# RASPBERRY PI ZERO POWER SENSOR HAT

## TABLE OF CONTENTS

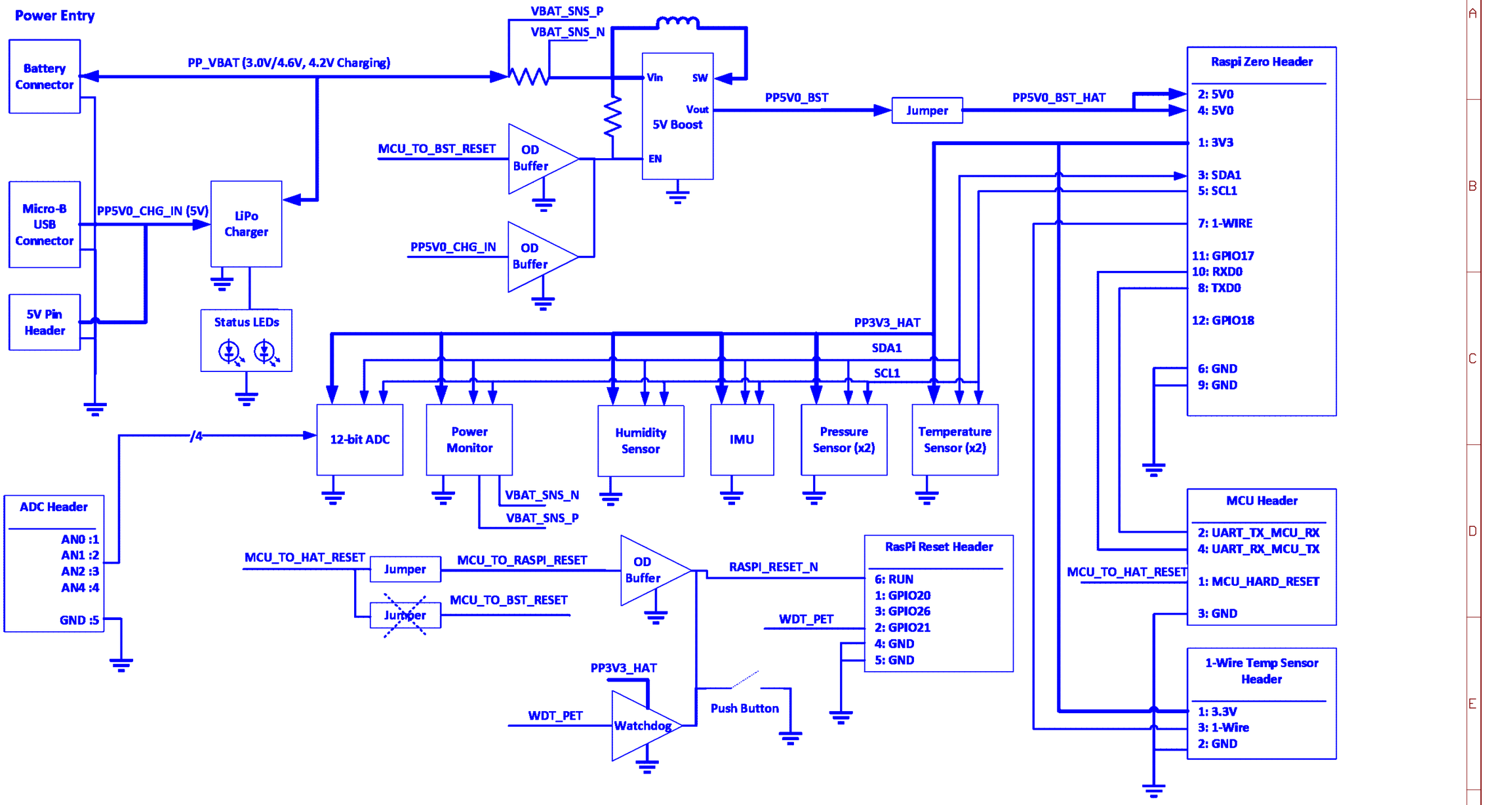

| SHEET | SHEET NAME |
|---|---|
| 1 | TITLE_TOC |
| 2 | BLOCK_DIAGRAM |
| 3 | LIPO_CHARGER_AND_BCM_RESET |
| 4 | POWER_ENTRY_BOOST_LDO |
| 5 | SENSORS |
| 6 | PI_MCU_CONNECT_AND_MOUNTING |
| 7 | ASSEMBLY_COMPONENTS |
| 8 | |
| 9 | |
| 10 | |



DESIGN: 001-001-01
TEAM: P17105
ENGINEER: CHRIS SCHWAB


| | |
|---|---|
| TITLE_TOC | |
| TITLE: raspi_zero_power_sensor_hat | |
| Document Number: | REV: 1 |
| Date: 2/28/17 10:47 PM | Sheet: 1/7 |

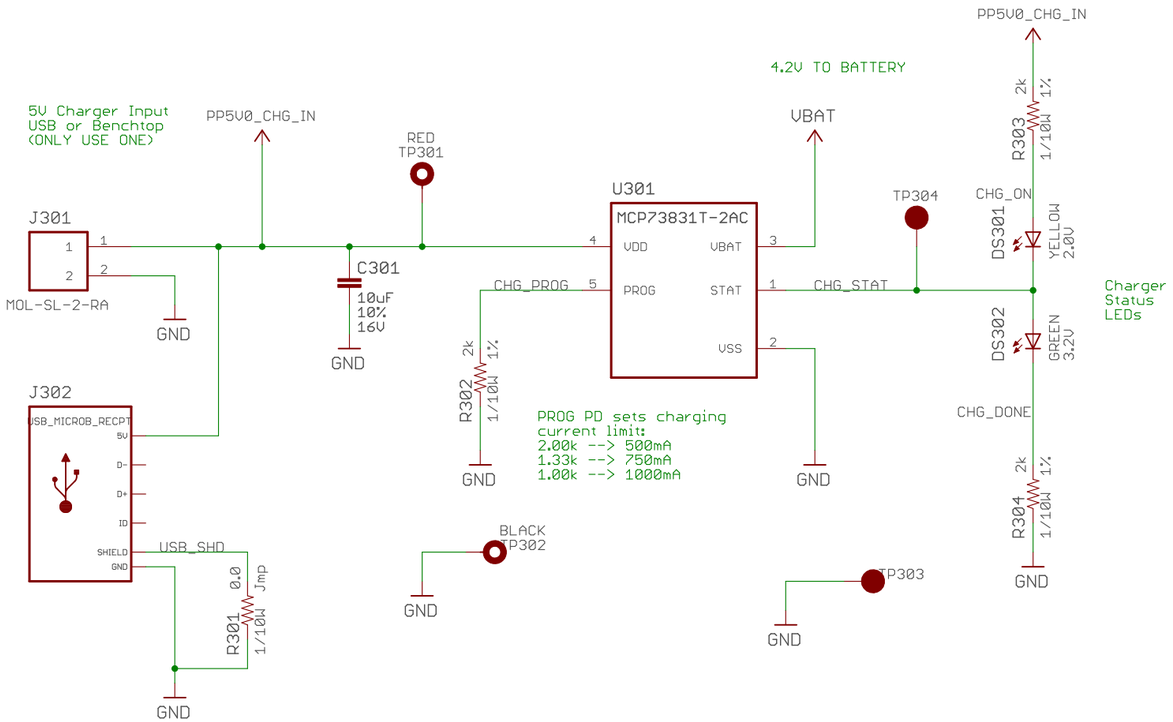
# Raspberry Pi Zero Power/Sensor HAT Block Diagram




| | |
|---|---|
| BLOCK_DIAGRAM | |
| TITLE: raspi_zero_power_sensor_hat | |
| Document Number: | REV: 1 |
| Date: 2/28/17 10:47 PM | Sheet: 2/7 |

# LiPo Battery Charger and BCM Reset Circuitry

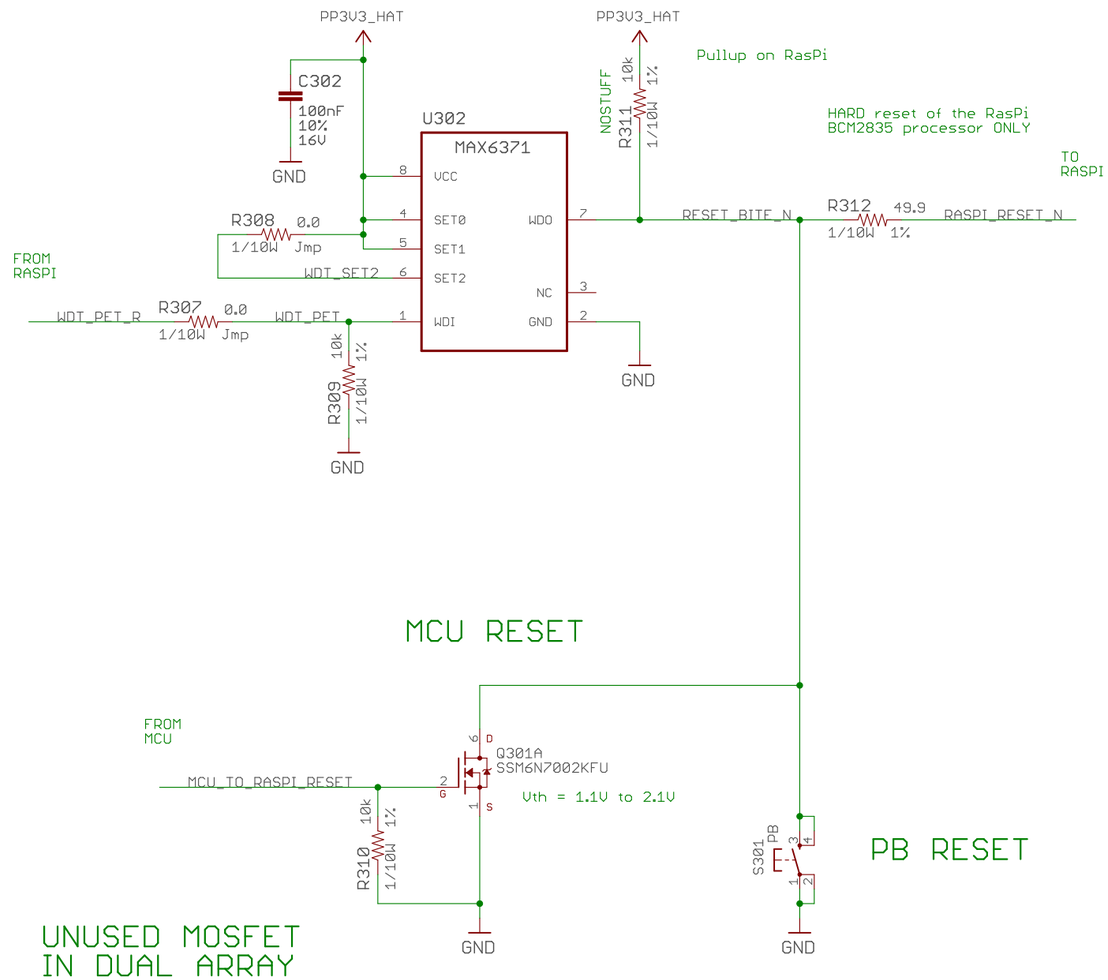
## 1-cell LiPo Battery Charger




## WATCHDOG TIMER

WDO is OD active low for at least 100us
Power-on delay is minimum of 60s

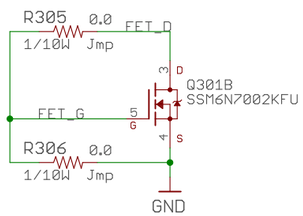
| SET2 | SET1 | SET0 | \|\| Mode |
|---|---|---|---|
| VCC | VCC | VCC | \|\| 60s timeout |
| GND | VCC | VCC | \|\| Disabled |




## MCU RESET




## UNUSED MOSFET IN DUAL ARRAY



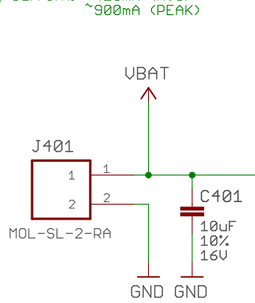

| | |
|---|---|
| LIPO_CHARGER_AND_BCM_RESET | |
| TITLE: raspi_zero_power_sensor_hat | |
| Document Number: | REV: 1 |
| Date: 2/28/17 10:47 PM | Sheet: 3/7 |

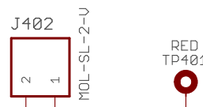
# POWER ENTRY, 5V BOOST, AND 3.3V LDO

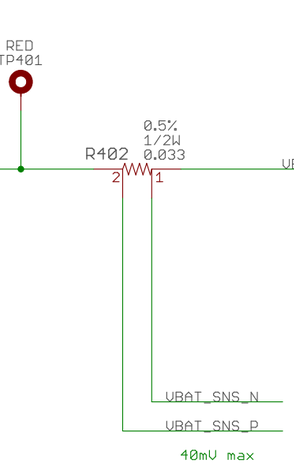
## BATTERY INPUT

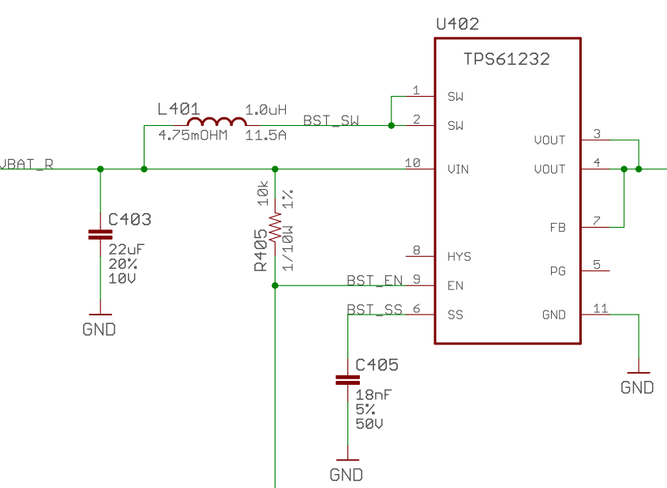
LiPo Battery: ~3.0V-4.2V or
3xAA Battery: ~3.7V to 4.6V
Battery Current: ~425mA (AVG)
~900mA (PEAK)

## BATTERY JUMPER



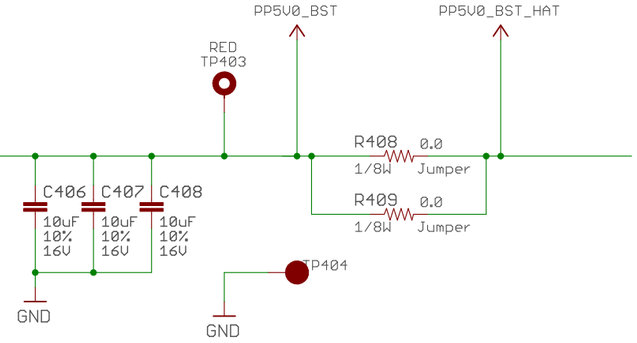

## 5V Boost SMPS

Vin UVLO: 2.1V (MAX)
Fsw: ~2MHz




## POWER TO SYSTEM

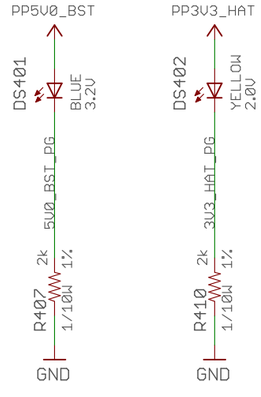
System Current: ~275mA (AVG)
~575mA (PEAK)




## BOOST MODES

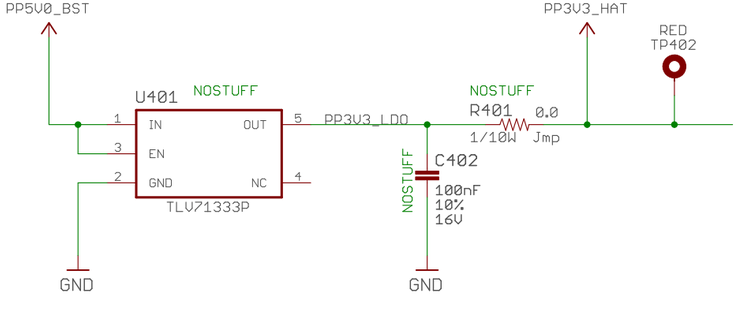
| EN | Mode |
|---|---|
| GND | Shutdown, True Load Disconnect (SD) |
| VIN | Boost Operating Mode (BST) |

## POWER STATUS LEDS



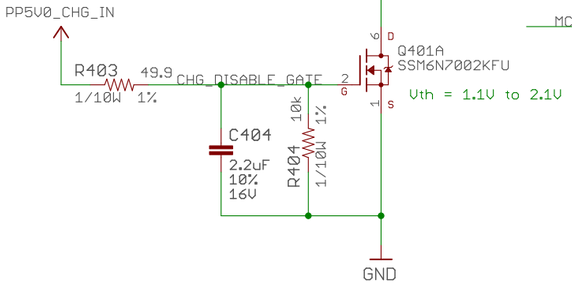

## 3.3V LDO (No RasPi Operation)

Placeholder for 3.3V rail supply if the
board is used without a RasPi, since the
RasPi supplies the 3.3V rail during operation



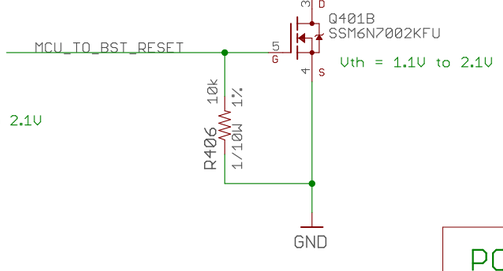

## CHARGER ATTACH BOOST DISABLE

NOSTUFF R403 to disable feature




## MCU TRIGGER BOOST DISABLE

NOSTUFF R611 to disable feature

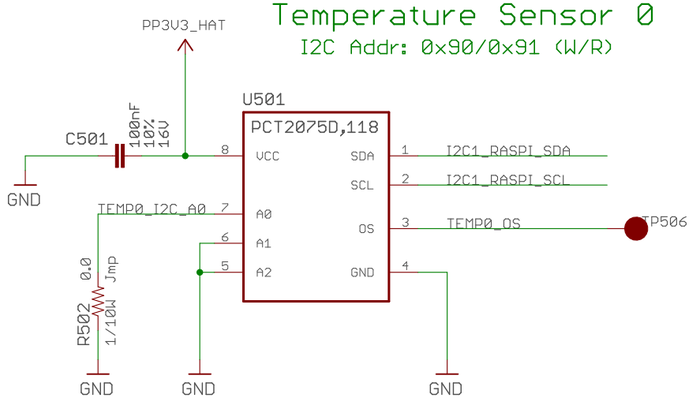



| | |
|---|---|
| POWER_ENTRY_BOOST_LDO | |
| TITLE: raspi_zero_power_sensor_hat | |
| Document Number: | REV: 1 |
| Date: 2/28/17 10:47 PM | Sheet: 4/7 |

# SENSORS

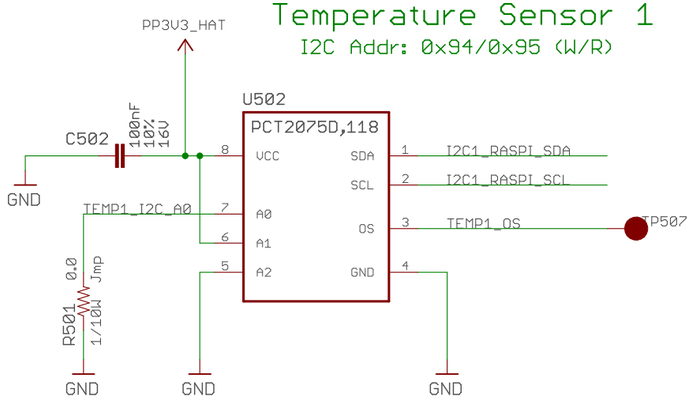
## Temperature Sensor 0

I2C Addr: 0x90/0x91 (W/R)



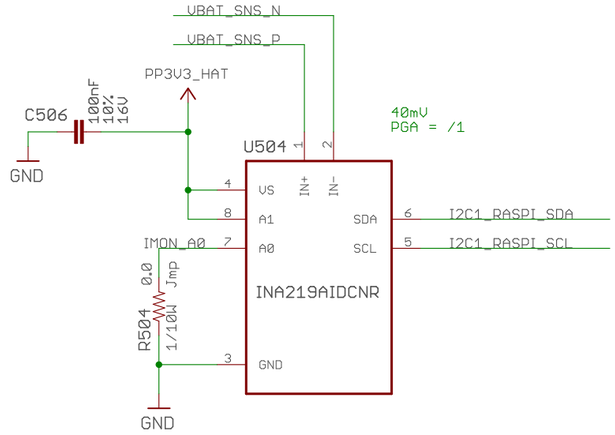

## Temperature Sensor 1

I2C Addr: 0x94/0x95 (W/R)




## Current/Voltage Sense Amp.

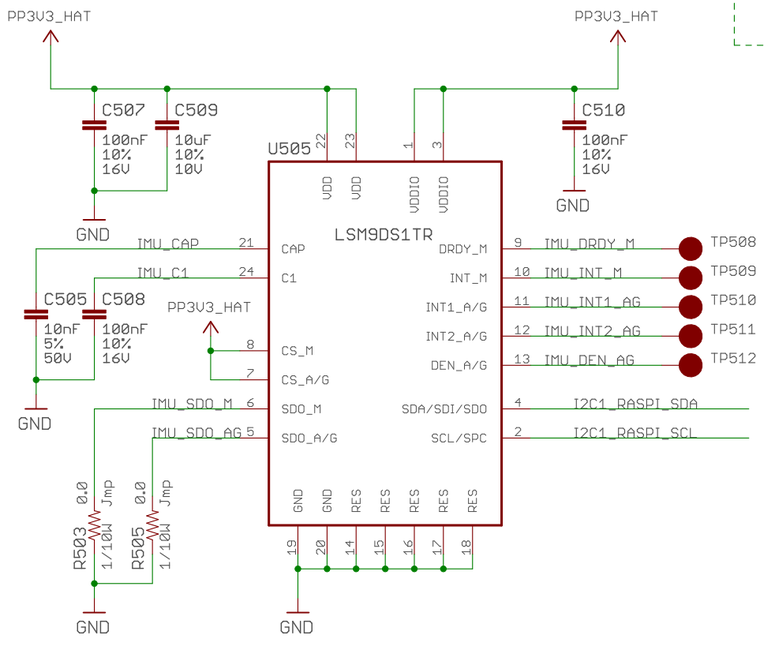
I2C Addr: 0x88/0x89 (W/R)




## IMU (Accel, Gyro, Mag)

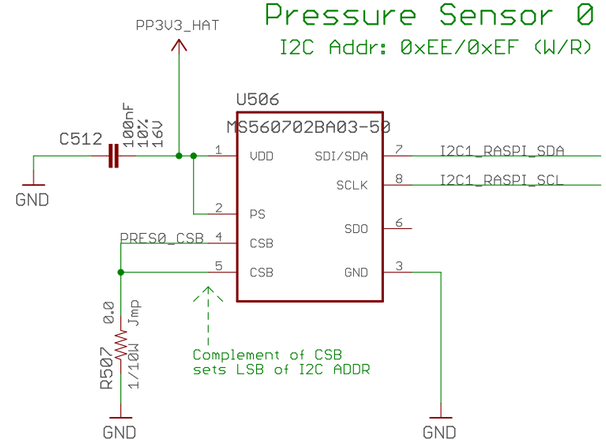
Accel/Gyro I2C Addr: 0xD4/0xD5 (W/R)

Mag I2C Addr: 0x38/0x39 (W/R)



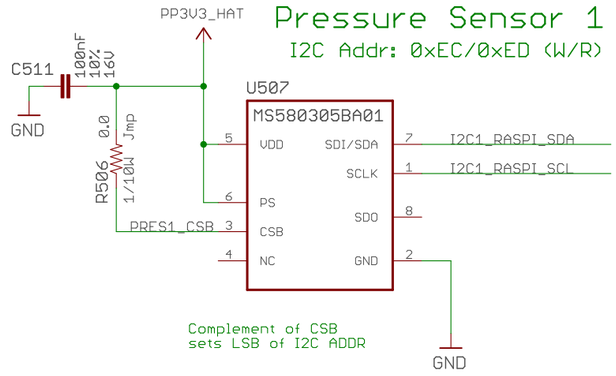

## Pressure Sensor 0

I2C Addr: 0xEE/0xEF (W/R)



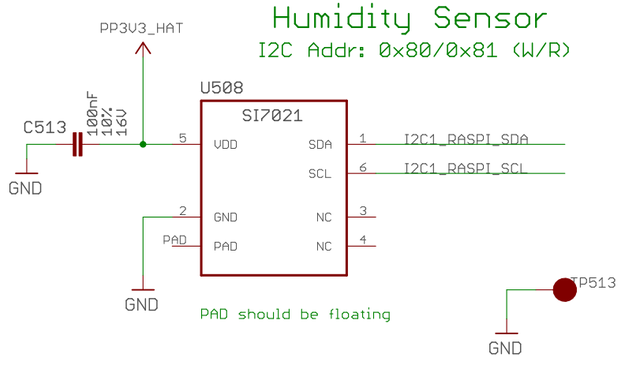

## Pressure Sensor 1

I2C Addr: 0xEC/0xED (W/R)



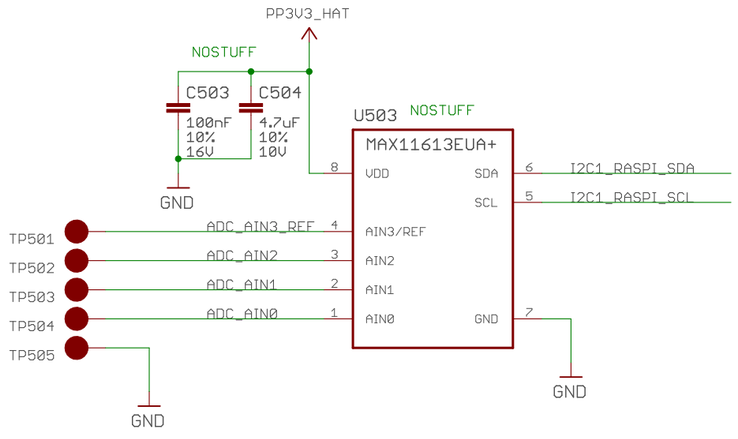

## Humidity Sensor

I2C Addr: 0x80/0x81 (W/R)




## 12-bit ADC

I2C Addr: 0x68/0x69 (W/R)




SENSORS

TITLE: raspi_zero_power_sensor_hat

Document Number:

REV: 1

Date: 2/28/17 10:47 PM

Sheet: 5/7

# HOST/RASPI CONNECTORS and MOUNTING

## RASPBERRY PI PWR/GPIO HEADER

1.8K I2C pullups on RasPi

PP3V3_HAT

NOSTUFF R603 2k 1/10W 1%

NOSTUFF R604 2k 1/10W 1%

PP3V3_HAT

PP3V3_RASPI

3.3V Power from Raspi

R606 0.0 1/10W Jmp

PP5V0_BST_HAT

5V Power to Raspi

J601

| | | | |
|---|---|---|---|
| 1 | 3V3 | 5V0 | 2 |
| 3 | GPIO2/SDA1 | 5V0 | 4 |
| 5 | GPIO3/SCL1 | GND | 6 |
| 7 | GPIO4/GPIO_GCLK/1-WIRE | GPIO14/TXD0 | 8 |
| 9 | GND | GPIO15/RXD0 | 10 |

RECEPTACLE-2x5-2.54MM

I2C1_RASPI_SDA — R601 0.0 1/10W Jmp — I2C1_RASPI_SDA_R

I2C1_RASPI_SCL — R602 0.0 1/10W Jmp — I2C1_RASPI_SCL_R

TEMP_1WIRE_BI — R605 0.0 1/10W Jmp — TEMP_1WIRE_BI_R

GND

Mates with 2x5 pin header on RasPi across 40-pin header pins 1-10

GND

## HOST MCU CONNECTOR

TP608

GND

TP607

J602

| | | |
|---|---|---|
| 1 | 1 | UART_RASPI_RXD_MCU_TXD |
| 2 | 2 | |
| 3 | 3 | UART_RASPI_TXD_MCU_RXD |
| 4 | 4 | MCU_TO_HAT_RESET |

MOL-SL-4-RA

GND

R611 0.0 1/10W Jmp — MCU_TO_BST_RESET

R612 0.0 1/10W Jmp — MCU_TO_RASPI_RESET

UART_RASPI_TXD_MCU_RXD_R — R609 0.0 1/10W Jmp

UART_RASPI_RXD_MCU_TXD_R — R610 0.0 1/10W Jmp

## EXTERNAL TEMPERATURE SENSOR CONNECTOR

PP3V3_HAT

F601 FUSE-50MA

C602 100nF 10% 16V

GND

R613 4.7k 1/10W 1%

J603

| | | |
|---|---|---|
| 1 | 1 | PP3V3_TEMP |
| 2 | 2 | TEMP_1WIRE_BI |
| 3 | 3 | |

MOL-SL-3-V

GND

TP610

GND

## I2C DEBUG HEADER

PP3V3_HAT

RED TP601

WHITE TP602 — I2C1_RASPI_SDA

YELLOW TP603 — I2C1_RASPI_SCL

BLACK TP604

GND

## RASPI ZERO HAT OUTLINE

Only using 3 mounting holes since the 2x6 pin connector stabilizes the upper left board quadrant.

This allows for easier routing of the boost output to the Pi's 5V0 pin.

OUTLINE601

RASPI_ZERO_OUTLINE_3S0C_ONLY

CMS LOGO

SQUAD LOGO

## DEBUG LEDs

TP605

TP606

DS601 YELLOW 2.0V

DS602 YELLOW 2.0V

DBG_LED0

DBG_LED1

R607 2k 1/10W 1%

R608 2k 1/10W 1%

GND

GND

## RASPBERRY PI RESET/GPIO HEADER

TP609 TP611

J604

| | | | | | |
|---|---|---|---|---|---|
| RASPI_GPIO20 | 1 | GPIO20/MOSI | 38 | 40 | GPIO21/SCLK | 2 | WDT_PET_R |
| RASPI_GPIO26 | 3 | GPIO26 | 37 | 39 | GND | 4 | |
| | 5 | GND | GND | RUN | RUN | 6 | RASPI_RESET_N |

RECEPTACLE-2x3-2.54MM

Mates with 2x3 pin header on RasPi across the RUN header and 40-pin header

GND

GND

C601 100nF 10% 16V

GND

Active low hard reset (10k pullup on RasPi)

TP612

GND

| | |
|---|---|
| PI_MCU_CONNECT_AND_MOUNTING | |
| TITLE: raspi_zero_power_sensor_hat | |
| Document Number: | REV: 1 |
| Date: 2/28/17 10:47 PM | Sheet: 6/7 |

# CONNECTOR ASSEMBLY and EXTERNAL SENSORS

## J301: 5V Charger Input

| | | | |
|---|---|---|---|
| BOM701 | SL 70066 2PIN HOUSING | Digi-key | WM2900-ND |
| BOM702 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |
| BOM703 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |

## J401: 1-cell Li-Ion Battery Input

| | | | |
|---|---|---|---|
| BOM704 | SL 70066 2PIN HOUSING | Digi-key | WM2900-ND |
| BOM705 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |
| BOM706 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |

2500mAh/2000mAh 3.7V Battery ordered from Adafruit (Part Number: 328/2011)

## J402: Battery Jumper

| | | | |
|---|---|---|---|
| BOM707 | SL 70066 2PIN HOUSING | Digi-key | WM2900-ND |
| BOM708 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |
| BOM709 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |

## J601: RasPi Power/GPIO Header

| | | | |
|---|---|---|---|
| BOM710 | HEADER-RECT-MALE-2X5 | Digi-key | 952-2380-ND |

## J602: MCU IO

| | | | |
|---|---|---|---|
| BOM711 | SL 70066 4PIN HOUSING | Digi-key | WM2902-ND |
| BOM712 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |
| BOM713 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |
| BOM714 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |
| BOM715 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |

## J603: 1-Wire Temperature Sensor

| | | | |
|---|---|---|---|
| BOM716 | SL 70066 3PIN HOUSING | Digi-key | WM2901-ND |
| BOM717 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |
| BOM718 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |
| BOM719 | SL 70058 GOLD CRIMP | Digi-key | WM2512CT-ND |
| BOM720 | 1-Wire Temperature Sensor | Digi-key | DS18B20+-ND |
| BOM721 | 1-Wire Temperature Sensor | Digi-key | DS18B20+-ND |

## J604: RasPi Reset/GPIO Header

| | | | |
|---|---|---|---|
| BOM722 | HEADER-RECT-MALE-2X3 | Digi-key | 952-2120-ND |

## 3x 12mm Nylon Standoffs (Top Righ, Bottom Right, Bottom Left)

Not listed on BOM, enough for 6 HATs (Amazon: B01HBYDH70)

ASSEMBLY_COMPONENTS

TITLE: raspi_zero_power_sensor_hat

Document Number:

REV: 1

Date: 2/28/17 10:47 PM

Sheet: 7/7