Power

1x Battery
3.8V | Fully Charged
3.0V | Nominal
2.2V | Empty

4x in Series
15.2V | Fully Charged
12.0V | Nominal
8.8V | Empty

N1
Battery Holder
BATT HOLDER 18650 4 CELL LEADS

18650 Sodium-ion 3V 1500mAh

SW1
SWITCH ROCKER SPST-NO 20A 12V
Rocker Switch SPST-NO 20A (DC) Panel Mount, Snap-In
Carling Technologies

F1
FAST-BLOW 375mA 32V 0.45Ω
FUSE BOARD MNT 375MA 32VDC 0603
Qty Multiplier: 2

375mA is ~3.5x min current for 8x390 ohm resistors

+VBattery
TP1
R1
0
Vishay Dale
0805 (2012 Metric)

Feedback resistors

Choose Vout = 7V, Vref = 0.8V, Rfbb = 10K

R_fbt = (Vout - Vref)*R_fbb/Vref
R_fbt = 77.5K -= 76.8K

Inductor sizing

$$\Delta I_L = \frac{V_{OUT} \times (V_{IN\_MAX} - V_{OUT})}{V_{IN\_MAX} \times L \times f_{SW}}$$

$$I_{LMIN} = \frac{V_{IN\_MAX} - V_{OUT}}{I_{OUT} \times K_{IND}} \times \frac{V_{OUT}}{V_{IN\_MAX} \times f_{SW}}$$

Choose K = 0.3

$f_{sw} = 400kHz, I_{OUT} \geq 150mA, V_{out} = 7V\ V_{in} = 12V$

Given $L_{min} = 160uH \geq 150uH, \Delta I_L \approx 40.6mA$

U2
LMR51603XFDBVR
ForcedPWM @ 400KHz

PWR_FLAG
VIN
EN
CB
SW
FB
GND

C3
0.1uF ±10%, X7R
BuckSW
BuckFB
TP2
L1
150uH
R3
76.8K+- 1%, ±100ppm/°C
R4
10K +-1%, ±100ppm/°C
C2
1uF, X7R
C4
1uF, X7R
C5
10uF, X7R
+VBattery_or_7V
TP4

J20
Conn_01x04
J3
Conn_01x04
GND

+VBattery <-> PWR_FLAG
+VBattery_or_7V <-> PWR_FLAG
+5V <-> PWR_FLAG
+3.3V <-> PWR_FLAG
GND <-> PWR_FLAG

H1 MountingHole
H2 MountingHole
H3 MountingHole
H4 MountingHole

U1A
NUCLEO-L476RG
Qty Multiplier: 2

PC10/SPI3_SCK/USART3_TX/UART4_TX
PC12/SPI3_MOSI/USART3_CK/UART5_TX
VDD
BOOT0
NC_CN7_9
NC_CN7_11
PA13/JTMS-SWDIO
PA14/JTCK-SWCLK
PA15/JTDI/SPI1_NSS/SPI3_NSS/UART4_RTS_DE
GND_CN7_19
PB7/USART1_RX/UART4_CTS/TIM17_CH1N
PC13
PC14/OSC32_IN
PC15/OSC32_OUT
PH0/OSC_IN
PH1/OSC_OUT
VBAT
PC2/ADC123_IN3/SPI2_MISO
PC3/ADC123_IN4/SPI2_MOSI/LPTIM2_ETR

PC11/SPI3_MISO/USART3_RX/UART4_RX
PD2/USART3_RTS_DE/UART5_RX
E5V
GND_CN7_8
NC_CN7_10
IOREF
RESET
+3V3
+5V
GND_CN7_20
GND_CN7_22
VIN
NC_CN7_26
PA0/ADC12_IN5/USART2_CTS/UART4_TX/TIM2_ETR
PA1/ADC12_IN6/USART2_RTS_DE/UART4_RX/TIM15_CH1N
PA4/ADC12_IN9/DAC1_OUT1/SPI1_NSS/SPI3_NSS/USART2_CK/LPTIM2_OUT
PB0/ADC12_IN15/USART3_CK
PC1/ADC123_IN2/LPUART1_TX
PC0/ADC123_IN1/LPUART1_RX/LPTIM2_IN1

VDD | +3.3V <JP6> VDD
+3.3V
BOOT0 | 10K PullDown
Table 4. Boot modes
BOOT1=x | BOOT0=0 | Main Flash Memory
PA13 | SWDIO
PA14 | SWCLK
PA15 I/O FT_l
FT meaning 5 V tolerant I/O
GPIO_StrainV_Enable_5VTolerant
PC13 | PC13 <SB17> B1, Blue PB
PC14 | OSC32_IN
PC15 | OSC32_OUT
PH0 | (NC)
PH1 | (NC)
VBAT | VDD

E5V | VIN -> E5V <JP5> +5V
IOREF | +3V3
RESET (Internal Pullup) = Black Pushbutton B2
+3.3V
+5V
VIN LDOs
LD1117S50TR | VIn 15V | VDropout 1.2V@800mA (6.2V) | CurrentOut 800mA
LD39050PU33R
<JP5> +5V from VIN -> E5V or U5V
+VBattery_or_7V
AIn_StrainV_1
AIn_StrainV_2
AIn_StrainV_3
AIn_StrainV_4
GPIO_BatteryV_Enable
AIn_BatteryV

U1B
NUCLEO-L476RG

PC9/TIM8_BKIN2_COMP1
PB8/CAN1_RX/TIM16_CH1
PB9/SPI2_NSS/CAN1_TX/TIM17_CH1
AVDD
GND_CN10_9
PA5/ADC12_IN10/DAC1_OUT2/SPI1_SCK/LPTIM2_ETR
PA6/ADC12_IN11/SPI1_MISO/USART3_CTS/TIM16_CH1
PA7/ADC12_IN12/SPI1_MOSI/TIM17_CH1
PB6/USART1_TX/TIM16_CH1N
PC7
PA9/USART1_TX/TIM15_BKIN
PA8/MCO/USART1_CK/LPTIM2_OUT
PB10/SPI2_SCK/USART3_TX/LPUART1_RX
PB4/NJTRST/SPI1_MISO/SPI3_MISO/USART1_CTS/UART5_RTS_DE/TIM17_BKIN
PB5/SPI1_MOSI/SPI3_MOSI/USART1_CK/UART5_CTS/TIM16_BKIN
PB3/JTDO-TRACESWO/SPI1_SCK/SPI3_SCK/USART1_RTS_DE
PA10/USART1_RX/TIM17_BKIN
PA2/ADC12_IN7/USART2_TX/TIM15_CH1
PA3/ADC12_IN8/USART2_RX/TIM15_CH2

PC8
PC6
PC5/ADC12_IN14/USART3_RX
U5V
NC_CN10_10
PA12/USART1_RTS_DE/CAN1_TX
PA11/USART1_CTS/CAN1_RX
PB12/SPI2_NSS/USART3_CK/LPUART1_RTS_DE/TIM15_BKIN
PB11/USART3_RX/LPUART1_TX
GND_CN10_20
PB2/RTC_OUT
PB1/ADC12_IN16/USART3_RTS_DE/LPTIM2_IN1
PB15/RTC_REFIN/SPI2_MOSI/TIM15_CH2
PB14/SPI2_MISO/USART3_RTS_DE/TIM15_CH1
PB13/SPI2_SCK/USART3_CTS/LPUART1_CTS/TIM15_CH1N
AGND
PC4/ADC12_IN13/USART3_TX
NC_CN10_36
NC_CN10_38

GPIO_ANT_Reset
GPIO_ANT_SPI_CS
AVDD | VDD <Bead> <SB57> AVDD
PA5 | PA5 <SB42> <SB21> LED2 (Active HI)
AIn_StrainV_6
GPInterruptPB6_MPU
GPIO_MPU_SPI_CS
PB3 | JTDO-TRACESWO
GPIO_Extra_SPI_CS
PA2 | USART2_TX
PA3 | USART2_RX

GPInterruptPC8_ANT_DIO0
GPIO_ANT_Enable
AIn_StrainV_5
PB11=VCAP1 <4.7uF>
AIn_StrainV_7
SPI2_MOSI
SPI2_MISO
SPI2_SCK
PB13 <SB29=OFF> LED2
AGND <SB60> GND
AIn_StrainV_8

U1C
NUCLEO-L476RG

GND_CN12_1
GND_CN12_2
GND_CN11_1
GND_CN11_2

GPIO_Extra_SPI_CS
SPI2_MOSI
SPI2_MISO
SPI2_SCK
Conn_01x05
J4 2
Conn_01x05
J5
GND

Application

SPI2_MOSI
SPI2_MISO
SPI2_SCK
GPIO_ANT_Enable
GPIO_ANT_Reset
GPInterruptPC8_ANT_DIO0
GPIO_ANT_SPI_CS
GPInterruptPB6_MPU
GPIO_MPU_SPI_CS
GPIO_BatteryV_Enable
AIn_BatteryV
GPIO_StrainV_Enable_5VTolerant
AIn_StrainV_1
AIn_StrainV_2
AIn_StrainV_3
AIn_StrainV_4
AIn_StrainV_5
AIn_StrainV_6
AIn_StrainV_7
AIn_StrainV_8

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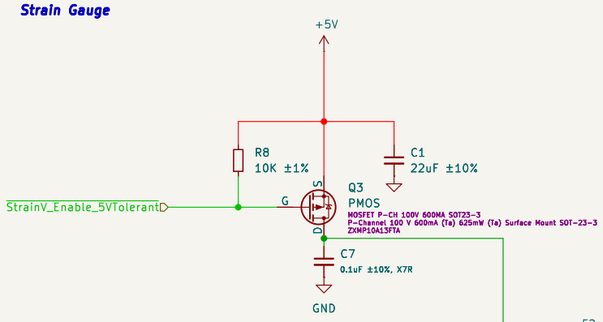
Strain Gauge



350 Ohm strain gauge
X 8 times

Power calculations:
Rtotal = 8/350 = 43.75 Ohm
5V/350 = 14.3mA per strain gauge

Itotal_5V = 5/43.75 = 114mA
P = 0.569W

INPUT (-15~15mV) ([-8kibs, +8kibs] on original test)
DESIRED OUTPUT(0~3V)

Gain = (3/30mV) = 100
G = 1 + 100k/(R_g)

R_g ~= 1000 Ohms

Stimulation OUTPUT: 180mV~3.15V

Full Bridge Strain Gauge 350 ohm
Brand Name: ZDA
Qty Multiplier: 16

FSR: 0~3V
Quantization step = 3V/(2^12) = 0.732mV

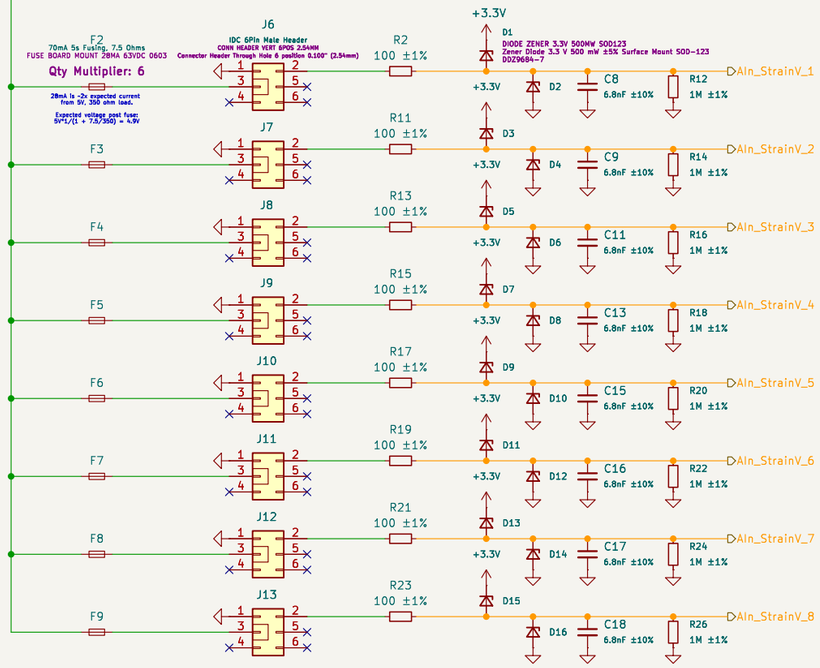
Max error = 0.732mV/2 = 0.366mV

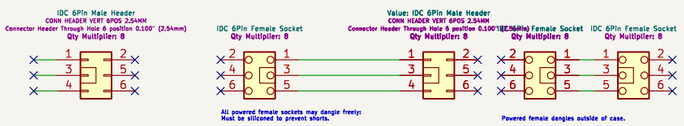
%Uncertainty = 0.366mV/3V

0.732mV/ 3V = 1.22% Uncertainty
Uncertainty goal 5%

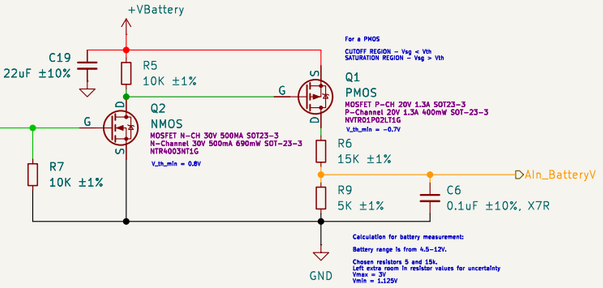
Features below

Overvoltage/undervoltage protection
RC filtering (500R + 6.8nF -> f_3db=40~50 kHz)
PULLDOWN(detect wire disconnection)





Battery Measurement



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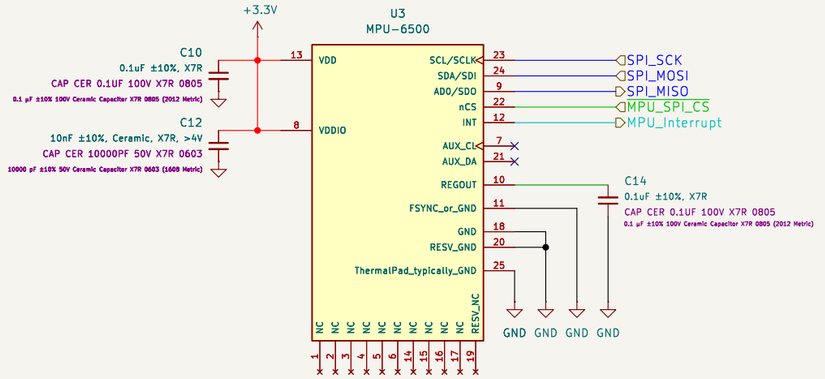
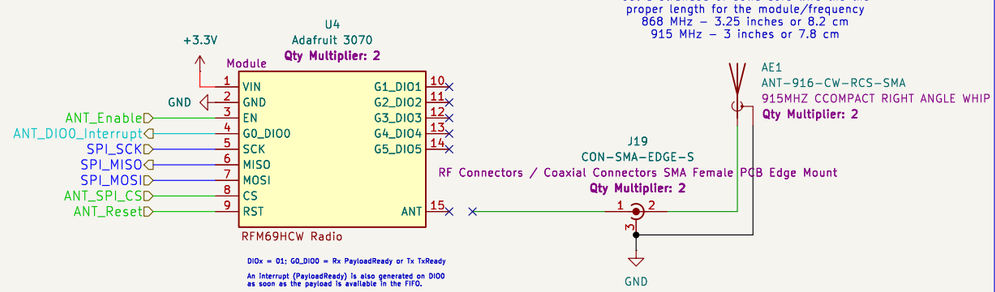
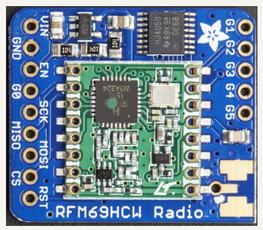


Antenna





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