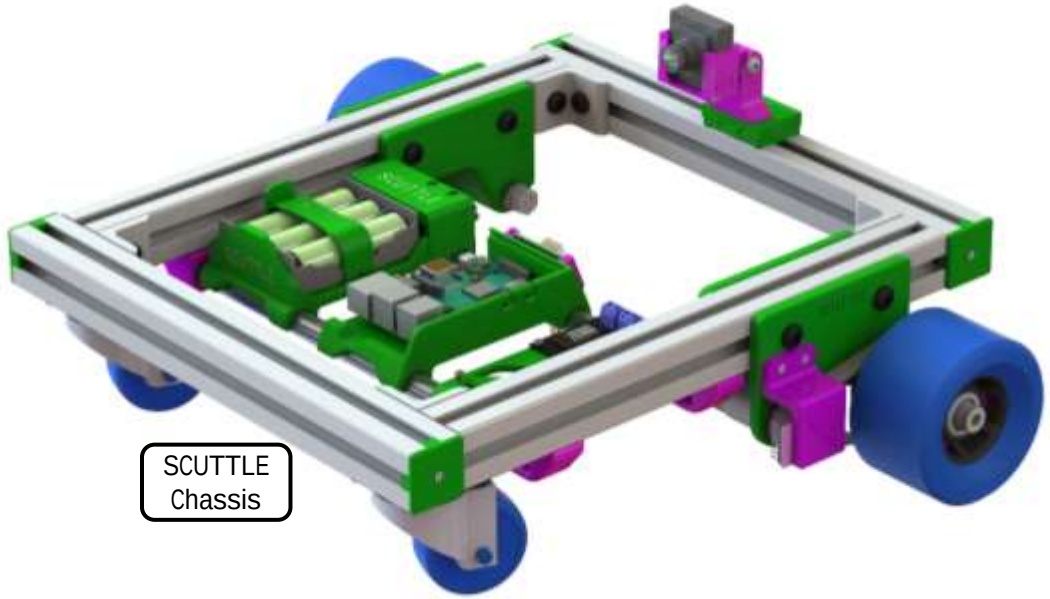
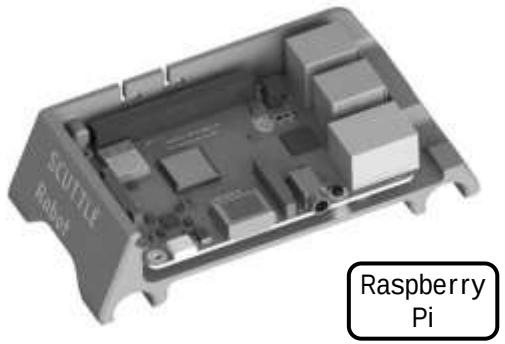
Scuttle robot Wiring Guide (rev 2020.12.09)

mxet.github.io/SCUTTLE



SCUTTLE Chassis



Raspberry Pi

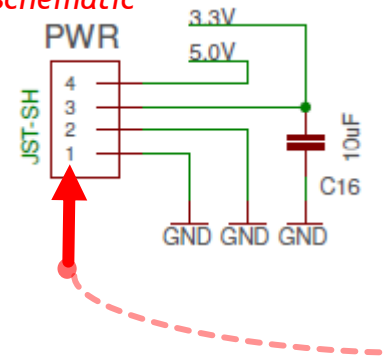
Beaglebone Blue

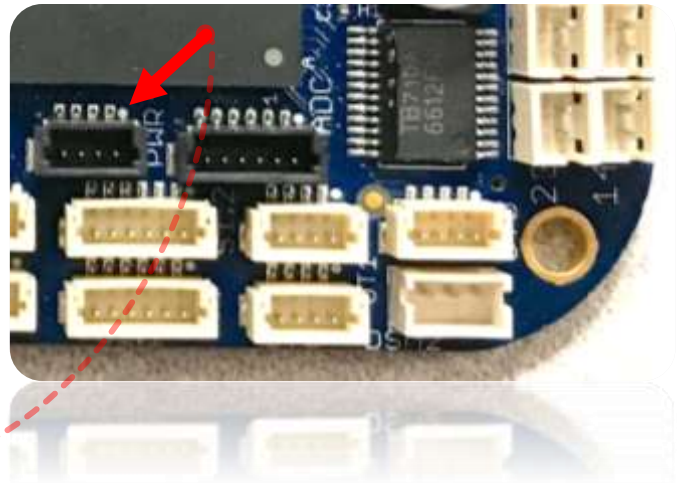
Jetson Nano

Before You Begin:

Important Info:
To match the beaglebone pins to the pin numbers on the diagram:
The tiny white circle on the silkscreen at each connector indicates “pin1”

images of this style are copied directly from the beaglebone schematic





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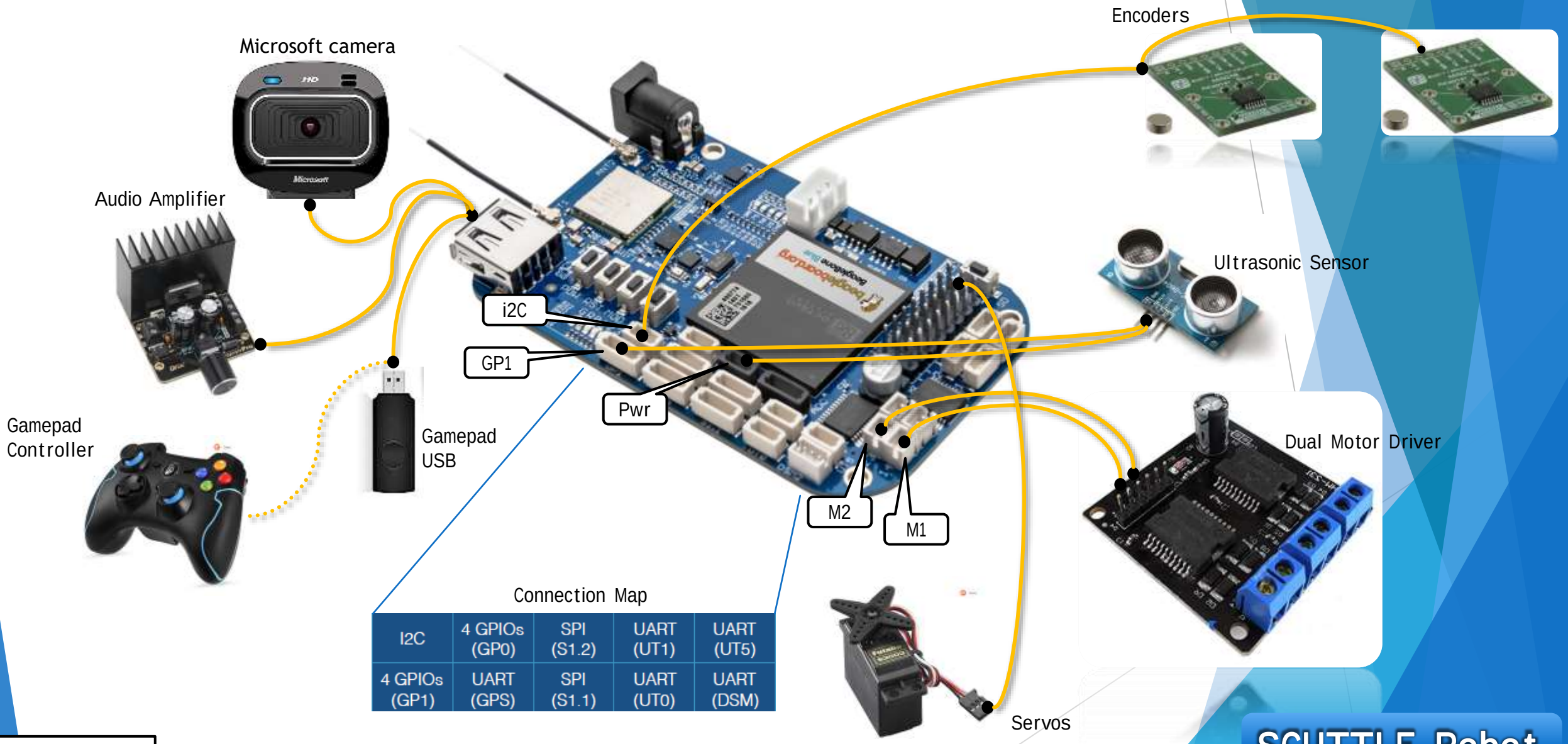
Validated Sensors & Actuators



Connection Map

I2C	4 GPIOs (GP0)	SPI (S1.2)	UART (UT1)	UART (UT5)
4 GPIOs (GP1)	UART (GPS)	SPI (S1.1)	UART (UT0)	UART (DSM)

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Motor Driver Signal Cables

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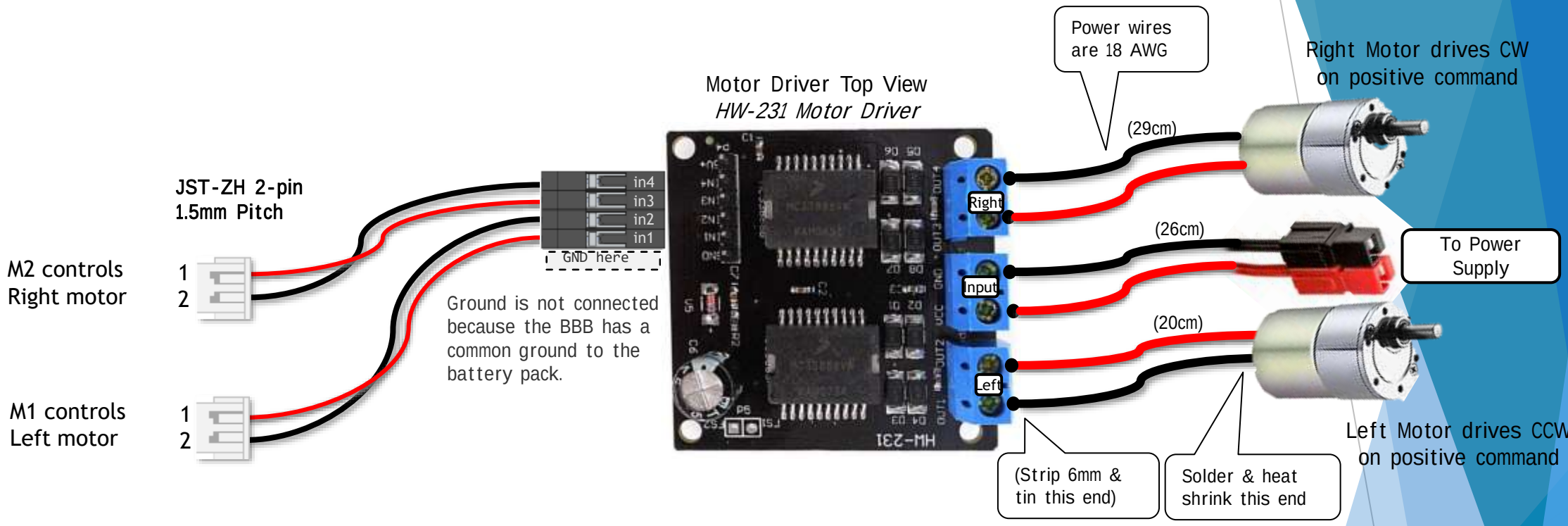

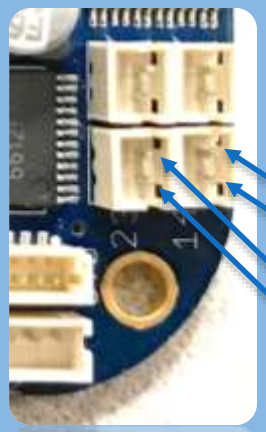

Pin 1 should be HIGH when
motor is driven FORWARD

Motor1 Pin1
Motor1 Pin2

Motor2 Pin1
Motor2 Pin2

Hardware design convention:
Pin 1 uses the square solder pad.

Connector vector
image reserved.

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H-Bridge L298N (optional)

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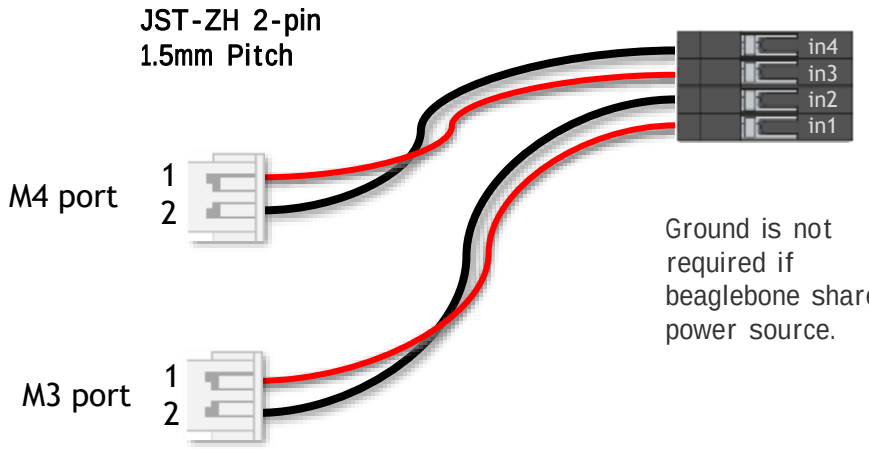
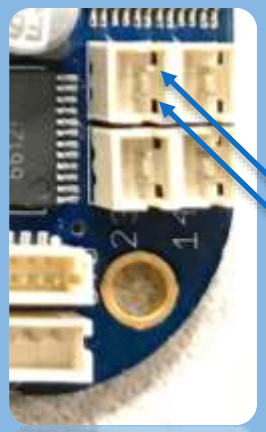
A versatile and cheap device for delivering variable voltage to low-powered DC actuators.



Ground is not required if beaglebone shares power source.

L298N DUAL H-BRIDGE

Image (and more great info!) found at [LastMinutEngineers.com]



Pin 1 should be HIGH when motor is driven FORWARD

Motor3 Pin1
Motor3 Pin2

More information about the 5v regulator
Found on the datasheet (L78M05)

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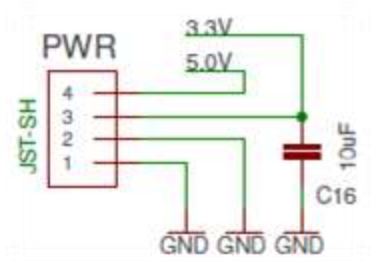
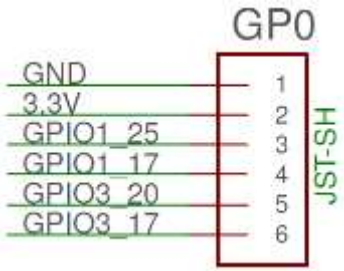
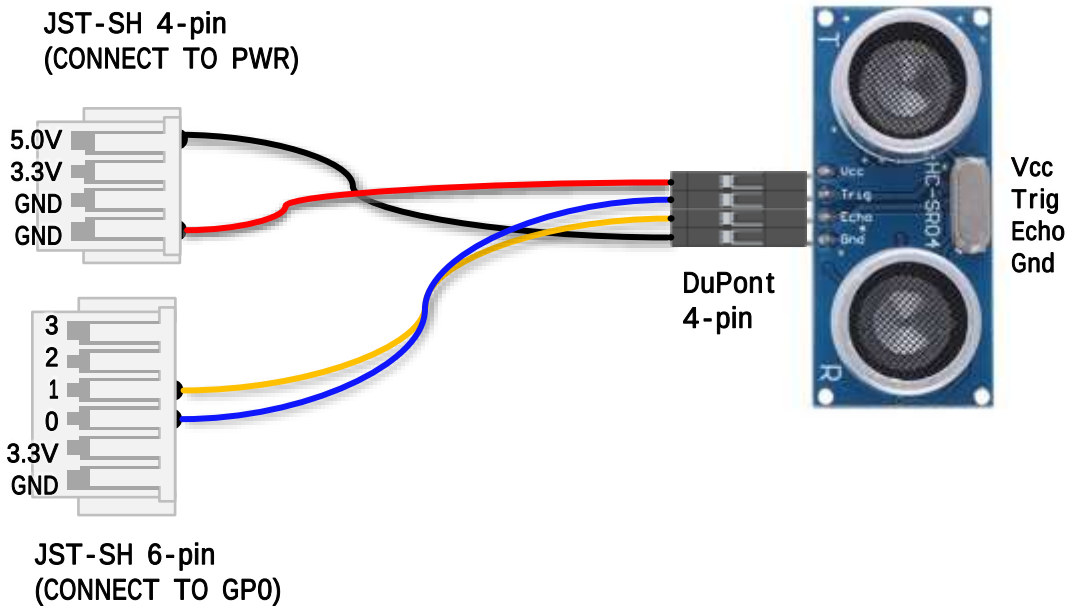
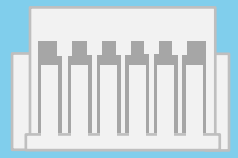
Ultrasonic Distance Sensor (GPIO)







NOTE: For JST connectors out-of-box, the colors are not in the correct order. You need to rearrange them.



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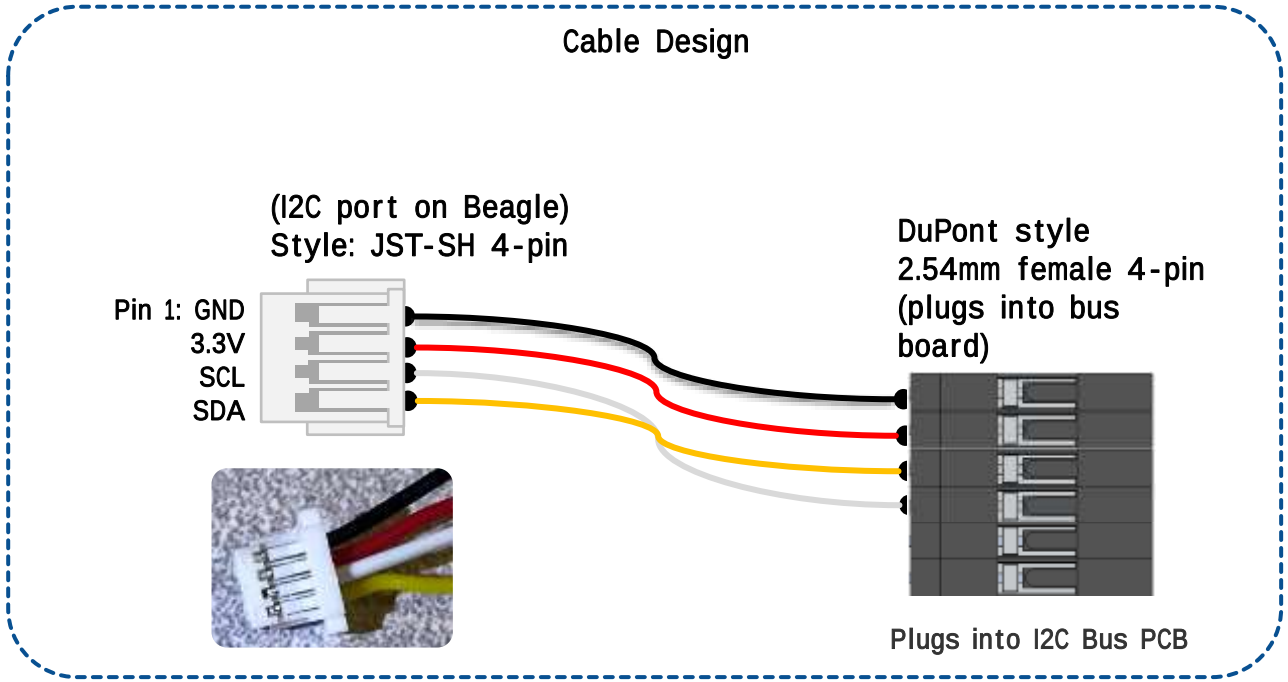
Beaglebone to I2C bus cable



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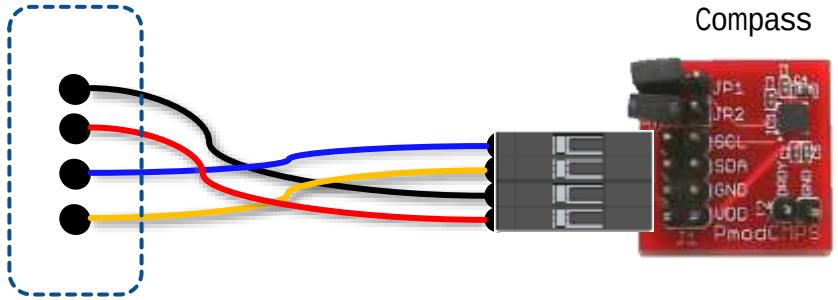
Compass CMPS or CMPS2 (I2C)

Plugs into I2C Bus Board

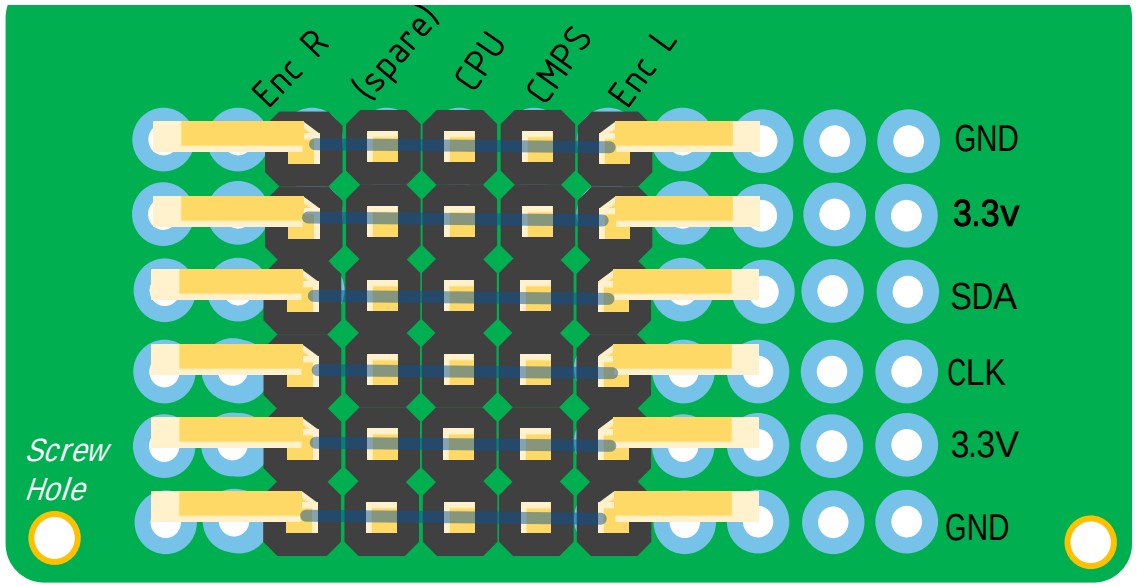


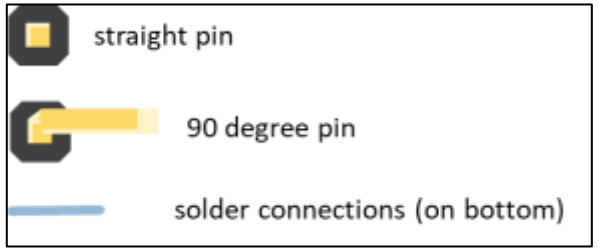
This compass is not necessary since you can access the compass on the beaglebone blue. Be sure to calibrate the compass on the blue since it lies within close proximity of magnetic hardware on the robot.

I2C Bus Board

Option A: solder a perfboard / breadboard

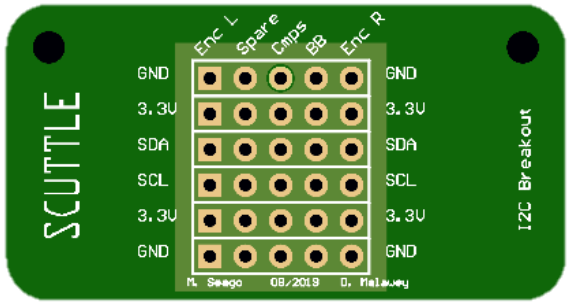
The board is made from a breadboard and soldered manually. The board can be cut between rows J & K. The solder bridges all pins from left to right.





Option B: Order the custom PCB

You can order the custom PCB from JLCPCB.com or any other service. We have posted the design files on our github under electronics hardware.



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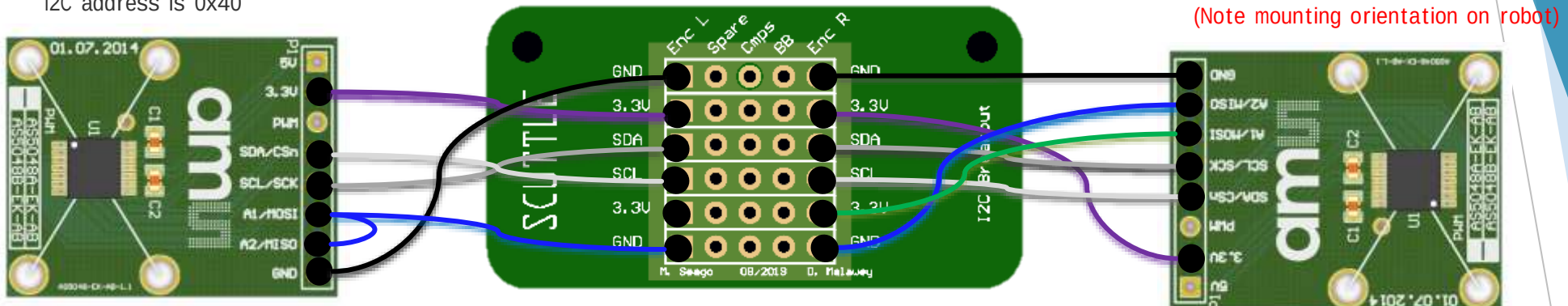
Encoder AMS AS5048 (I2C)

Left Hand Encoder
A1 is pulled **down** to GND
I2C address is 0x40

Nodes on the I2C bus board are indicated here

Right Hand Encoder
A1 is pulled **up** to 3.3v
I2C address is 0x41
(Note mounting orientation on robot)



Left

Right

PIN	Left	Right
A1	0 (low)	1 (high)
A2	0 (low)	0 (low)
i2C Address	0x40	0x41

On the Left Hand Encoder PCB, bridge the pins A1 and A2 using solder, to each other.

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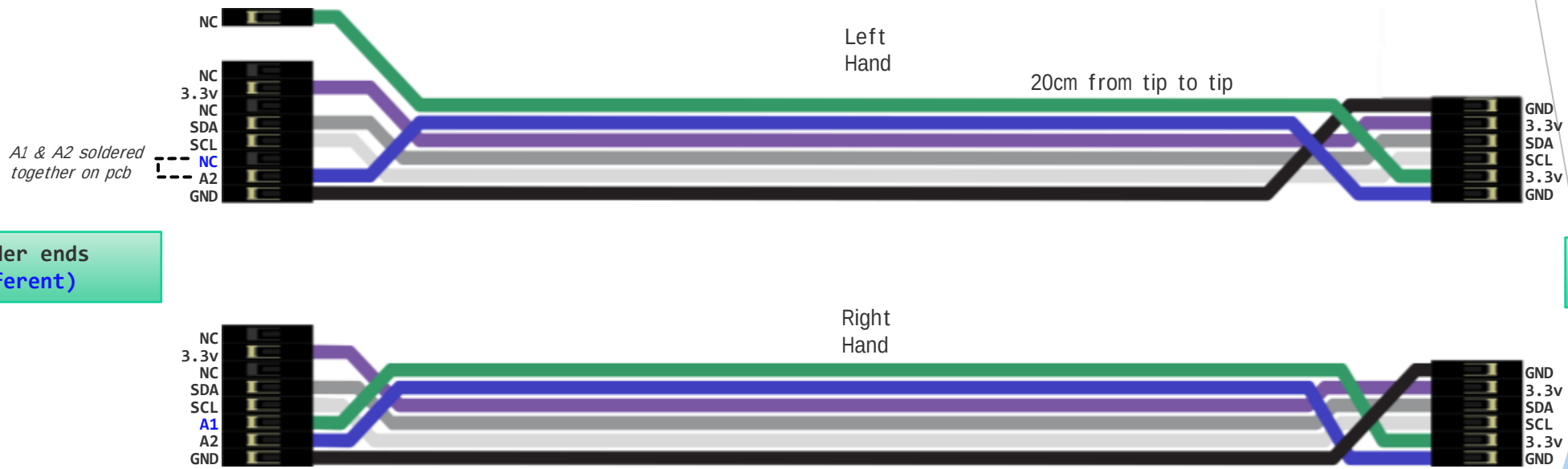
Encoder Cables

Cables modified as of 2020.12

SDA = GREY SCL= WHITE



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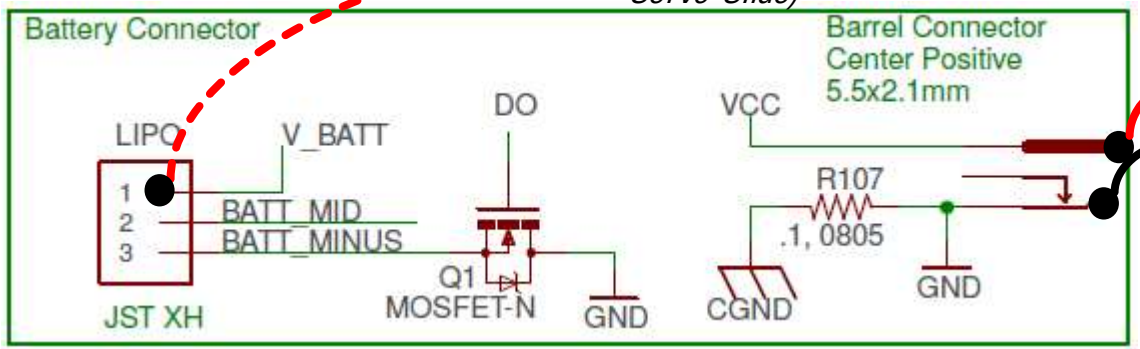
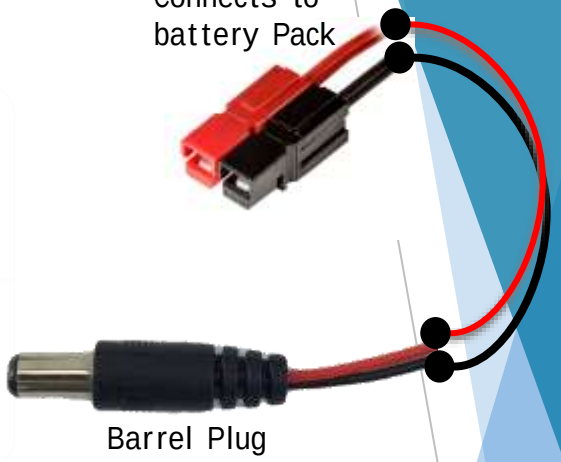
Battery

As an option, bridge LiPo terminal to 12v positive terminal (see Servo Slide)

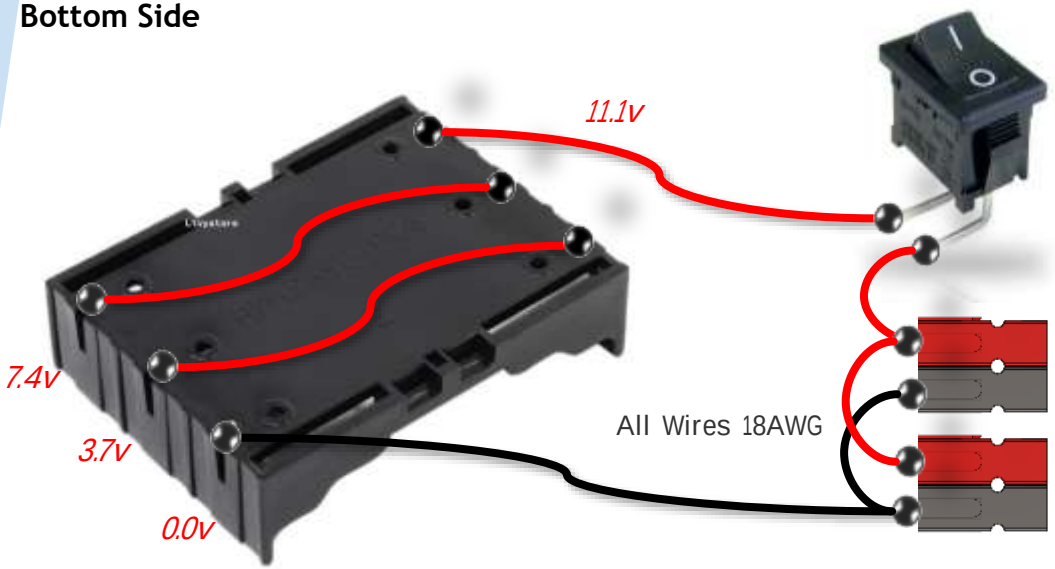




The "Battery Connector" is disconnected. Actual battery uses Barrel Connector.

Battery Pack (version1 configuration)

Bottom Side



3-Cell 18650 holder

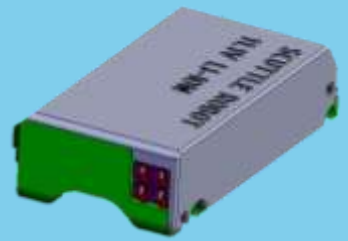
Switch PN:SRB22A2FBBNN
Carries 10A max

Two pairs of Anderson connectors are attached here.

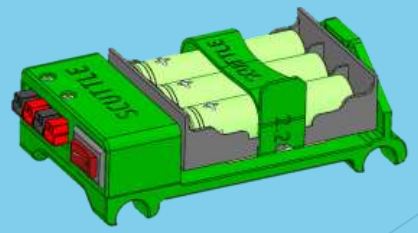
This battery pack was used through 2020.09. The wires are appropriate for the CAD designs posted prior to version 2.1.

You may build a battery pack without a Battery Management System (BMS) as shown here, or copy our latest design which includes BMS. See next slide.

Pack version 1
BMS: does not fit
Model on GrabCAD



Pack version 2
BMS: optional
Model on GrabCAD



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Battery Pack (v2, enhanced with BMS)

The BMS adds several functions to the battery pack. Look out for a Youtube video covering the SCUTTLE BMS soon (-DM 2020.11)

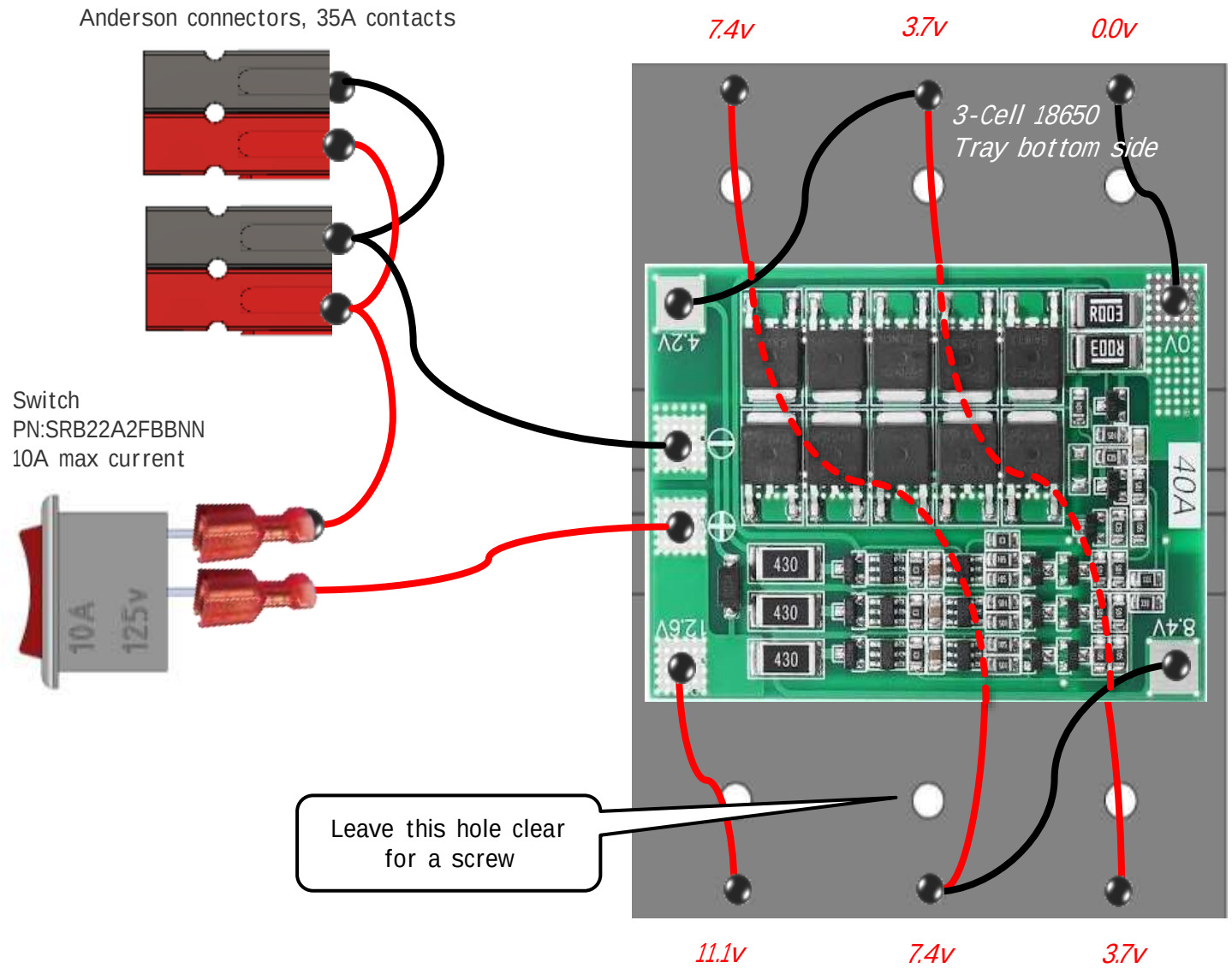

Table of wires to cut (11 total)

Length (mm)
25, 25
35, 35
55, 55
65
70
90, 90, 90

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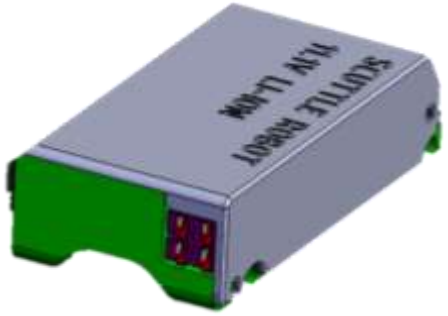
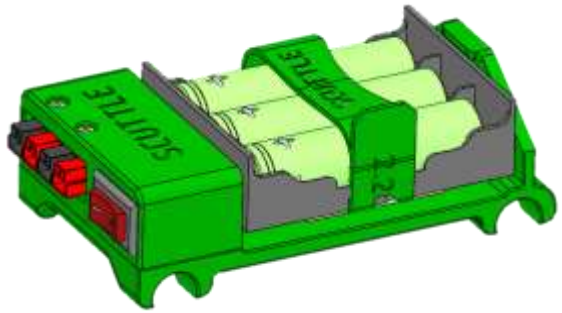
Battery Pack Styles

Pack version 1
- BMS: does not fit
- Model on GrabCAD
- Access CAD model from within SCUTTLE assembly



Pack version 2
- BMS: optional
- Model on GrabCAD
- Access the model as a standalone assembly

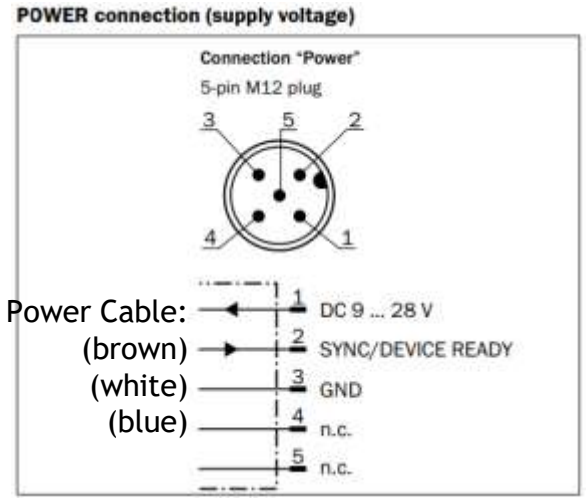


LIDAR

Lidar Device

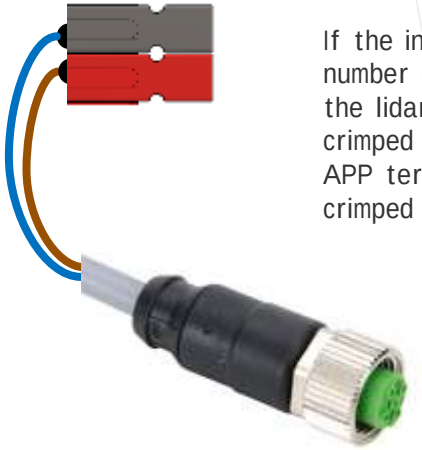
TiM 561

Power Connector Diagram (lidar side)



LIDAR-side connector (male pins)

Power Cable Diagram (plugs into lidar)



If the indicated cable part number is used for power to the lidar, brown will be crimped into the 12v positive APP terminal and blue is crimped into the negative.

Cable: 7000-12241-2150300

Cable-side connector (female pins)

Typical Lidar power consumption: 2.1w

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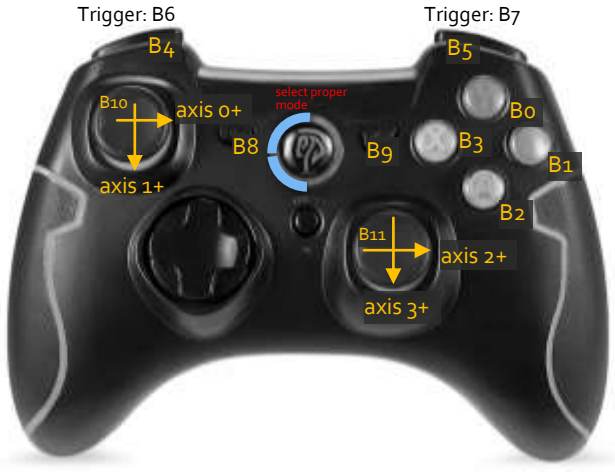
GamePad

Gamepad Controls Mapping



Button Behavior:

- not pressed: 0
- Pressed: 1

Axis behavior:

- Right returns positive values
- down returns positive values

- Outputs:
- Analog axes return values between -1 and 1
- These axes reach their limits before the hard-stop.
- To discover the behavior graphically, visit the html graphical test page here

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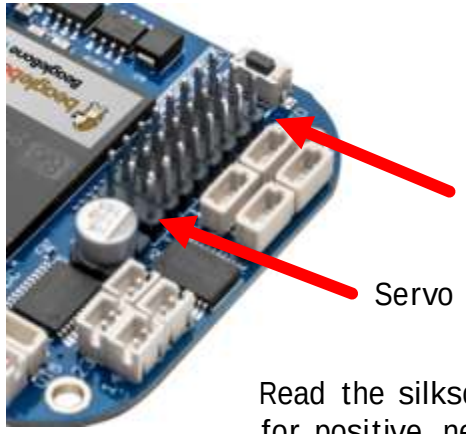
Servos

Bridge Power to the liPo connector

Without a power source available at the positive (third pin) input of the liPo connector, the board has insufficient current available to the servos to drive servos at full torque or to drive multiple servos.

A safe fix is to solder the positive terminal of the DC jack to the third pin of the connector shown. When a battery is connected, the pins correspond to 0.0v, 3.7v, and 7.2v terminals of a 2-cell lipo.



Read the silkscreen to see correct connector orientation for positive, negative, and signal.

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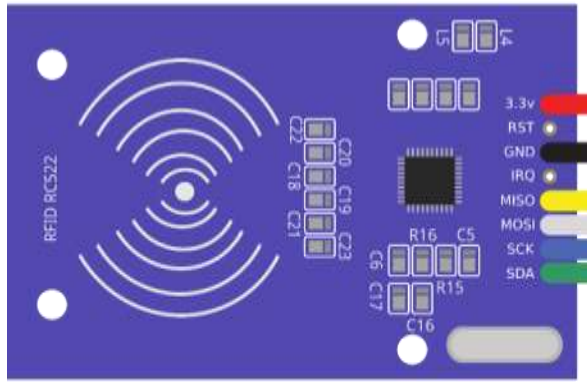
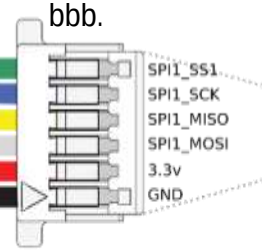
RFID reader

RC522 low-cost
RFID Scanner



Plug into 6-pin
JST-SH port on
bbb.



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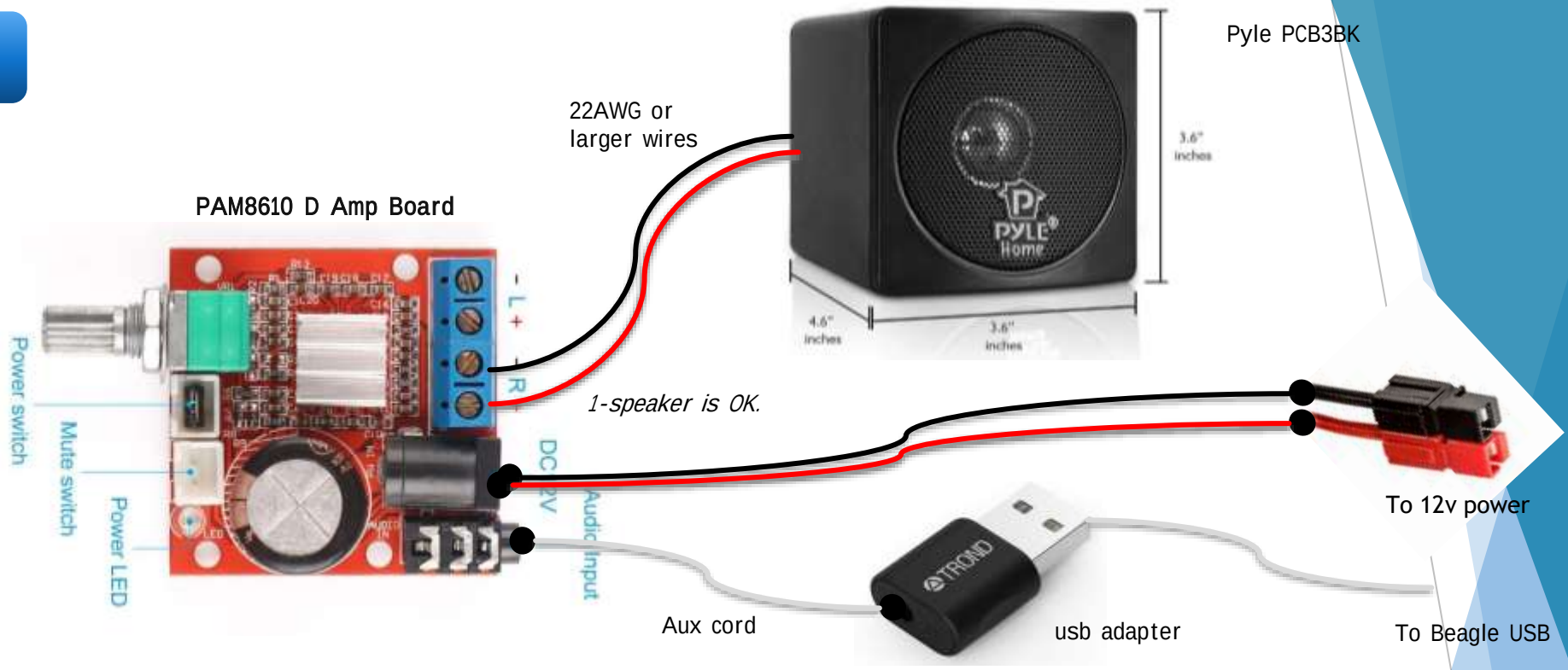
Audio Amp



Alternative:

The above setup will support at least 10 watts (this is actually quite loud – easy to hear in a crowded room).

It is also possible to find a speaker which receives BOTH power AND signal over USB. These will be more compact but less powerful. (The speaker shown is 3w max)

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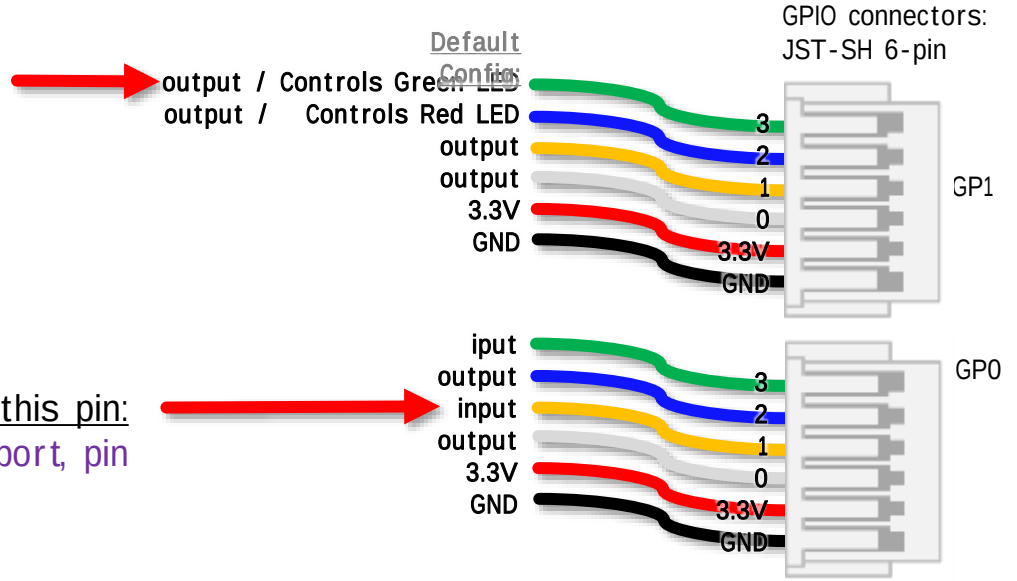
GPIO Connections

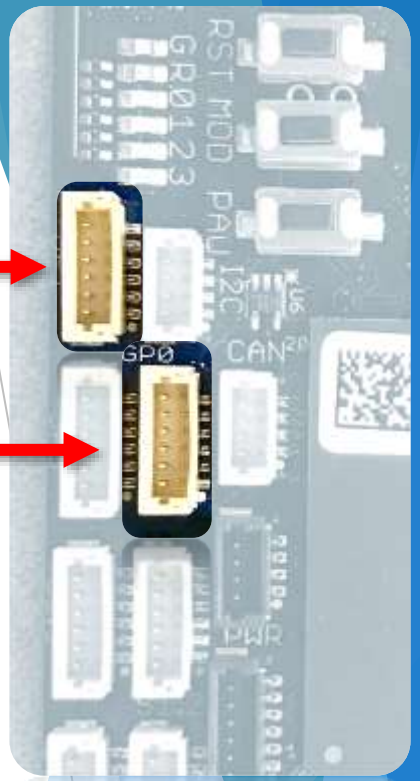
Example call for writing to this pin:
write(1,3,1) # arguments: port, pin, state



GPIO connectors:
JST-SH 6-pin

Example call for reading this pin:
read(0, 1) #arguments: port, pin

SCUTTLE naming convention (used in L1_gpio.py)



Note: JST wires don't come with the proper color sequence. They must be rearranged.

Connector vector image preserved for later use.

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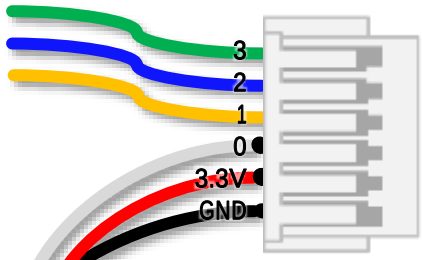
GPIO Example - Relay



GP0 connector
JST-SH 6-pin on
Beagle

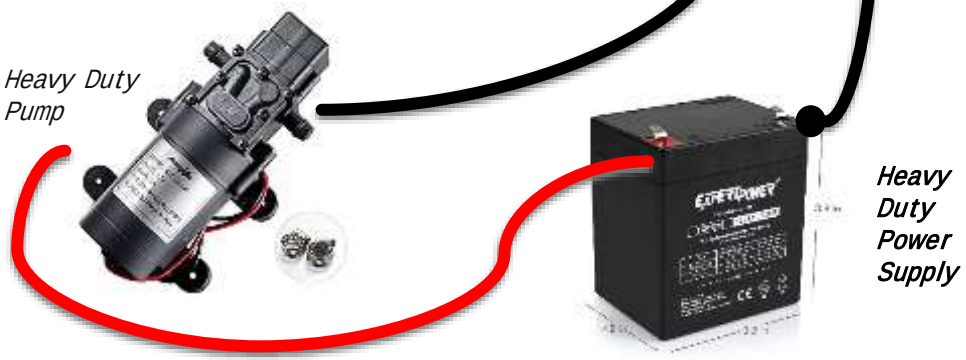
Relays are appropriate for switching of high powered devices. For heavy pumps, motors, fans, or floodlights, it may be best to add a dedicated power source such as an ancilliary battery. Then, control the power to the device using logic-level signals and a relay or solid-state relay.

A great detailed writeup is here.

3v Relay with both Normally Open (NO) contact and Normally Closed (NC) contact.

This kind of board usually includes an opto-coupler and your powered device does NOT need to share a ground with your microcomputer. There are two circuits here, isolated from each other.

Heavy Duty Pump



Heavy Duty Power Supply

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Twin Relays (tested)

Successfully tested setup 2020.10.10

- Jumper pin is removed from Vcc pins
- Send GND and 5v to the device from Beaglebone PWR
- In our test, the 3.3v from Beagle was insufficient to drive the relays
- Our device was found to be active low although advertised as active high

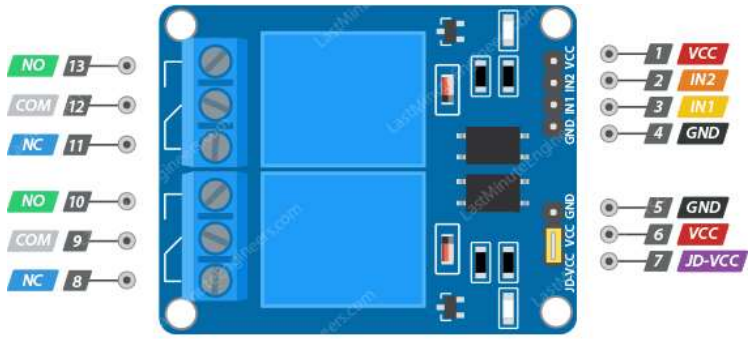
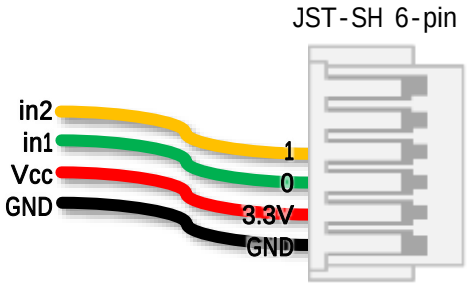
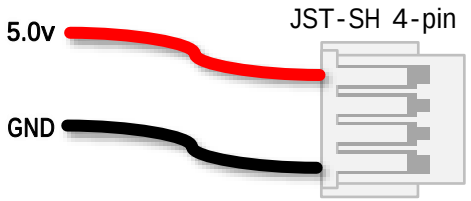
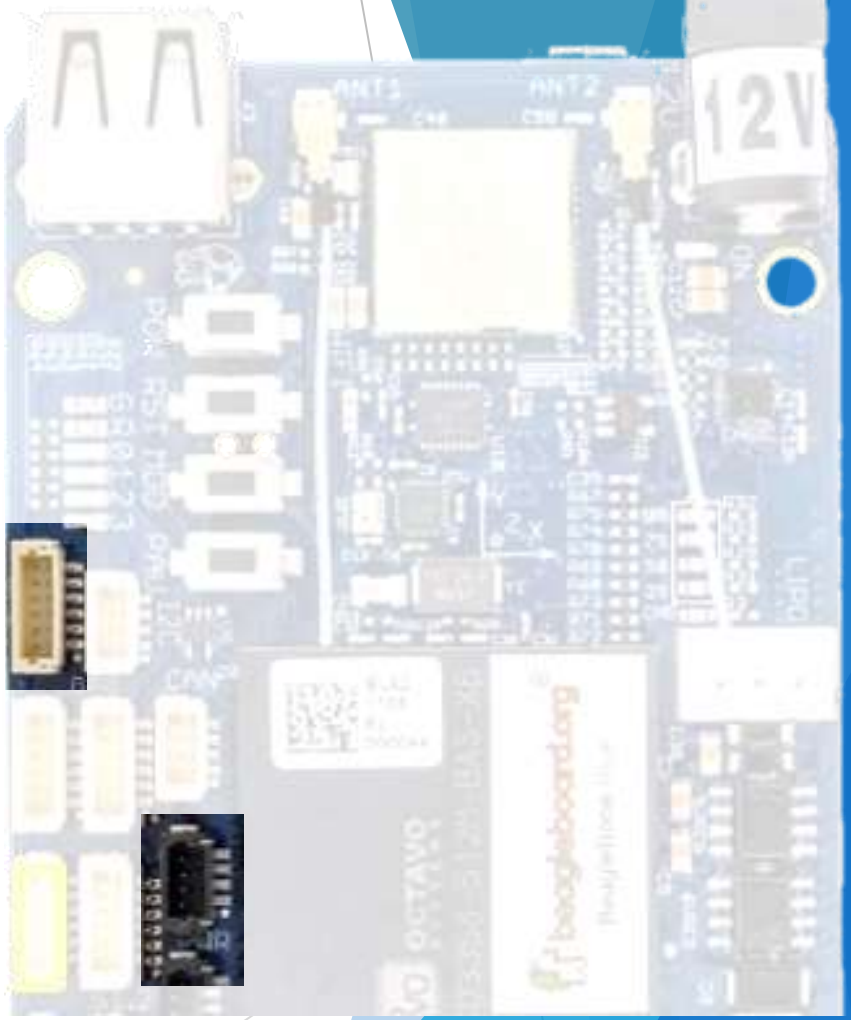


Image credit: Last Minute Engineers (visit)







The problem with active-low relays:
If you have an actuator which must not be actuated until the right moment, (such as a car horn we tested indoors) an active-low device may cause you trouble.

Unless the coil power is provided at the exact moment that the signal pin is driven high, there will be an actuation during startup. Consider this when you shop for a relay.

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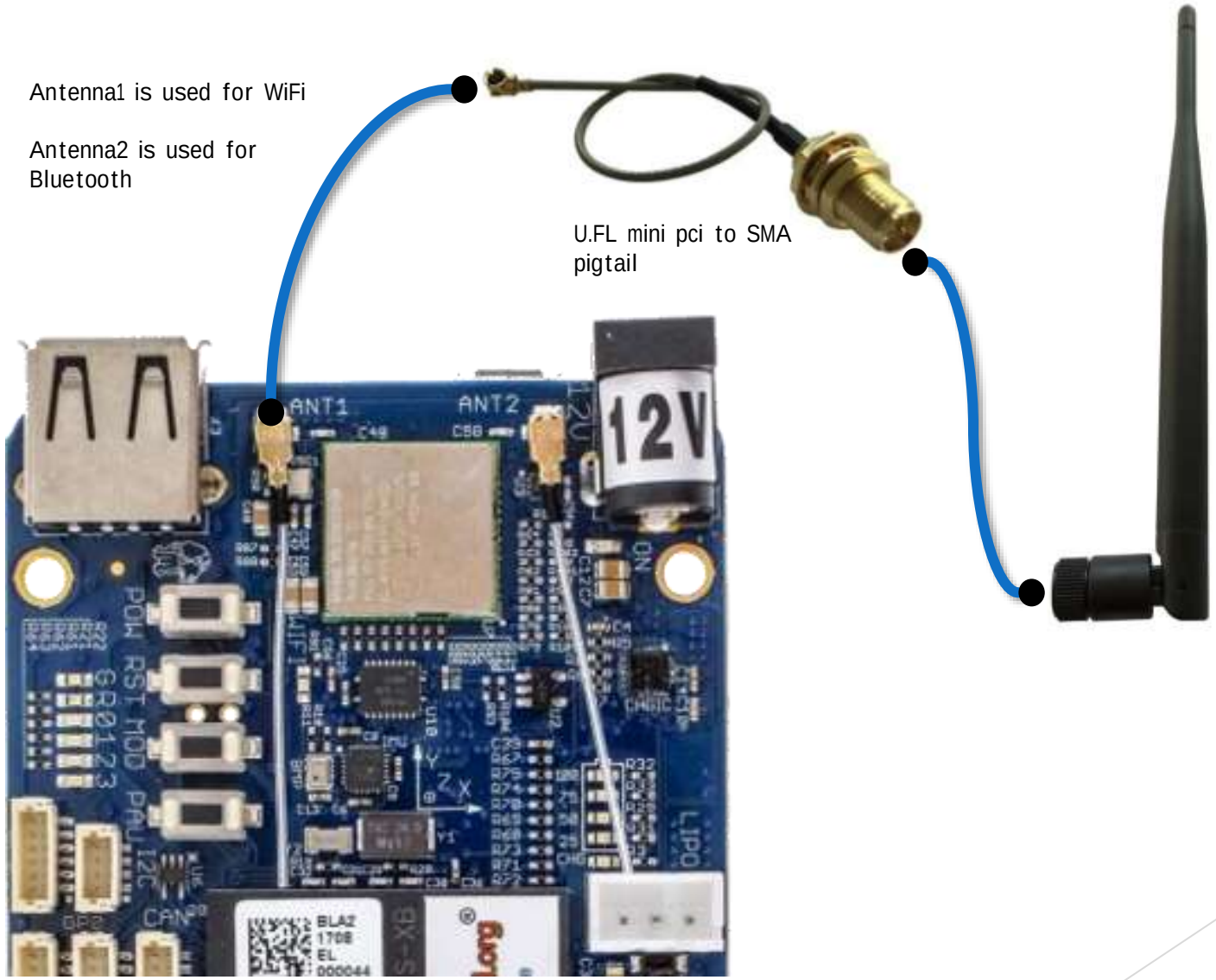
Wifi Antenna

Users can replace the small onboard antenna with their own selected antenna.

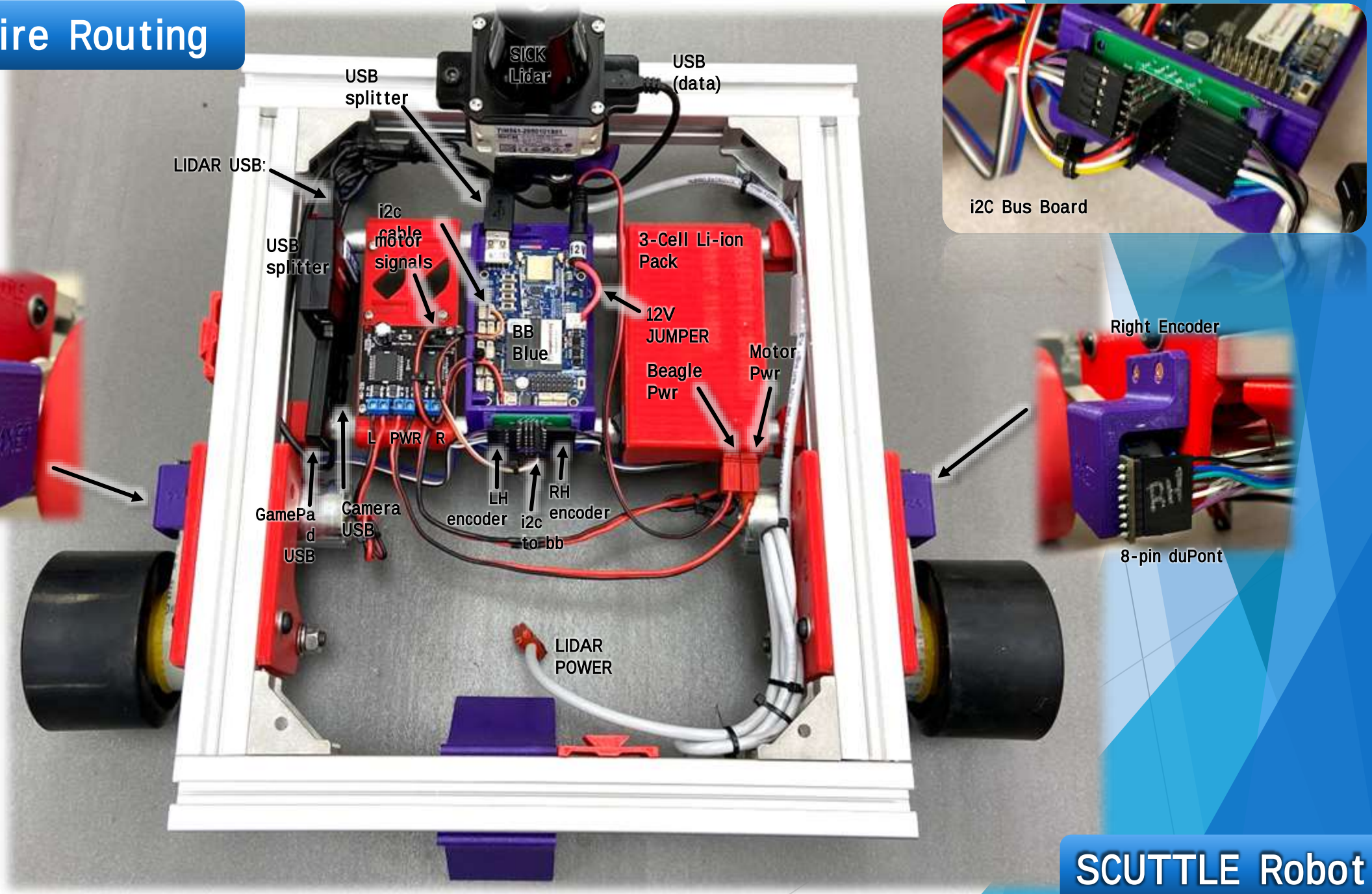
Antenna1 is used for WiFi

Antenna2 is used for Bluetooth



If you see a mistake email:
scuttleproject@gmail.com

SCUTTLE Wire Routing



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SCUTTLE Robot