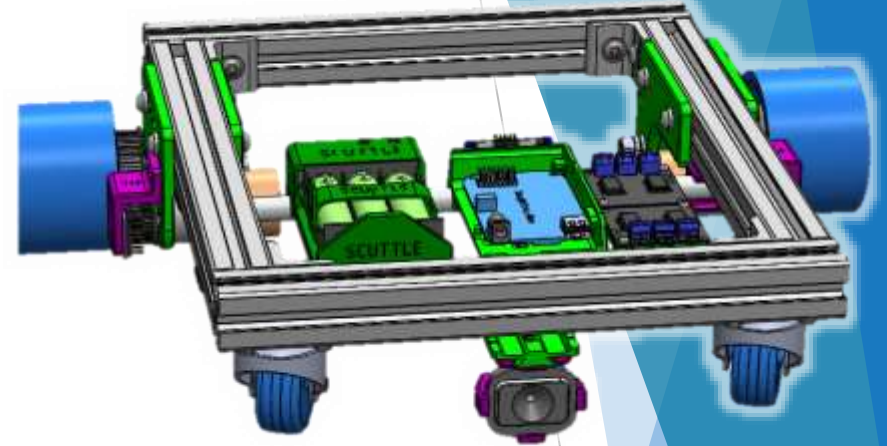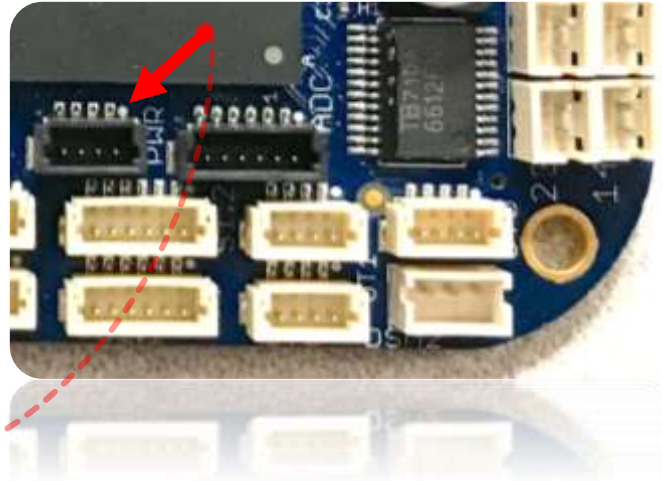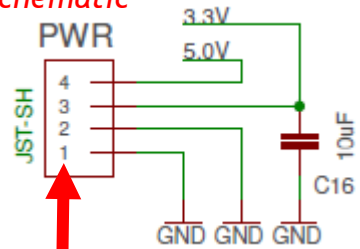# Scuttle robot Wiring Guide (rev 2020.11.12)

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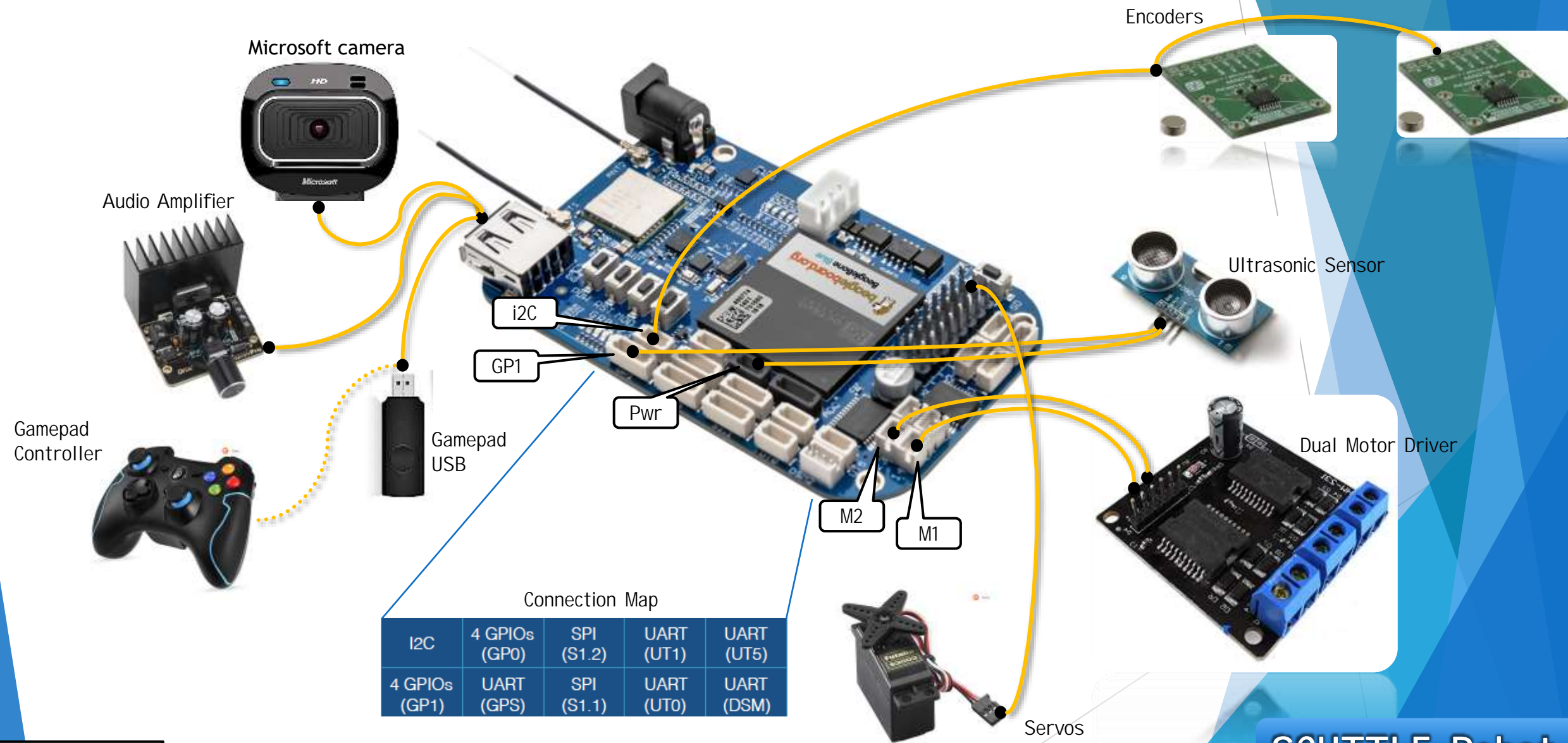To match the beaglebone pins to the pin numbers on the diagram:
The tiny white circle on the silkscreen at each connector indicates "pin1"

images of this style are copied directly from the beaglebone schematic

SCUTTLE Robot

Validated Sensors & Actuators

Microsoft camera

Audio Amplifier

Encoders

Ultrasonic Sensor

i2C

GP1

Pwr

Gamepad
Controller

Gamepad
USB

M2

M1

Dual Motor Driver

Servos

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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scuttleproject@gmail.com

SCUTTLE Robot

Motor Driver Signal Cables

Power wires
are 18 AWG

Right Motor drives CW
on positive command

Motor Driver Top View
HW-231 Motor Driver

(29cm)

JST-ZH 2-pin
1.5mm Pitch

in4
in3
in2
in1

GND here

**M2 controls
Right motor**

1
2

Right

To Power
Supply

(26cm)

Ground is not connected
because the BBB has a
common ground to the
battery pack.

Input

**M1 controls
Left motor**

1
2

(20cm)

Left

Left Motor drives CCW
on positive command

(Strip 6mm &
tin this end)

Solder & heat
shrink this end

Pin 1 should be HIGH when
motor is driven FORWARD

Hardware design convention:
Pin 1 uses the square solder pad.
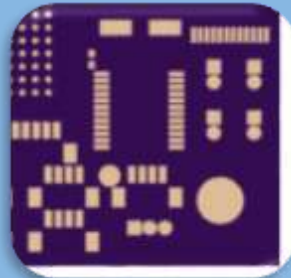
Connector vector
image reserved.

Motor1 Pin1
Motor1 Pin2

Motor2 Pin1
Motor2 **Pin2**

SCUTTLE Robot

H-Bridge L298N (optional)

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

Connect any actuator
(below 2A)

L298N DUAL H-BRIDGE

JST-ZH 2-pin
1.5mm Pitch

in4
in3
in2
in1

M4 port
1
2

To Power
Supply

output

Input
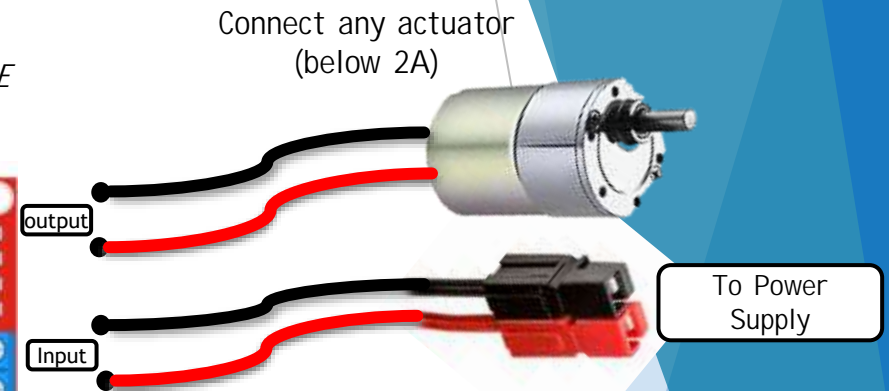
Ground is not
required if
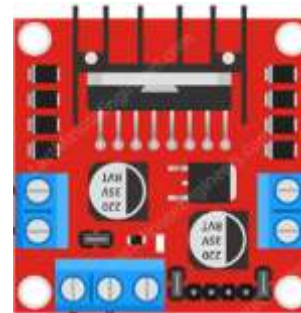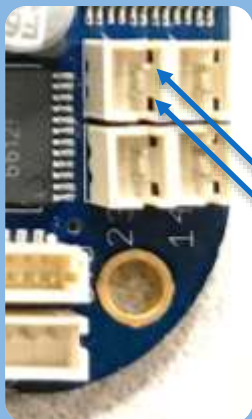beaglebone shares
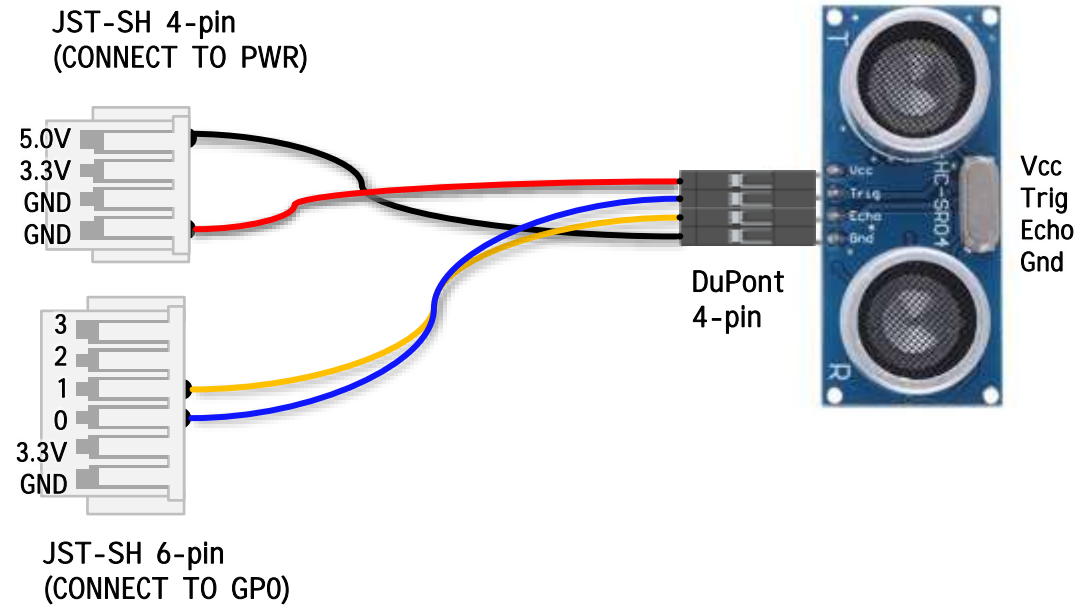power source.

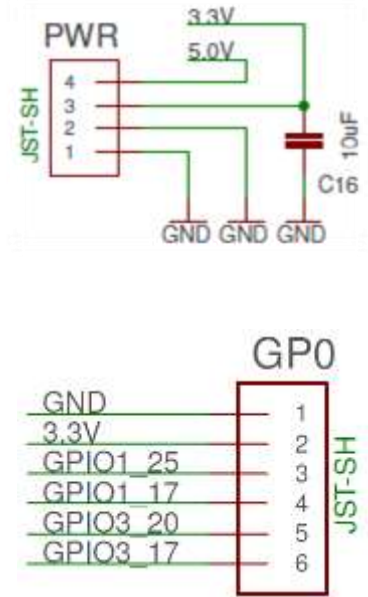M3 port
1
2
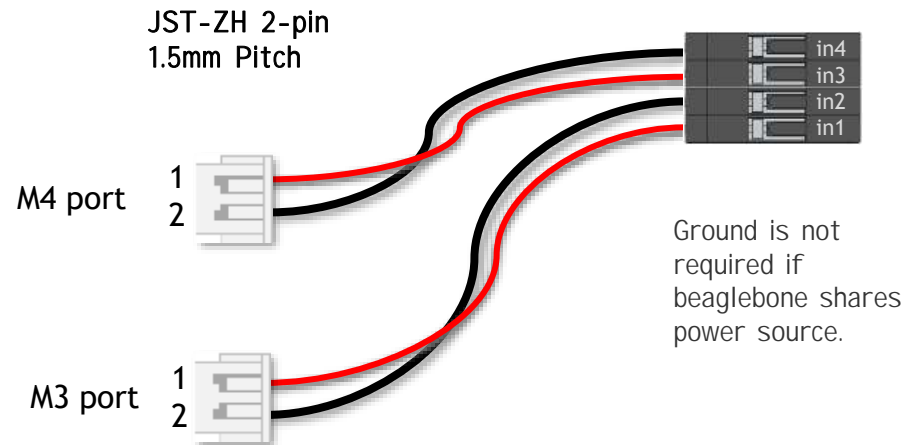
Image (and more great info!) found at LastMinutEngineers.com

Pin 1 should be HIGH when
motor is driven FORWARD

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

Motor3 Pin1
Motor3 **Pin2**

SCUTTLE Robot

Ultrasonic Distance Sensor (GPIO)

PWR

JST-SH

4
3
2
1

3.3V
5.0V

10uF
C16

GND GND GND

GP0

GND
3.3V
GPIO1_25
GPIO1_17
GPIO3_20
GPIO3_17

1
2
3
4
5
6

JST-SH

JST-SH 4-pin
(CONNECT TO PWR)

5.0V
3.3V
GND
GND

JST-SH 6-pin
(CONNECT TO GP0)

3
2
1
0
3.3V
GND

DuPont
4-pin

Vcc
Trig
Echo
Gnd

Ucc
Trig
Echo
Gnd

HC-SR04

Vcc
Trig
Echo
Gnd

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

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scuttleproject@gmail.com

SCUTTLE Robot
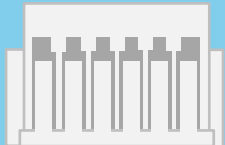
Beaglebone to I2C bus cable

Diagram

BeagleBone I2C Connector
Style: JST-SH 4-pin

I2C

GND	1
3.3V	2
I2C1_SCL	3
I2C1_SDA	4

Plugs into I2C Bus PCB
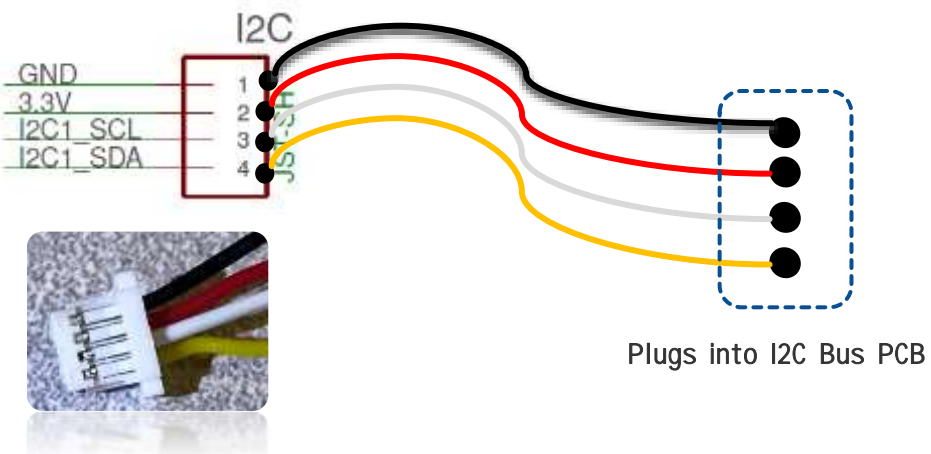
Cable Design

(I2C port on Beagle)
Style: JST-SH 4-pin

DuPont style
2.54mm female 4-pin
(plugs into bus
board)

SCUTTLE Robot

Compass CMPS or CMPS2 (I2C)

Plugs into I2C Bus Board

Compass

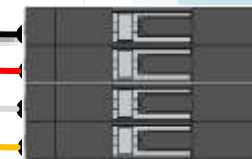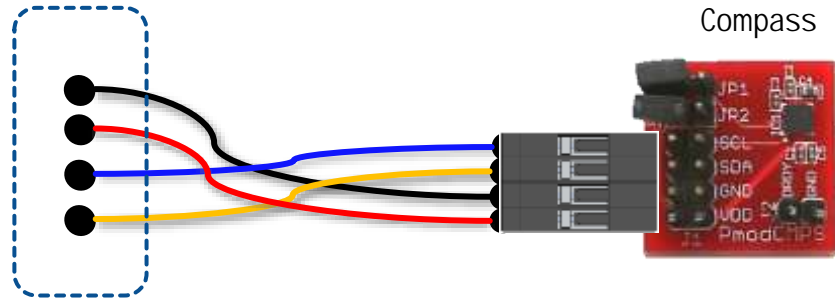This compass is not necessary since you can access the compass on the beaglebone blue. Be sure to calibrate the compass on the blue since it lies within close proximity of magnetic hardware on the robot.

SCUTTLE Robot
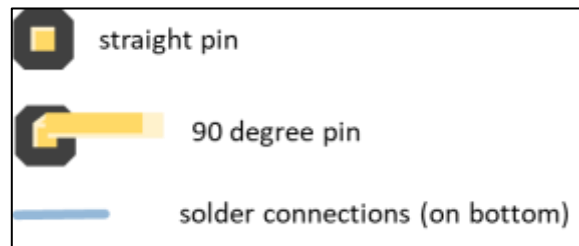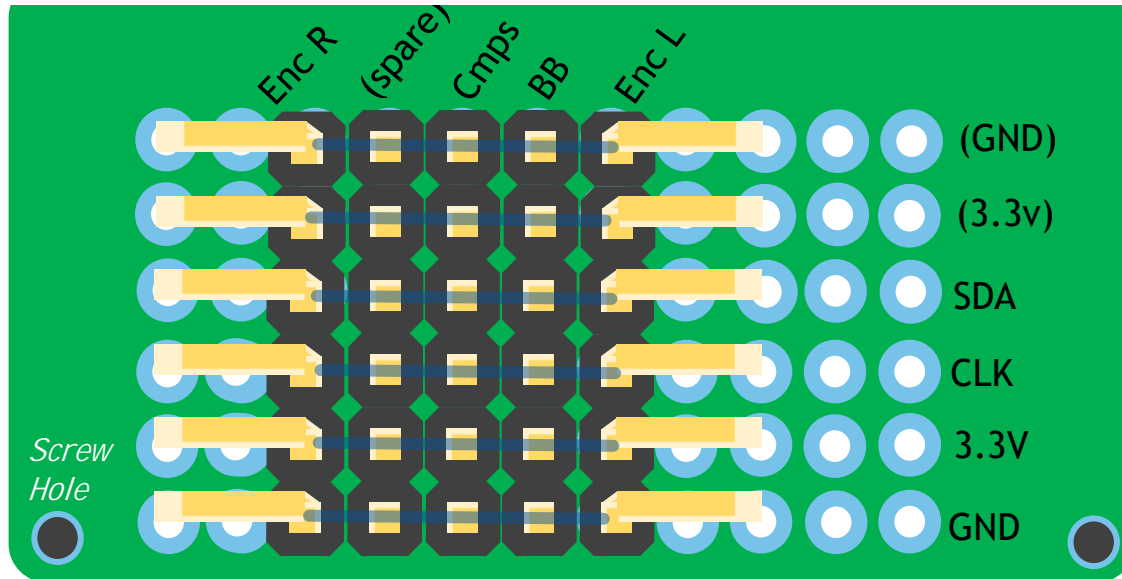
I2C Bus Board

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.

Enc R · (spare) · Cmps · BB · Enc L

(GND)
(3.3v)
SDA
CLK
3.3V
GND

Screw Hole

□ straight pin

⌐ 90 degree pin

— solder connections (on bottom)

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.

SCUTTLE

Enc L · Spare · Cmps · BB · Enc R

GND   GND
3.3V   3.3V
SDA   SDA
SCL   SCL
3.3V   3.3V
GND   GND

I2C Breakout

M. Seago   08/2019   D. Malawey

SCUTTLE Robot
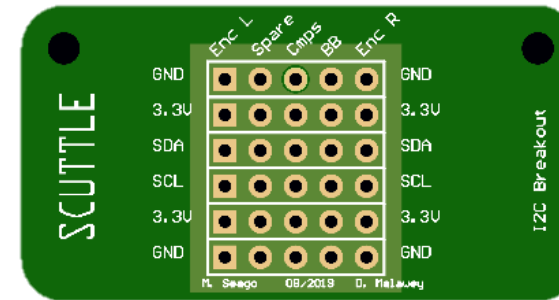
Encoder AMS AS5048 (I2C)

Left

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

Right

Right Hand Encoder
A1 is pulled **up** to 3.3v
I2C address is 0x41
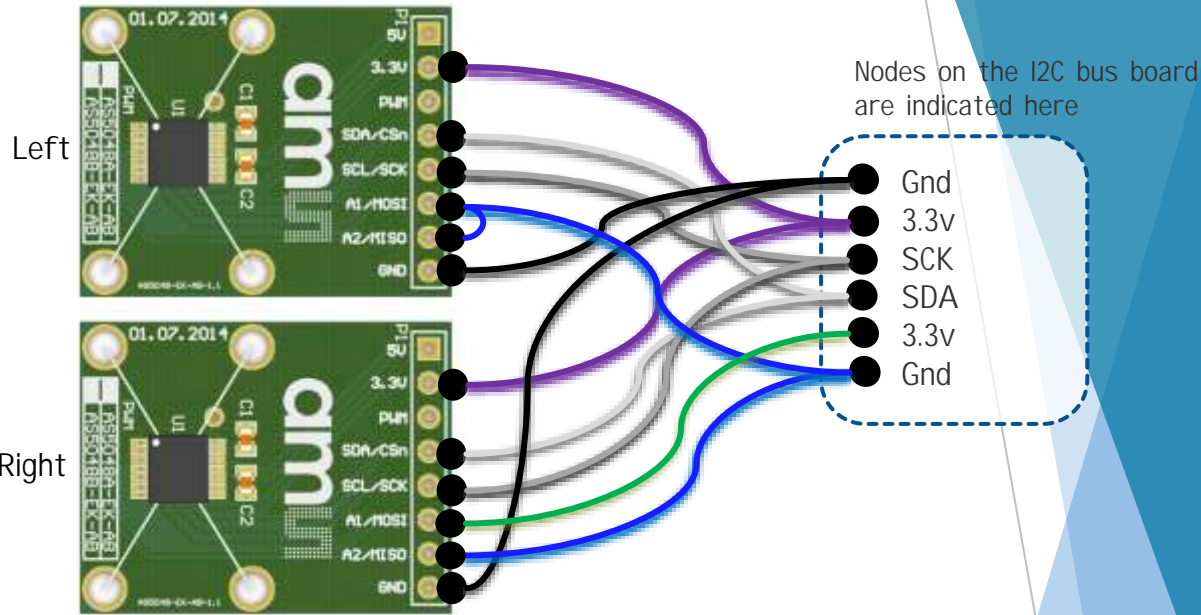
Nodes on the I2C bus board
are indicated here

Gnd
3.3v
SCK
SDA
3.3v
Gnd

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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SCUTTLE Robot

Encoder Cables

NC

NC
3.3v
NC
SDA
SCK
NC
A2
GND

A1 & A2 soldered together on pcb

Left
Hand

20cm from tip to tip

GND
3.3v
SCK
SDA
3.3v
GND

Encoder ends (different)

Bus Board Ends (matching)

NC
3.3v
NC
SDA
SCK
A1
A2
GND

Right
Hand

GND
3.3v
SCK
SDA
3.3v
GND

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

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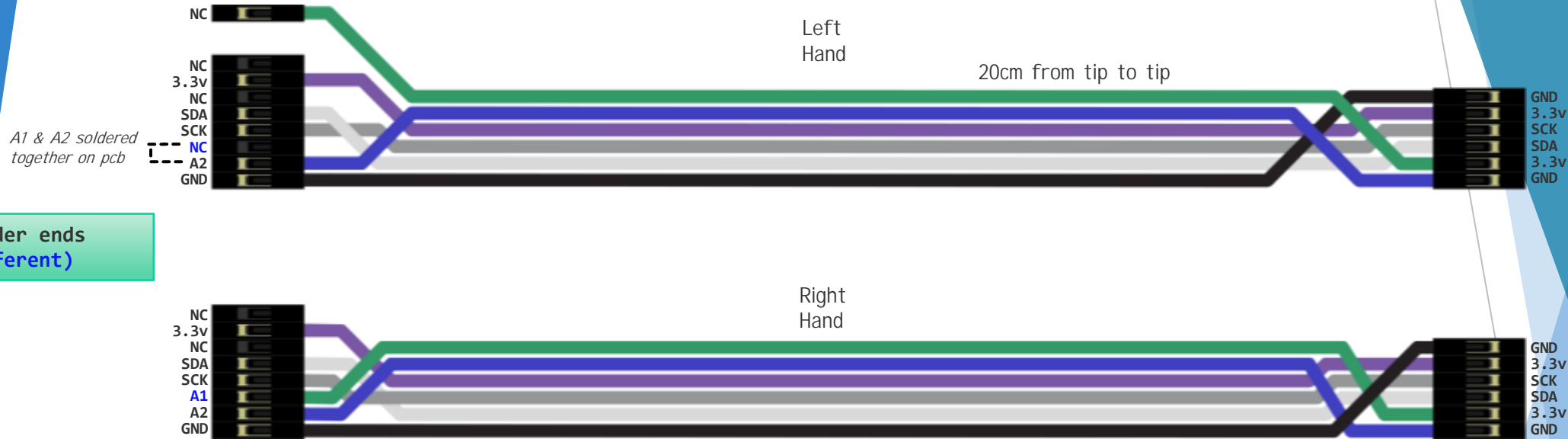
As an option, bridge LiPo terminal to 12v positive terminal (see Servo Slide)

Battery Connector

Barrel Connector Center Positive 5.5x2.1mm

LIPO   V_BATT   DO

VCC

1
2   BATT_MID
3   BATT_MINUS

R107
.1, 0805

JST XH   Q1   GND   CGND   GND
MOSFET-N
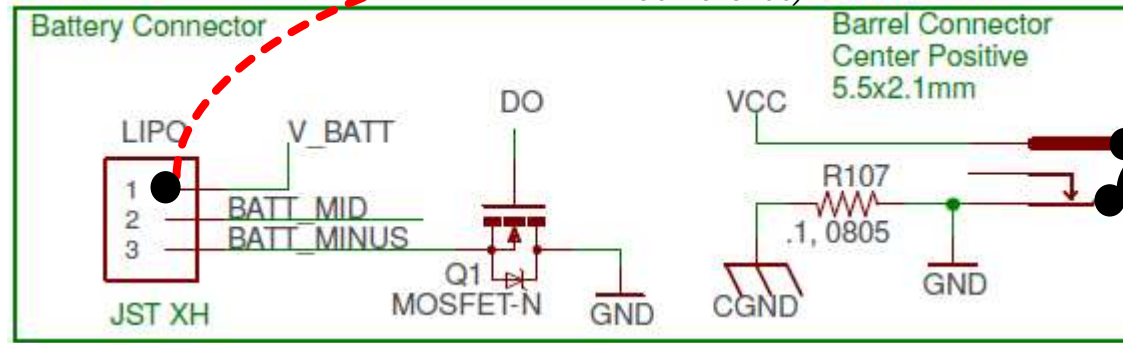
The "Battery Connector" is disconnected. Actual battery uses Barrel Connector.

Connects to battery Pack

12V

Barrel Plug

SCUTTLE Robot

Battery Pack (version1 configuration)

Bottom Side

11.1v

7.4v

3.7v

0.0v

3-Cell 18650 holder
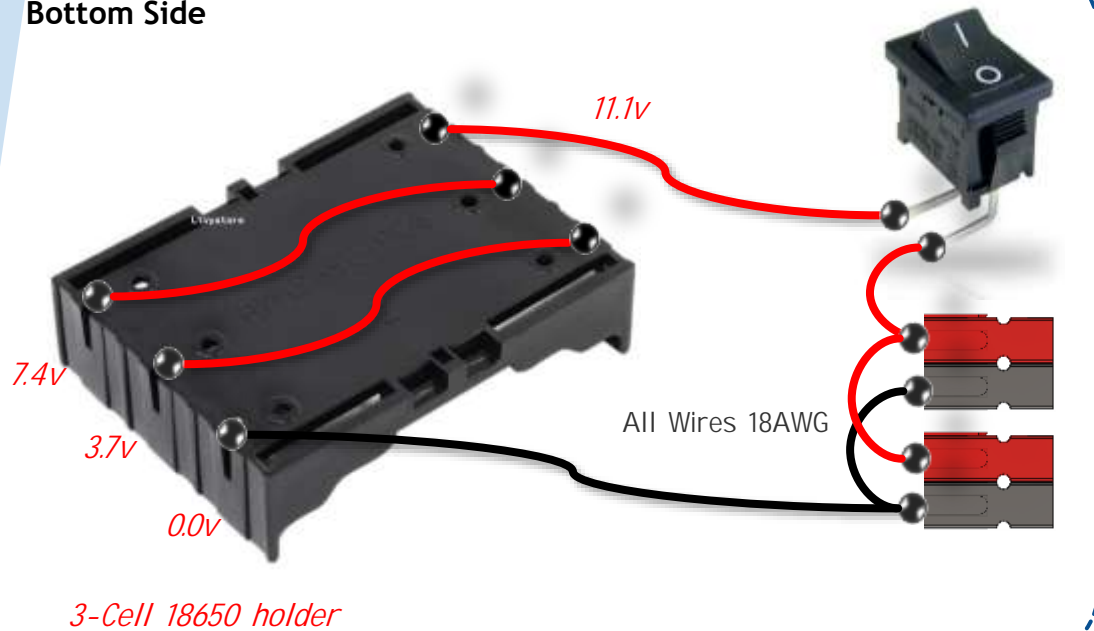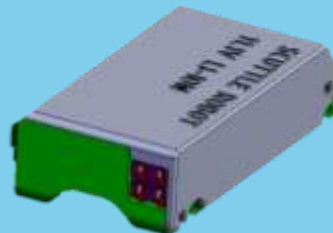
Switch PN:SRB22A2FBBNN
Carries 10A max

Two pairs of Anderson connectors are attached here.

All Wires 18AWG

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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SCUTTLE Robot
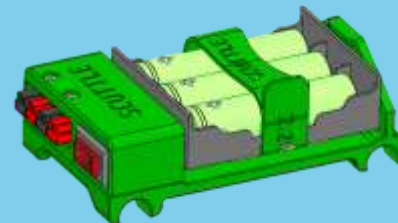
Battery Pack (v2, enhanced with BMS)

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

Anderson connectors, 35A contacts

Switch
PN:SRB22A2FBBNN
10A max current

7.4v   3.7v   0.0v

3-Cell 18650
Tray bottom side

11.1v   7.4v   3.7v

Leave this hole clear for a screw
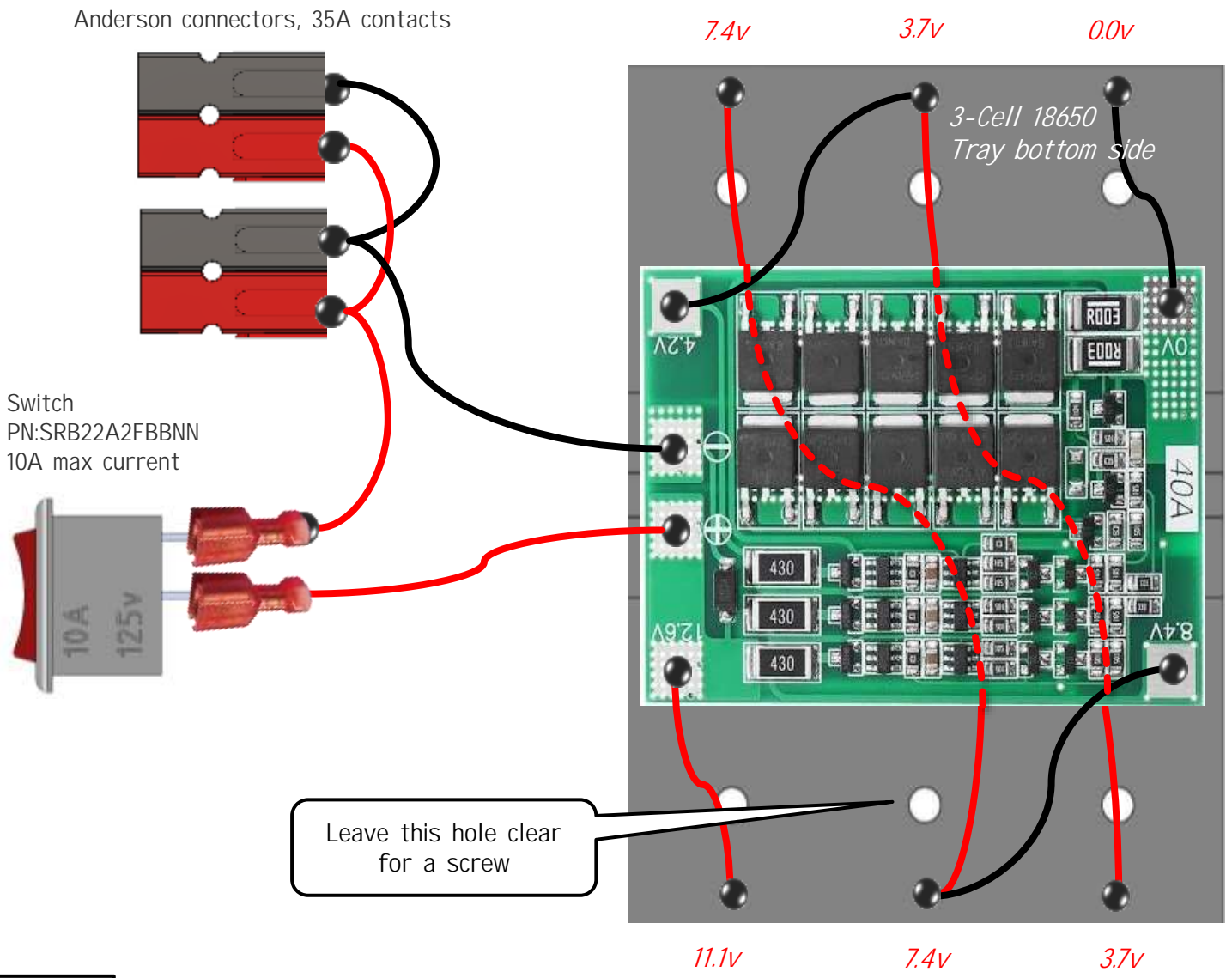
Table of wires to cut (11 total)

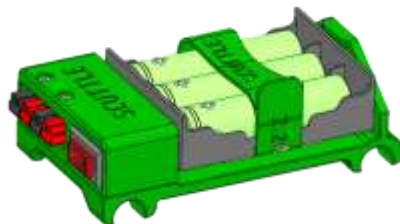| Length (mm) |
| --- |
| 25, 25 |
| 35, 35 |
| 55, 55 |
| 65 |
| 70 |
| 90, 90, 90 |

SCUTTLE Robot

Battery Pack Styles

Pack version 1
- BMS: does not fit
- Model on GrabCAD
- Access CAD model from within SCUTTLE assembly
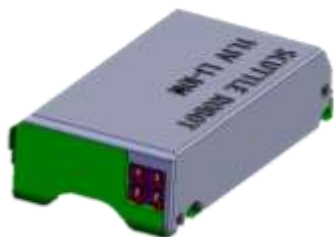
Pack version 2
- BMS: optional
- Model on GrabCAD
- Access the model as a standalone assembly

LIDAR

Lidar Device

TiM 561

Power Connector Diagram (lidar side)

POWER connection (supply voltage)

Connection "Power"
5-pin M12 plug

Power Cable:
(brown) → 1 DC 9 ... 28 V
→ 2 SYNC/DEVICE READY
(white) → 3 GND
(blue) → 4 n.c.
5 n.c.
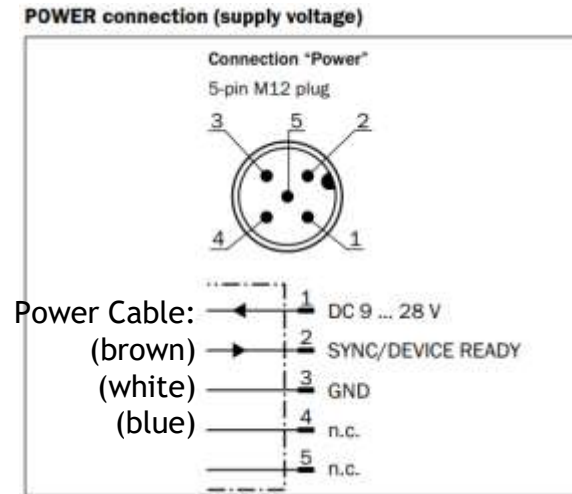
LIDAR-side connector (male pins)

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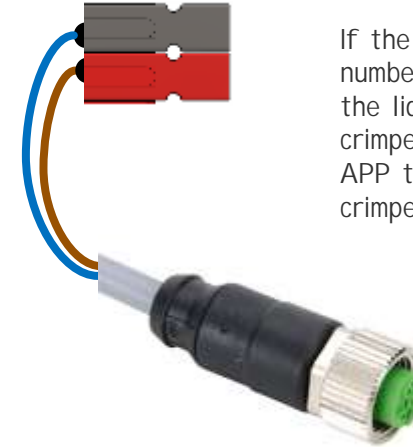
If the indicated cable part number is used for power to the lidar, brown will be crimped into the 12v positive APP terminal and blue is crimped into the negative.

Cable: 7000-12241-2150300

Cable-side connector (female pins)

Typical Lidar power consumption: 2.1w

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scuttleproject@gmail.com

SCUTTLE Robot

Gamepad Controls Mapping

Trigger: B6   Trigger: B7
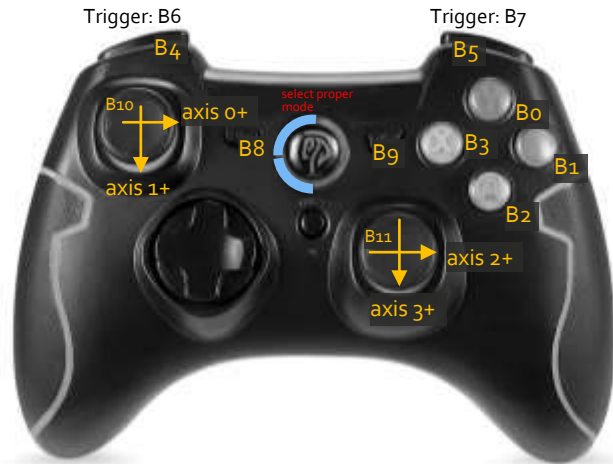
B4   B5

B10   axis 0+   B0

select proper mode

B8   B9   B3

B1

B2

B11   axis 2+

axis 1+

axis 3+

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 <u>here</u>

SCUTTLE Robot

Bridge Power to the liPo connector

positive terminal

solder to third pin

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.

Servo Channel 8

Servo Channel 1

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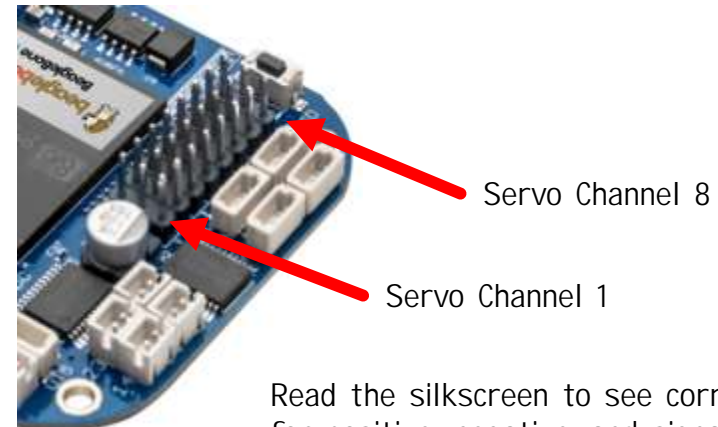
RFID reader

RC522 low-cost
RFID Scanner

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

SPI1_SS1
SPI1_SCK
SPI1_MISO
SPI1_MOSI
3.3v
GND

3.3v
RST
GND
IRQ
MISO
MOSI
SCK
SDA

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SCUTTLE Robot

Audio Amp

Pyle PCB3BK

3.6" inches

4.6" inches   3.6" inches

22AWG or larger wires

PAM8610 D Amp Board

Power switch

Mute switch

Power LED

- L +
R

DC 12V

Audio input

1-speaker is OK.

To 12v power

Aux cord   usb adapter   To Beagle USB
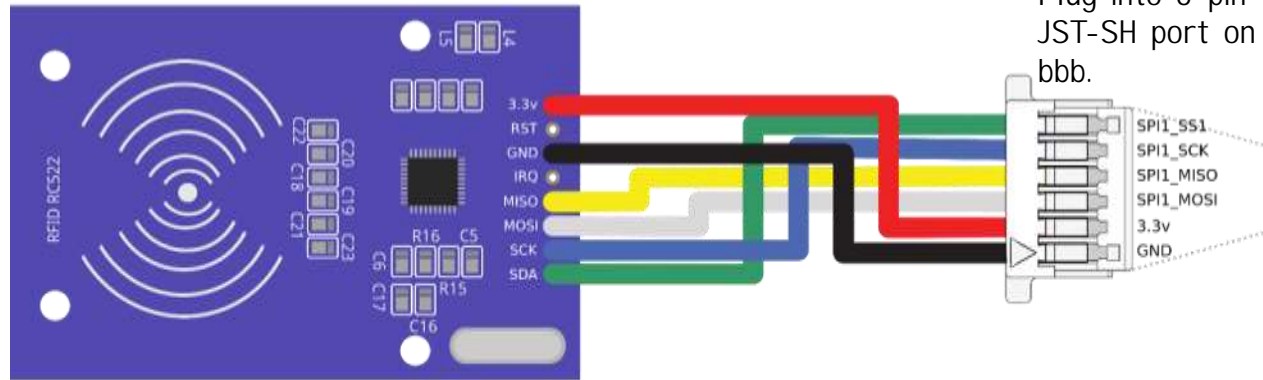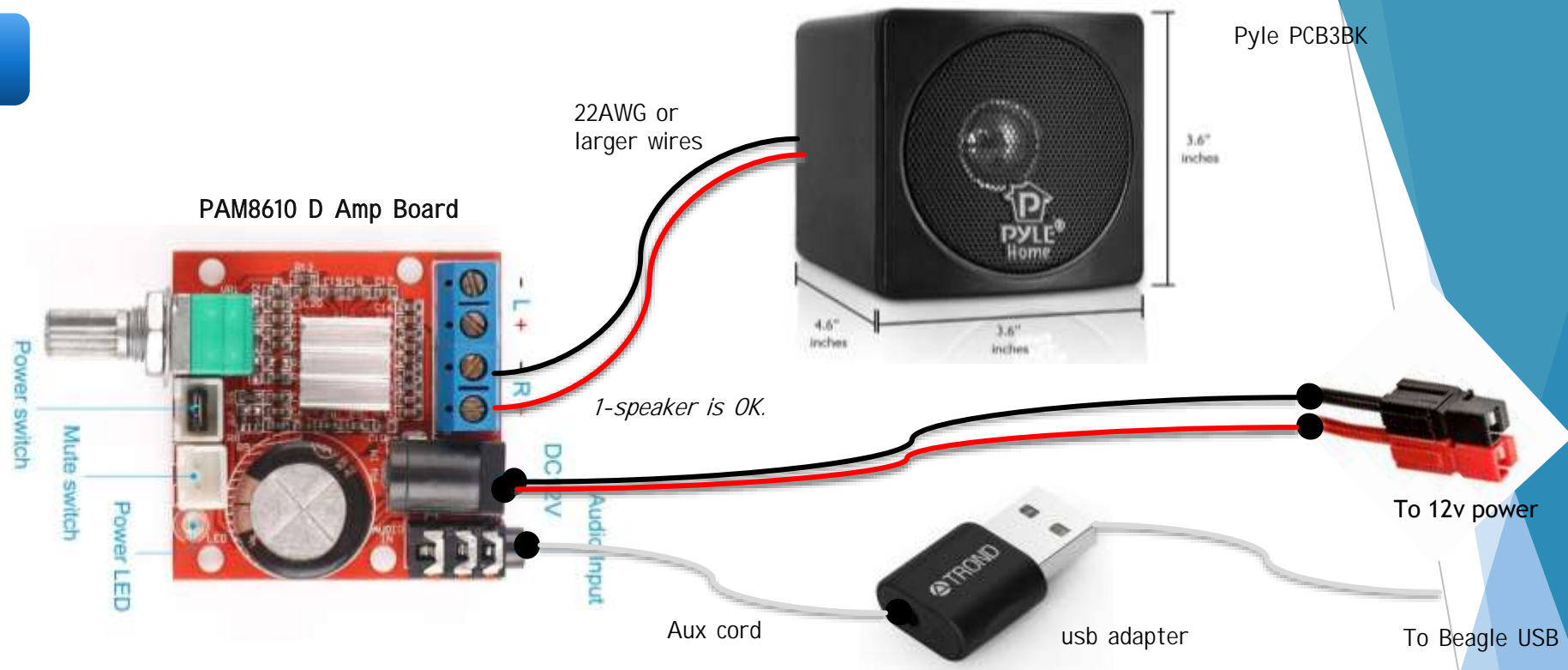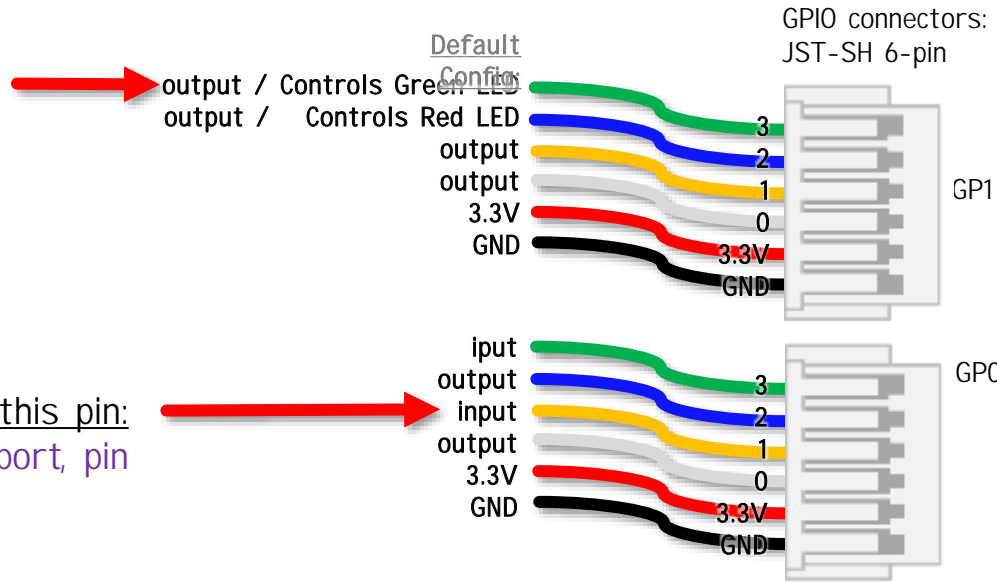
Alternative:

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)
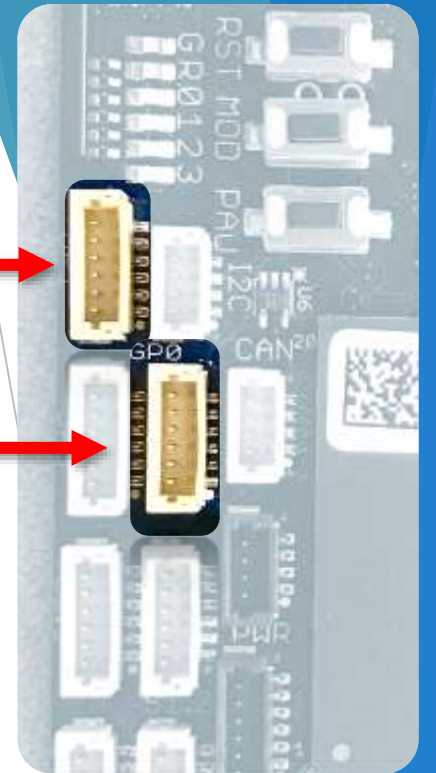
USB SPEAKER

SCUTTLE Robot

GPIO Connections

Example call for writing to this pin:

write(1,3,1) # arguments: port, pin, state

Example call for reading this pin:

read(0, 1) #arguments: port, pin

GPIO connectors:
JST-SH 6-pin

Default Config

output / Controls Green LED
output /   Controls Red LED
output
output
3.3V
GND

3
2
1
0
3.3V
GND

GP1

iput
output
input
output
3.3V
GND

3
2
1
0
3.3V
GND

GP0

*SCUTTLE naming convention
(used in L1_gpio.py)*

GP1

GP0
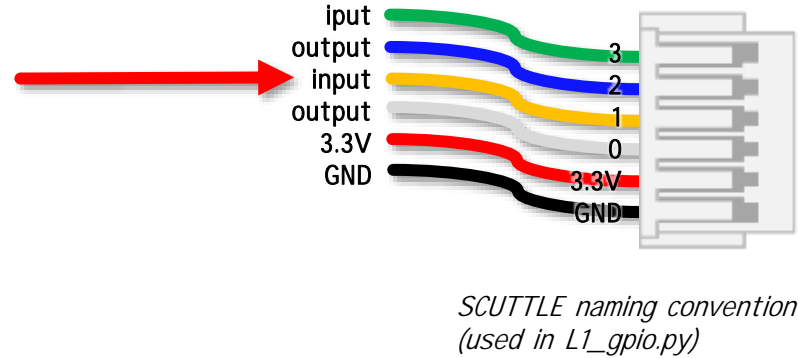
Connector vector image
preserved for later use.

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

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 scuttleproject@gmail.com

SCUTTLE Robot

GPIO Example - Relay
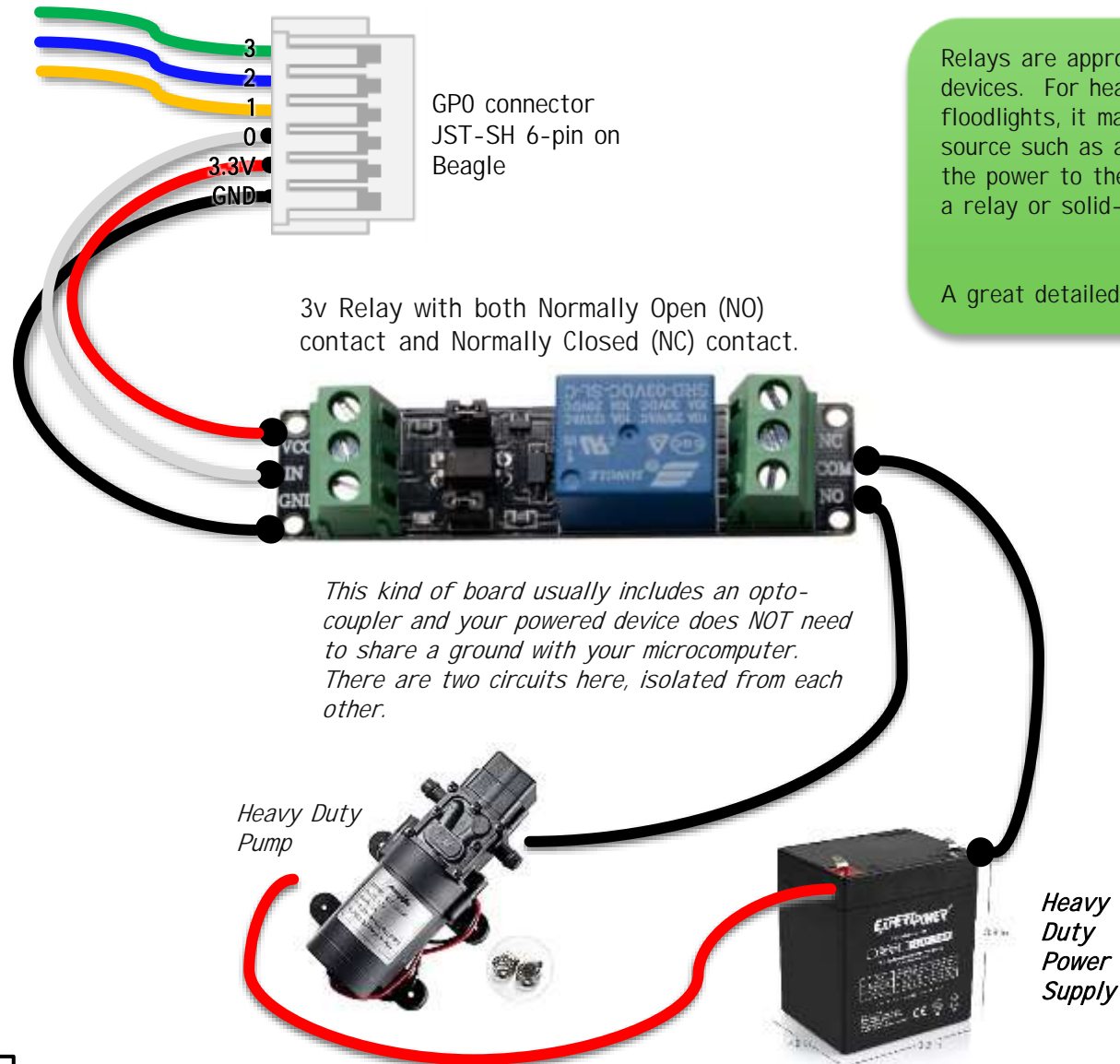
3
2
1
0
3.3V
GND

GPO 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

SCUTTLE Robot

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
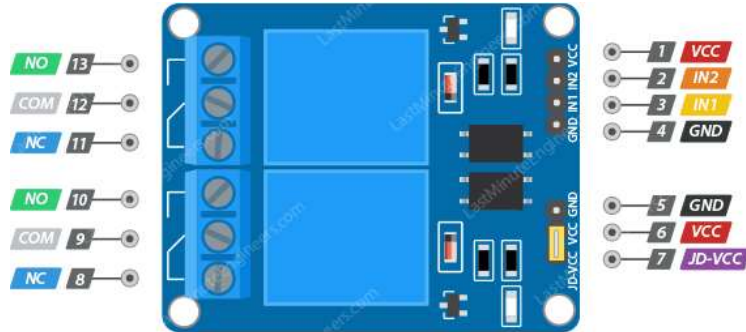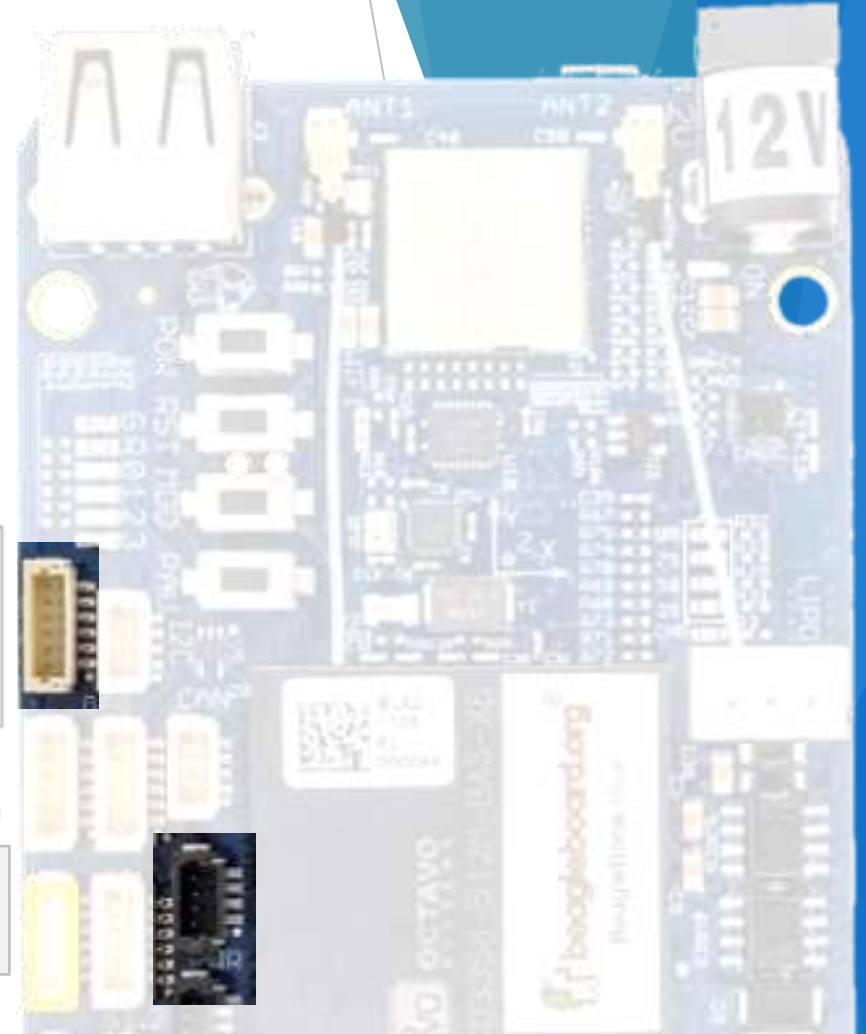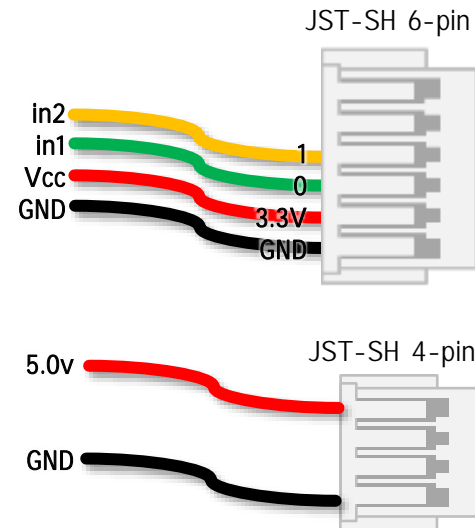- Our device was found to be active low although advertised as active high

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.

JST-SH 6-pin

in2
in1
Vcc
GND

1
0
3.3V
GND

JST-SH 4-pin

5.0v

GND

SCUTTLE Robot

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

Antenna1 is used for WiFi

Antenna2 is used for Bluetooth

U.FL mini pci to SMA pigtail

6dBi antenna offers improved RSSI if pointed properly.

SCUTTLE Wire Routing

SICK Lidar

USB splitter

USB (data)

LIDAR USB:

i2c cable

motor signals

USB splitter

i2C Bus Board

3-Cell Li-ion Pack

12V JUMPER

Beagle Pwr

Motor Pwr

BB Blue

Left Encoder

L PWR R

8-pin duPont

GamePad USB

Camera USB

LH encoder

i2c to bb

RH encoder

Right Encoder

8-pin duPont

LIDAR POWER

SCUTTLE Robot