devices and the optional devices are shown below.

| DEVICE | DESCRIPTION | HEX ADDRESS | COMMENTS |
|--------|-------------|-------------|----------|
| BMP280 | Barometer / Temperature | 0x77 | Included |
| DS3231 | Real Time Clock | 0x68 | Included |
| AT24C32 | EEPROM | 0x56 | Included |
| ADS1015 | ADC | 0x48 | Optional Board.  Can change I2C Addresses. |
| MOD-1016 | Lightning Detector | 0x03 | Optional Board. |
| HTU21D-F | Humidity Detector | 0x40 | Optional Board. |
| FRAM | 32KB FRAM | 0x50 | Optional Board.  Can change I2C Addresses. |

## External Modules

There are a number of sources of each one of these external modules.  If you do choose to use an alternative source of boards, make sure that you are connecting to the correct pins.  The pinouts on Weather Board are set up for the following modules.

- Adafruit ADS1015 ADC - 12 bit 4 channel Analog to Digital Converter

- Embedded Adventures MOD-1016G Grove Lightning Detector - detect nearby and far away lightning storms

- Adafruit Humidity Detector HTU21D-F - humidity and temperature sensors

- Adafruit 32KB FRAM - very fast non-volatile RAM

The specifications for all of these devices are on the SwitchDoc Labs Weather Board product page.

## Operating Values

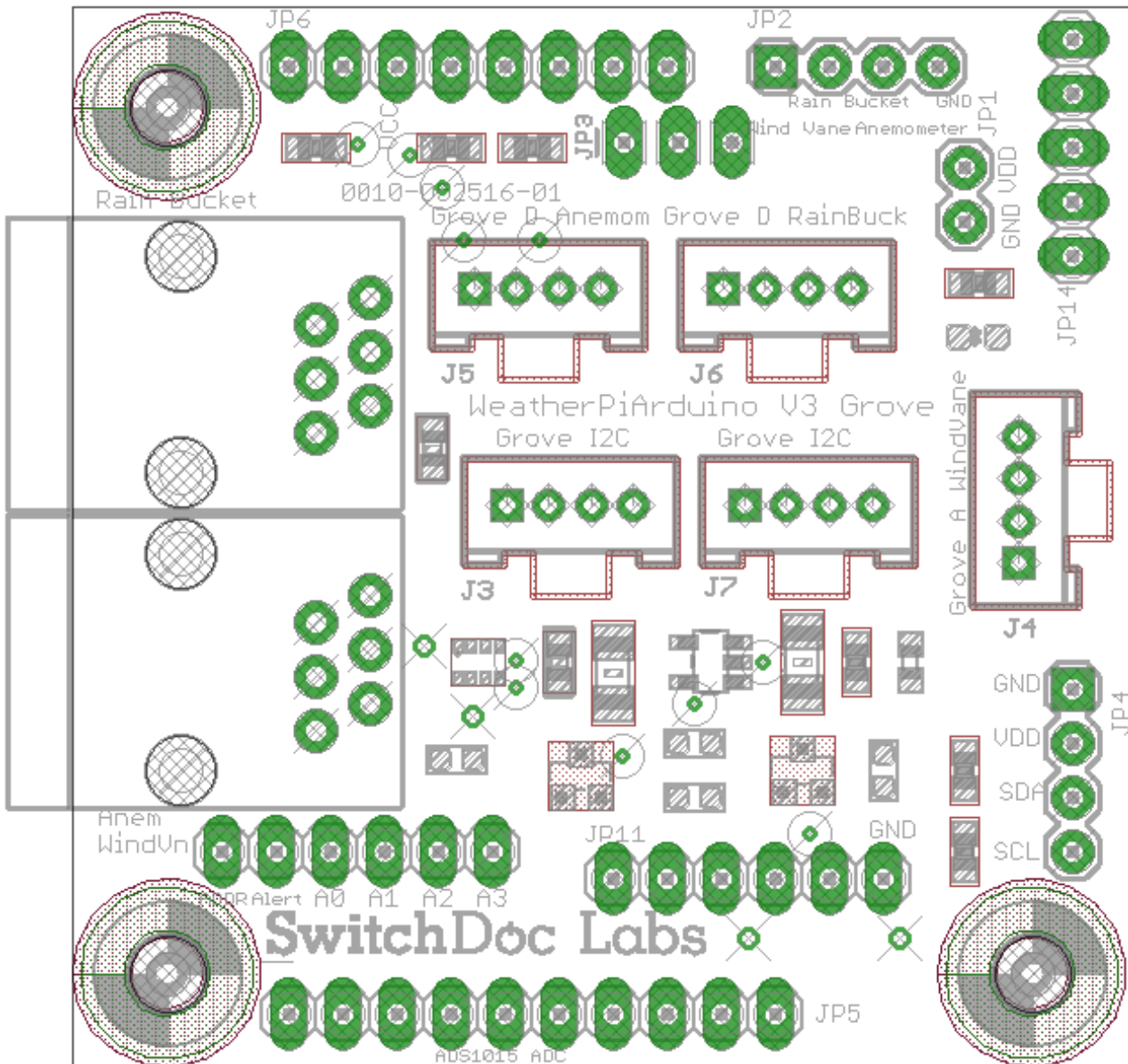|  | Min | Normal | Max | Unit |
|---|---|---|---|---|
| VDD | 3.313V |  | 5.25 | V |
| Idd* |  | 5 |  | mA |

*Weather Board Power Consumption depends on what other devices you have added to the board.

**Weather Board Board Jumper Pin and Plug Locations**

Physical dimensions of board:  50mm x 50mm x 14.5mm(max).  Mounting holes inset 3.8mm x 3.8mm  from each corner to center of hole.  Diameter of hole 2mm.

## What is a Grove Connector?
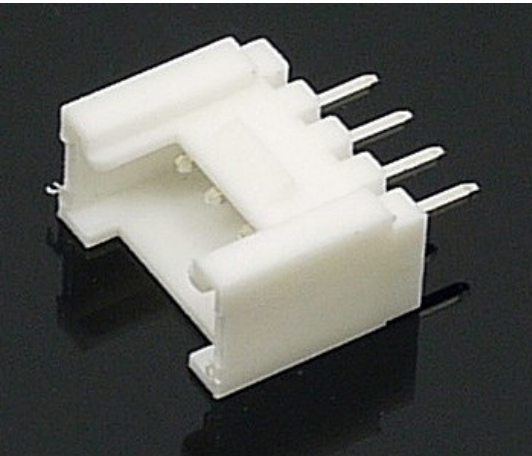


The way we have been wiring I2C connections before just didn't work for large projects. Basically, we used to put the I2C bus to screw terminals or snap down connectors and then ran wires to each device. This would not work for complex projects. Because of this, we moved to Grove connectors.

There are dozens of Grove I2C sensors out now.   Many different kinds of cables and I2C Hubs.

We quickly found the connectors and their respective cables very useful. With the large selection of Grove I2C devices available, we decided to include a Grove connector on all our future I2C boards.   The white connectors on the Weather Board board picture at the top are Grove connectors for easy, non-soldered connections to the I2C bus and for data inputs. The picture below shows  the SunRover robot built using Grove connectors for the 8 different I2C busses in the robot.  A Grove OLED display is shown underneath the picture.



## Connecting to Grove Connectors

There are a number of Grove shields and Hats for Raspberry Pi and Arduino devices.

Grove I2C Connectors are keyed so they can not be plugged in incorrectly.  Below is the I2CMux board hooked up with both Grove and non-Grove devices.
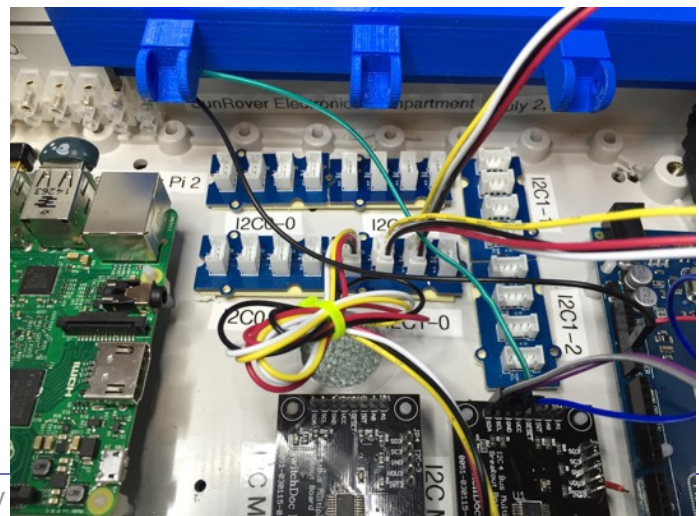
# SwitchDoc Labs
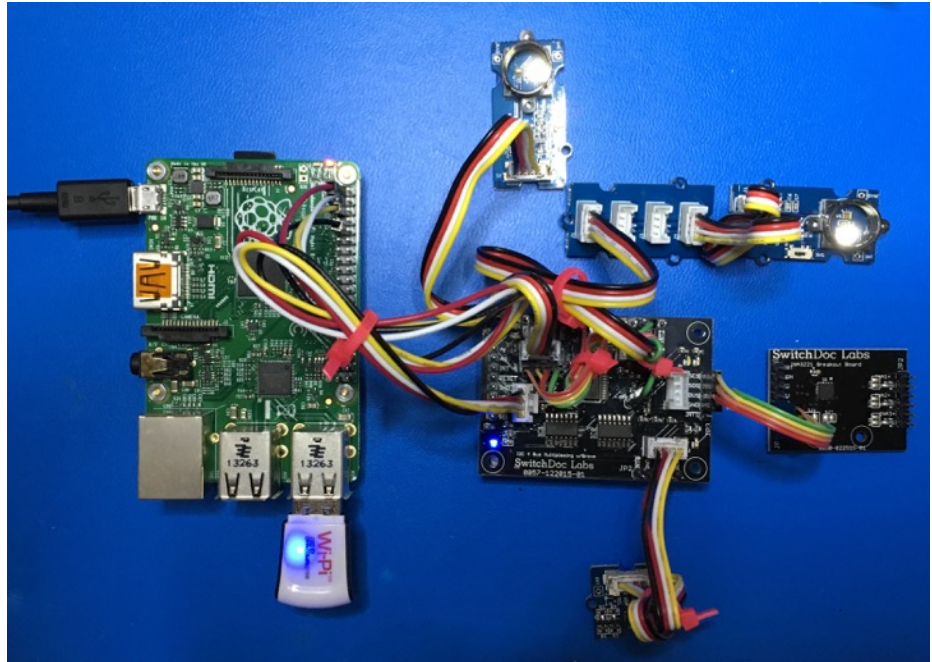


# What Grove Connectors Are On The Weather Pi Arduino?

There are two types of Grove Connectors on the Weather Board board.   There is one Grove I2C and two Grove Digital connectors.

## Grove Digital

A digital Grove connector consists of the standard four lines coming into the Grove plug.   The two signal lines are generically called D0 and D1.  Most modules only use D0, but some do (like the LED Bar Grove display) use both.   Often base units will have the first connector called D0 and the second called D1 and they will be wired D0/D1 and then D1/D2, etc.

| Grove Digital | | |
|---|---|---|
| **Pin 1** | D0 | Primary Digital Input/Output |
| **Pin 2** | D1 | Secondary Digital Input/Output |
| **Pin 3** | VCC | Power for Grove Module  (5V or 3.3V) |

| Grove Digital | | |
|---|---|---|
| Pin 4 | GND | Ground |

---

## Grove I2C

SwitchDoc Labs customers know that our favorite devices are I2C sensors.   There are many types of I2C Grove sensors available.   Most are 5V/3.3V devices, but there are a few that are only 3.3V or 5.0V.  You need to check the specifications.

The Grove I2C connector has the standard layout.   Pin 1 is the SCL signal and Pin 2 is the SDA signal.  Power and Ground are the same as the other connectors.  This is another special version of the Grove Digital Connector.  In fact, often the I2C bus on a controller (like the ESP8266, Raspberry Pi and the Arduino) just uses Digital I/O pins to implement the I2C bus.  The pins on the Raspberry Pi and Arduino are special with hardware support for the I2C bus.  The ESP8266 is purely software.

Note that the Grove I2C Connectors on the Weather Board is a 5V or 3.3V (depending on what VDD is connected to) I2C connector.

| Grove I2C | | |
|---|---|---|
| Pin 1 | SCL | I2C Clock |
| Pin 2 | SDA | I2C Data |
| Pin 3 | VCC | Power for Grove Module  (5V or 3.3V) |
| Pin 4 | GND | Ground |

# SwitchDoc Labs

**I/O Key:**

**I - Digital Input**
**O - Digital Output**
**A - Analog**

## Grove Connections

### J3 - Grove I2C

This Connector can be used to connect up to a processor such as the Raspberry PI or to an I2C Hub expander.  See articles and application notes on www.switchdoc.com.

| J3 - Grove I2C | | |
|---|---|---|
| **Pin 1** | SCL | I2C Clock |
| **Pin 2** | SDA | I2C Data |
| **Pin 3** | VDD | Power for Grove Module |
| **Pin 4** | GND | Ground |

### J7 - Grove I2C

This Connector can be used to connect up to a processor such as the Raspberry PI or to an I2C Hub expander.  See articles and application notes on www.switchdoc.com.

| J7 - Grove I2C | | |
|---|---|---|
| **Pin 1** | SCL | I2C Clock |
| **Pin 2** | SDA | I2C Data |
| **Pin 3** | VDD | Power for Grove Module |
| **Pin 4** | GND | Ground |

# J5 - Grove Digital Anemometer (VDD)

| J5 - Grove Digital Anemometer | | |
|---|---|---|
| Pin 1 | D0 | Anemometer Output (has 10K Ohm pullup to VDD) |
| Pin 2 | N/C | N/C |
| Pin 3 | N/C | N/C |
| Pin 4 | GND | Ground |

# J6 - Grove Digital RainBucket (VDD)

| J6 - Grove Digital Rain Bucket | | |
|---|---|---|
| Pin 1 | D0 | Rain Bucket Output (has 10K Ohm pullup to 3.3V) |
| Pin 2 | N/C | N/C |
| Pin 3 | N/C | N/C |
| Pin 4 | GND | Ground |

# J4 - Grove Analog Wind Vane (VDD)

This Grove Analog Connector connects to the output of the resistor divider for measuring the wind direction. It should be connected to the Analog input for the SwitchDoc Labs Grove 4 Ch/16 Bit ADC board or to an analog input on an Arduino board.

| J4 - Grove Analog Wind Vane | | |
|---|---|---|
| Pin 1 | A0 | Output of Wind Vane resistor divider.  range: 0 - VDD |
| Pin 2 | N/C | N/C |
| Pin 3 | N/C | N/C |

| J4 - Grove Analog Wind Vane | | |
|---|---|---|
| Pin 4 | GND | Ground |

# Plug Functions

## J1 - Anemometer  / Wind Vane RJ11 Plug

Used to connect the Weather Board to a wind vane and anemometer such as used in the SwitchDoc Labs WeatherRack, the SparkFun Weather Sensor and the ArgentData Sensors.  The standard Anemometer in these devices measures wind speed by closing a contact as a magnet moves past a switch.  One contact closure a second indicates 1.492 MPH (2.4 km/h).  If you use a different anemometer, this constant can be changed in software.    The Wind vane has 8 switches, each connected to a different resistor.  The Weather Board measures the resistance value of the resistor by measuring the voltage on a resistor divider (with 10 K Ohm resistor).    With an Arduino, it is measured either with the optional ADS1015, SwitchDoc Labs Grove 16 Bit ADC or the internal 10 bit A/D converters.   In the case of a Raspberry Pi measuring this voltage requires an external A/D converter such as the SwitchDoc Labs Grove 16 Bit ADC.  See the SwitchDoc Labs WeatherRack Product Specification for more information on the Wind Vane.

| NAME | PIN | I/O | DESCRIPTION |
|---|---|---|---|
| N/C | J2 / 1 | | No Connection |
| GND | J3 / 2 | A | Connected to GND |
| GND | J3 / 3 | A | Connected to GND |
| Anemometer | J4 / 4 | A | Connected to Anemometer pin on JP2 and 10K Ohm Pullup to VDD |
| Wind Vane | J5 / 5 | A | Connected to Wind Vane Pin on JP2 and also to ADC-A1 on JP5 and JP8 for use by the optional ADS1015 ADC or SwitchDoc Labs ADS1116 and 10K Ohm Pullup to VDD |
| N/C | J6 / 6 | | No Connection |

## J2 - Rain Bucket RJ11 Plug

Used to connect the Weather Board to a tipping bucket Rain Gauge used in the SwitchDoc Labs WeatherRack, the SparkFun Weather Sensor and the ArgentData Sensors.  The standard rain gauge used in these devices makes one momentary contact closure that can be recorded with a micro controller interrupt input.  Each contact closure of the standard unit indicates 0.011 inch (0.2794 mm).  If you use a different tipping rain gauge you can adjust these values in software.

Note that most RJ11 cables only have 4 wires instead of the six allowed by the plug.

| NAME | PIN | I/O | DESCRIPTION |
|---|---|---|---|

| N/C | J1 / 1 | | No Connection |
|---|---|---|---|
| N/C | J1 / 2 | | No Connection |
| GND | J1 / 3 | A | Connected to GND |
| RainBucket Contact | J1 / 4 | A | Connected to Rain Gauge ping on JP2 and 10K Ohm Pullup to VDD |
| N/C | J1 / 5 | | No Connection |
| N/C | J1 / 6 | | No Connection |

# Jumper Pin Functions

## JP1 - Power

Used to supply power to the Weather Board board.

| NAME | PIN | I/O | DESCRIPTION |
|------|-----|-----|-------------|
| GND | JP1 / 1 | A | Connected to GND |
| VDD | JP1 / 2 | A | Connect to 3.3V or 5V - Note:  If you connect your Weather Board to the Raspberry Pi or Arduino I2C connector, the connector can be left unconnected.   VDD |

## JP2 - WeatherOut

This is the Weather Board header that can be optionally used instead of the Grove Connectors

| NAME | PIN | I/O | DESCRIPTION |
|------|-----|-----|-------------|
| WindVane | JP2 / 1 | O | Connect to A/D Input on Arduino.  N/C for Raspberry Pi.  Use an external ADC for Raspberry Pi (such as the Optional ADS1015 or the SwitchDoc Labs Grove ADS1115 16 bit board) |
| RainBucket | JP2 / 2 | I | Active Low Interrupt on each click of the Rain Bucket - Not Debounced.  10K pullup resistor |
| Anemometer | JP2 / 3 | I | Active Low Interrupt on each click of the Anemometer - Not Debounced.  10K pullup resistor |
| GND | JP2 / 4 | A | Connected to GND |

## JP4 - I2C Pin header

This is an I2C Pin Header for optional non-Grove connectors.  Connected directly to the I2C Grove Connectors.

| NAME | PIN | I/O | DESCRIPTION |
|------|-----|-----|-------------|
| SCL | JP4 / 1 | I | Serial bus clock line; open-drain input.  10K Ohm Pullup |
| SDA | JP4 / 2 | I/O | Serial bus data line; open-drain input/output.  10K Ohm Pullup |
| VDD | JP4 / 3 | A | VDD |
| GND | JP4 / 4 | A | GND |

# JP5 - Optional ADS1015 ADC

The ADS1015 is a precision analog-to-digital converter (ADC) with 12 bits of resolution. The ADS1015 is designed with precision, power, and ease of implementation in mind. Data are transferred via an I2C-compatible serial interface; four I2C slave addresses can be selected.   You can also use a SwitchDoc Labs Grove 16 bit ADS1115 board to get more accuracy.

The ADS1015 chips have a base 7-bit I2C address of 0x48 and an addressing scheme that allows four different addresses using just one address pin. To program the address, connect the address pin as follows:
  •       0x48 (1001000) ADDR -> GND
  •       0x49 (1001001) ADDR -> VDD
  •       0x4A (1001010) ADDR -> SDA
  •       0x4B (1001011) ADDR -> SCL
The ADDR should be connected to GND for the default address 0x48.  **Do not leave it floating.**   Might work, might not.

| NAME | PIN | I/O | DESCRIPTION |
|------|-----|-----|-------------|
| A3 | JP5 / 1 | A | Differential channel 2:  Negative Input or single-ended channel 4 input |
| A2 | JP5 / 2 | A | Differential channel 2:  Positive Input or single-ended channel 3 input. |
| A1 | JP5 / 3 | A | Differential channel 1:  Negative Input or single-ended channel 2 input. Connected to WindVane Input on JP1 |
| A0 | JP5 / 4 | A | Differential channel 1:  Positive Input or single-ended channel 1 input |
| ALRT | JP5 / 5 | O | Digital comparator output or conversion ready |
| ADDR | JP5 / 6 | I | I2C slave address select |
| SDA | JP5 / 7 | I/O | Serial bus data line; open-drain input/output.  No Pullup on Weather Board board. |
| SCL | JP5 / 8 | I | Serial bus clock line; open-drain input.  No Pullup on Weather Board board. |
| GND | JP5 / 9 | A | GND |
| VDD | JP5 / 10 | A | VDD |

**See JP8 for Internal ADS1015 Jumper Pin Connections**

# SwitchDoc Labs

## JP6 - Optional Non-Volatile FRAM

The MB85RC256V is a 256K-bits FRAM with serial interface (I2C), using the ferroelectric process and CMOS process technologies for forming the nonvolatile memory cells. A FRAM is able to write high-speed even though it is a nonvolatile memory.  The optional FRAM module is much faster to read and write to than the included EEPROM device.

It is suitable for the log management and the storage of the resume data, etc.  Project Curacao (www.switchdoc.com) uses it to record Weather data during the night when the Raspberry Pi is not powered up.  Each byte can be read and written instantaneously (like SRAM) but will keep the memory for 95 years at room temperature. Each byte can be read/written 10,000,000,000,000 times.

| NAME | PIN | I/O | DESCRIPTION |
|------|-----|-----|-------------|
| VDD | JP6 / 1 | A | VDD |
| GND | JP6 / 2 | A | GND |
| WP | JP6 / 3 | I | Write Protect pin. This is used to force write protection so you cannot write to the FRAM. It has an internal pulldown. Bring to a high voltage (VCC) to turn on WP |
| SCL | JP6 / 4 | I | Serial bus clock line; open-drain input.  No Pullup on Weather Board board. |
| SDA | JP6 / 5 | I/O | Serial bus data line; open-drain input/output.  No Pullup on Weather Board board |
| A2 | JP6 / 6 | I | High selection bit (use A2,A1,A0 as three bits and add to 0x50) |
| A1 | JP6 / 7 | I | Middle selection bit (use A2,A1,A0 as three bits and add to 0x50) |
| A0 | JP7 / 8 | I | Low selection bit (use A2,A1,A0 as three bits and add to 0x50) |

## JP3 - Optional FRAM Address

Used to set other I2C addresses for the Optional I2C FRAM Module.  These are the I2C address selection pins. By default the I2C address is 0x50. Connecting these pins to VDD and power cycling the chip will adjust the lower three bits of the address. For example, if A0 is high, the address is 0x51. If A1 and A2 are high, the address is 0x56

| NAME | PIN | I/O | DESCRIPTION |
|------|-----|-----|-------------|
| A2 | JP3 / 1 | I | High selection bit (use A2,A1,A0 as three bits and add to 0x50) |
| A1 | JP3 / 2 | I | Middle selection bit (use A2,A1,A0 as three bits and add to 0x50) |
| A0 | JP3 / 3 | I | Low selection bit (use A2,A1,A0 as three bits and add to 0x50) |

# JP8 - Optional A/D Inputs for Optional ADS1015 ADC

**NOTE:  This header does not have the JP8 label on the board.   JP8 is located directly above the SwitchDoc Labs logo on the board.**

Connect up external A/D Inputs using this header.  The ADS1015 chips have a base 7-bit I2C address of 0x48 and an addressing scheme that allows four different addresses using just one address pin. To program the address, connect the address pin as follows:
- 0x48 (1001000) ADDR -> GND
- 0x49 (1001001) ADDR -> VDD
- 0x4A (1001010) ADDR -> SDA
- 0x4B (1001011) ADDR -> SCL

The ADDR should be connected to GND for the default address 0x48.  **Do not leave it floating.**

| NAME | PIN | I/O | DESCRIPTION |
| --- | --- | --- | --- |
| ADDR | JP8 / 1 | I | I2C slave address select |
| ALRT | JP8 / 2 | O | Digital comparator output or conversion ready |
| A0 | JP8 / 3 | A | Differential channel 1:  Positive Input or single-ended channel 1 input |
| A1 | JP8 / 4 | A | Differential channel 1:  Negative Input or single-ended channel 2 input. Connected to WindVane Input on JP1 |
| A2 | JP8 / 5 | A | Differential channel 2:  Positive Input or single-ended channel 3 input. |
| A3 | JP8 / 6 | A | Differential channel 2:  Negative Input or single-ended channel 4 input |

# JP11 - Included DS3231/EEPROM Real Time Clock and Storage

The DS3231 is a low-cost, extremely accurate I$^2$C real- time clock (RTC) with an integrated temperature- compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input, and maintains accurate timekeeping when main power to the device is interrupted.   This is included with the Weather Board Board.  **When plugging the DS321 module into the Weather Board make sure to align the GND pins.   Battery side towards the center of the board.**

| NAME | PIN | I/O | DESCRIPTION |
| --- | --- | --- | --- |
| 32K | JP11 / 1 | O | 32kHz Output. This open-drain pin requires an external pullup resistor to VDD. When enabled, the output operates on either power supply. It may be left open if not used. |

| SQW | JP11 / 2 | O | Active-Low Interrupt or Square-Wave Output. This open-drain pin requires an external pullup resistor to VDD.  It may be left open if not used. |
|-----|----------|---|----|
| SCL | JP11 / 3 | I | Serial bus clock line; open-drain input.  No Pullup on Weather Board board. |
| SDA | JP12 / 4 | I/O | Serial bus data line; open-drain input/output.  No Pullup on Weather Board board |
| VDD | JP12 / 5 | A | VDD |
| GND | JP12 / 5 | A | GND |

## JP12 - Optional Lightning Detector - MOD-1016

The new Mod-1016G has Grove connectors for the Interrupt and the I2C bus so we have removed this pin header.

## JP14 - Optional HTU21D-F Humidity/Temperature Sensor

This I2C digital humidity sensor has a typical accuracy of ±2% with an operating range that's optimized from 5% to 95% RH.   HTU21D(F) digital humidity sensors are dedicated humidity and temperature plug and play transducers.

Every sensor is individually calibrated and tested. Lot identification is printed on the sensor and an electronic identification code is stored on the chip – which can be read out by command. Low battery can be detected and a checksum improves communication reliability. The resolution of these digital humidity sensors can be changed by command (8/12bit up to 12/14bit for RH/T).

| NAME | PIN | I/O | DESCRIPTION |
|------|-----|-----|-------------|
| SCL | JP14 / 1 | I | Serial bus clock line; open-drain input.  No Pullup on Weather Board board. |
| SDA | JP14 / 2 | I/O | Serial bus data line; open-drain input/output.  No Pullup on Weather Board board |
| GND | JP14 / 3 | A | GND |
| 3V3 | JP14 / 4 | A | N/C (3V3 Output - not used in Weather Board) |
| VIN | JP14 / 5 | A | Connected to VDD |

# Example Applications

The following diagrams show how to hook up a Weather Board board to the WeatherRack Anemometer. WindVane and RainBucket and the Raspberry Pi or Arduino.

# SwitchDoc Labs

## Connecting a Raspberry Pi B+ / Pi2 / Pi3 to the Weather Board Using the Pi2Grover Grove Interface Board (5V)



## Parts List

| Parts List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **Part Number** | **Part Description** | **Source** |
| **Raspberry Pi** | Pi B+ / Pi2 / Pi3 / PiZero | Multiple |
| **Pi2Grover** | Raspberry Pi to Grove Interface | www.switchdoc.com |
| **Weather Board** | Weather Instrument and Grove Interface (includes DS3231 RTC) | www.switchdoc.com |

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| Parts List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **Part Number** | **Part Description** | **Source** |
| **Grove AM2315** | Grove I2C Outdoor Temperature and Humidity | www.switchdoc.com |
| **WeatherRack** | Weather Instruments - Wind Speed, Rain, Wind Vane | www.switchdoc.com www.argentdata.com www.sparkfun.com |
| **Grove I2C 4Ch/16Bit ADC** | 4 channel 16 bit I2C Analog to Digital Converter | www.switchdoc.com |
| **Grove OLED 64x128 I2C Display** | OLED display for Weather Station | www.switchdoc.com www.seeedstudio.com |
| **HUT21D-F Inside Temperature / Humidity Sensor** | Optional Inside Temperature and Humidity Sensor | www.adafruit.com |
| **Grove to Grove Connector Cables (6)** | For connecting from Grove to Grove Connectors | Multiple |

## Wiring List

**(Note:  Do all connections with the POWER OFF!  You can destroy components unplugging and plugging them with the power on).**

**Plug the Pi2Grover Grove to Pi Interface onto the Raspberry Pi before beginning.**

| Wiring List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **From** | **To** | **Description** |
| **Pi2Grover / D21/D26** | Weather Board / Grove D Rain Bucket | Grove Cable |
| **Pi2Grover / D26** | Weather Board / Grove D Anemometer | Grove Cable |
| **Pi2Grover / Grove I2C** | OLED Display / Grove I2C | Grove Cable |
| **Pi2Grover / Grove I2C** | Grove 4Ch/16Bit ADC / Grove I2C | Grove Cable |
| **Pi2Grover / Grove I2C** | Weather Board / Grove I2C | Grove Cable |
| **Grove 4Ch/16Bit ADC / Grove A1** | Weather Board / Grove A Wind Vane | Grove Cable |
| **Weather Board / Grove I2C** | Grove AM2315 Temperature / Humidity Sensor | Grove Cable |

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| Wiring List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **From** | **To** | **Description** |
| **(Optional) HTU21D-F Inside Temperature / Humidity Sensor** | Weather Board / JP14 Plug in | Plug in Board |
| **Weather Board RJ11 - Rain Bucket** | WeatherRack Rain Bucket Plug | RJ11 Cable |
| **Weather Board RJ11 - Anemometer / Wind Vane** | WeatherRack Anemometer / Wind Vane Plug | RJ11 Cable |

The software for this setup is at github.com/switchdoclabs/SDL_Pi_WeatherBoard

To test your setup, you can run "sudo i2cdetect -y 1"

Your output should look like this:

```
sudo i2cdetect -y 1
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- 3c -- -- --
40: 40 -- -- -- -- -- -- -- 48 -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- 57 -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- 68 -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- 77
```

# SwitchDoc Labs

## Connecting a Raspberry Pi B+ / Pi2 / Pi3 to the Weather Board Using the Pi2Grover Grove Interface Board (5V) Including a MOD-1016G Grove Lighting Detector



## Parts List

| Parts List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **Part Number** | **Part Description** | **Source** |
| **Raspberry Pi** | Pi B+ / Pi2 / Pi3 / PiZero | Multiple |
| **Pi2Grover** | Raspberry Pi to Grove Interface | www.switchdoc.com |
| **Weather Board** | Weather Instrument and Grove Interface (includes DS3231 RTC) | www.switchdoc.com |
| **Grove AM2315** | Grove I2C Outdoor Temperature and Humidity | www.switchdoc.com |

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| Parts List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **Part Number** | **Part Description** | **Source** |
| MOD-1016G | Grove Lightning Detector | www.embeddedadventures.com www.switchdoc.com |
| WeatherRack | Weather Instruments - Wind Speed, Rain, Wind Vane | www.switchdoc.com www.argentdata.com www.sparkfun.com |
| Grove I2C 4Ch/16Bit ADC | 4 channel 16 bit I2C Analog to Digital Converter | www.switchdoc.com |
| Grove 4 Channel I2C Mux | 4 Channel I2C Mux | www.switchdoc.com |
| I2C 4 Slot Expander | 4 Slot I2C Expander | Multiple |
| Grove OLED 64x128 I2C Display | OLED display for Weather Station | www.switchdoc.com www.seeedstudio.com |
| HUT21D-F Inside Temperature / Humidity Sensor | Optional Inside Temperature and Humidity Sensor | www.adafruit.com |
| Grove to Grove Connector Cables (10) | For connecting from Grove to Grove Connectors | Multiple |
| 4 Female to Female Jumper Wires | Connecting up the I2C Mux Voltages for all busses | Multiple |

## Wiring List

**(Note:  Do all connections with the POWER OFF!  You can destroy components unplugging and plugging them with the power on).**

**Plug the Pi2Grover Grove to Pi Interface onto the Raspberry Pi before beginning.**

| Wiring List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **From** | **To** | **Description** |
| Pi2Grover / D13/D16 | MOD-1016G / Grove IRQ | Grove Cable |
| Pi2Grover / D21/D26 | Weather Board / Grove D Rain Bucket | Grove Cable |
| Pi2Grover / D26 | Weather Board / Grove D Anemometer | Grove Cable |

# SwitchDoc Labs

| Wiring List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
| --- | --- | --- |
| **From** | **To** | **Description** |
| **Pi2Grover / Grove I2C** | 4 Chan I2C Mux / Grove J1 - Computer I2C | Grove Cable |
| **4 Chan I2C Mux / Grove J2** | 4 Slot I2C Expander / Any Slot | Grove Cable |
| **4 Chan I2C Mux / Grove J3** | MOD-1016 / Grove I2C | Grove Cable |
| **4 Chan I2C Mux / Pin Header JP7-1** | 4 Chan I2C Mux / Pin Header JP6-1 | Set Power of I2C Bus to VDD |
| **4 Chan I2C Mux / Pin Header JP7-2** | 4 Chan I2C Mux / Pin Header JP6-2 | Set Power of I2C Bus to VDD |
| **4 Chan I2C Mux / Pin Header JP7-3** | 4 Chan I2C Mux / Pin Header JP6-3 | Set Power of I2C Bus to VDD |
| **4 Chan I2C Mux / Pin Header JP7-4** | 4 Chan I2C Mux / Pin Header JP6-4 | Set Power of I2C Bus to VDD |
| **4 Slot I2C Expander / Any Slot** | OLED Display / Grove I2C | Grove Cable |
| **4 Slot I2C Expander / Any Slot** | Grove 4Ch/16Bit ADC / Grove I2C | Grove Cable |
| **4 Slot I2C Expander / Any Slot** | Weather Board / Grove I2C | Grove Cable |
| **Grove 4Ch/16Bit ADC / Grove A1** | Weather Board / Grove A Wind Vane | Grove Cable |
| **Weather Board / Grove I2C** | Grove AM2315 Temperature / Humidity Sensor | Grove Cable |
| **(Optional) HTU21D-F Inside Temperature / Humidity Sensor** | Weather Board / JP14 Plug in | Plug in Board |
| **Weather Board RJ11 - Rain Bucket** | WeatherRack Rain Bucket Plug | RJ11 Cable |
| **Weather Board RJ11 - Anemometer / Wind Vane** | WeatherRack Anemometer / Wind Vane Plug | RJ11 Cable |

The software for this setup is at github.com/switchdoclabs/SDL_Pi_WeatherBoard

To test your setup, you can run "sudo python

Your output should look like this:

```
sudo python testSDL_Pi_TCA9545.py

Test SDL_Pi_TCA9545 Version 1.0 – SwitchDoc Labs

Sample uses 0x73
```

# SwitchDoc Labs

**Program Started at:2016-07-18 22:10:38**


```
-----------BUS 0-------------------
tca9545 control register B3-B0 = 0x1
ignore Interrupts if INT3' - INT0' not connected
tca9545 control register Interrupts = 0x0
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- 3c -- -- --
40: 40 -- -- -- -- -- -- -- 48 -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- 57 -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- 68 -- -- -- -- -- -- --
70: -- -- -- 73 -- -- -- 77
```


```
------------------------------------
```


```
-----------BUS 1-------------------
tca9545 control register B3-B0 = 0x2
ignore Interrupts if INT3' - INT0' not connected
tca9545 control register Interrupts = 0x0
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          03 -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- 73 -- -- -- --
```


```
------------------------------------
```


```
-----------BUS 2-------------------
tca9545 control register B3-B0 = 0x4
ignore Interrupts if INT3' - INT0' not connected
tca9545 control register Interrupts = 0x0
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
```

```
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- 73 -- -- -- --
```

------------------------------------

```
-----------BUS 3-------------------
tca9545 control register B3-B0 = 0x8
ignore Interrupts if INT3' - INT0' not connected
tca9545 control register Interrupts = 0x0
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- 73 -- -- -- --
```

------------------------------------

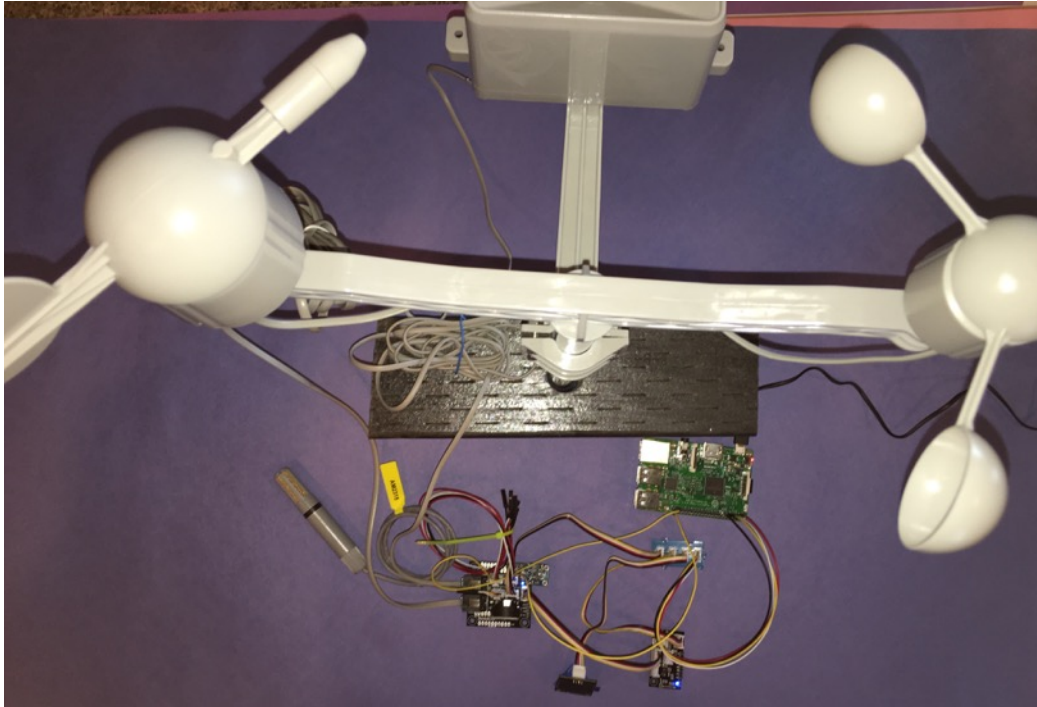# SwitchDoc Labs

## Connecting a Raspberry Pi B+ / Pi2 / Pi3 to the Weather Board Using Pin Headers (3.3V)



You can build this version without a Pi2Grover Interface board using pin headers and jumpers. We are using Grove to Pin Header cables and an I2C Expander to simplify the wiring.

## Parts List

| Parts List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **Part Number** | **Part Description** | **Source** |
| **Raspberry Pi** | Pi B+ / Pi2 / Pi3 / PiZero | Multiple |
| **Weather Board** | Weather Instrument and Grove Interface (includes DS3231 RTC) | www.switchdoc.com |
| **Grove AM2315** | Grove I2C Outdoor Temperature and Humidity | www.switchdoc.com |

# SwitchDoc Labs

| Parts List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **Part Number** | **Part Description** | **Source** |
| **WeatherRack** | Weather Instruments - Wind Speed, Rain, Wind Vane | www.switchdoc.com www.argentdata.com www.sparkfun.com |
| **Grove I2C 4Ch/16Bit ADC** | 4 channel 16 bit I2C Analog to Digital Converter | www.switchdoc.com |
| **I2C 4 Slot Expander** | 4 Slot I2C Expander | Multiple |
| **Grove OLED 64x128 I2C Display** | OLED display for Weather Station | www.switchdoc.com www.seeedstudio.com |
| **HUT21D-F Inside Temperature / Humidity Sensor** | Optional Inside Temperature and Humidity Sensor | www.adafruit.com |
| **Grove to Female Pin Headers (2)** | For connecting from Grove to Pin Headers | Multiple |
| **Grove to Grove Connector Cables (4)** | For connecting from Grove to Grove Connectors | Multiple |

## Wiring List

**(Note:  Do all connections with the POWER OFF!  You can destroy components unplugging and plugging them with the power on).**

**Plug the Pi2Grover Grove to Pi Interface onto the Raspberry Pi before beginning.**

| Wiring List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **From** | **To** | **Description** |
| **Weather Board / Grove D Rain Bucket** | | Grove Cable |
| **Weather Board / Grove D Anemometer** | | Grove Cable |
| **Raspberry Pi GPIO Pin 3 - SCL** | Yellow Wire Grove to Male Pin Header Cable #1 | Grove to Pin Header Cable |
| **Raspberry Pi GPIO Pin 2 - SDA** | White Wire Grove to Male Pin Header Cable #1 | Grove to Pin Header Cable |
| **Raspberry Pi GPIO Pin 1 - 3.3V** | Red Wire Grove to Male Pin Header Cable #1 | Grove to Pin Header Cable |

| Wiring List for Raspberry Pi B+ / Pi2 / Pi3 / PiZero with Pi2Grover and Lightning Detector | | |
|---|---|---|
| **From** | **To** | **Description** |
| **Raspberry Pi GPIO Pin 6 - GND** | Black Wire Grove to Male Pin Header Cable #1 | Grove to Pin Header Cable |
| **Grove to Male Pin Header Cable #1** | I2C 4 Slot Expander / Any Slot | |
| **I2C 4 Slot Expander / Any Slot** | Grove 4Ch/16Bit ADC / Grove I2C | Grove Cable |
| **I2C 4 Slot Expander / Any Slot** | Grove OLED / Grove I2C | Grove Cable |
| **I2C 4 Slot Expander / Any Slot** | Weather Board / Grove I2C | Grove Cable |
| **Raspberry Pi GPIO Pin 37 - GPIO 26** | Yellow Wire Grove to Male Pin Header Cable #2 - Anemometer | Grove to Pin Header Cable |
| **Grove to Male Pin Header Cable #2** | Weather Board / Grove Digital Anemometer | |
| **Raspberry Pi GPIO Pin 40 - GPIO 21** | Yellow Wire Grove to Male Pin Header Cable #3 - Wind Vane | Grove to Pin Header Cable |
| **Grove to Male Pin Header Cable #3** | Weather Board / Grove Digital Rain Bucket | |
| **Grove 4Ch/16Bit ADC / Grove A1** | Weather Board / Grove A Wind Vane | Grove Cable |
| **Weather Board / Grove I2C** | Grove AM2315 Temperature / Humidity Sensor | Grove Cable |
| **(Optional) HTU21D-F Inside Temperature / Humidity Sensor** | Weather Board / JP14 Plug in | Plug in Board |
| **Weather Board RJ11 - Rain Bucket** | WeatherRack Rain Bucket Plug | RJ11 Cable |
| **Weather Board RJ11 - Anemometer / Wind Vane** | WeatherRack Anemometer / Wind Vane Plug | RJ11 Cable |

The software for this setup is at github.com/switchdoclabs/SDL_Pi_WeatherBoard

To test your setup, you can run "sudo i2cdetect -y 1"

Your output should look like this:

```
sudo i2cdetect –y 1
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
```

```
20: -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- 3c -- -- --
40: 40 -- -- -- -- -- -- -- 48 -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- 57 -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- 68 -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- 77
```

## Connecting an Arduino UNO or Mega2560 Using an Arduino Grove Shield

*Coming Soon*

## Connecting an Arduino UNO or Mega2560 Using Pin Headers

*Coming Soon*

## Control Panels

The RasPiConnect and ArduinoConnect for the Weather Board are available in the App store. The control panel for the Weather Board is shown below.