Power Supply

R54 365k R52 365k R53 365k
AC-L C8 680nF R15 150 D8 U6 VIN VOUT VSS +3V3
C9 1000uF D6 9.1V 1W C11 100uF C3 100nF
D9 GND
C10 100uF D7 5.1V 1W D5 1.8V 500mW C5 100nF
AC-N R17 200 -1V8

Voltage Feedback

+3V3
R4 511k R3 511k R2 511k R1 511k LMV321IDBVRG U2 +3V3
R5 2k ± 0.1% C2 100nF C1 10uF 180k ± 0.1% R33 VSENSE
AC-L -1V8 R32 33k ± 0.1%
GND GND

Voltage Reference, 2 options, install one or the other.

+3V3 +3V3 C27 ± 1% 2.2uF
R37 1K ± 1%
R36 15k ± 0.1% GND
VREFA
U9 ADR5040A R46 5k ± 0.1%
GND

<- OR ->

+3V3
C16 2.2uF VDD FEEDBACK U10 OUT GND GND R40 10k R39 ± 0.1%
SHDN# GND R38 10k C17 2.2uF VREFA
GND R41 10k ± 0.1%
(Alternate Package)
U11 OUT VDD GND GND GND #SHDN

Current Monitoring

12k,2k = Gain of 6. Which translates to 12A current range.
Formula: IMax = (1.024/2) / (0.005 * Gain * sqrt(2))

+3V3 C14 100nF +3V3
TLV333AIM5/TR U16 R7 180k ± 0.1%
AC-N-OUT-1 R10 2k ± 0.1% C4 10uF CS1
R30 5m R19 12k ± 0.1% C28 1nF R11 12k ± 0.1% R6 33k ± 0.1%
AC-N R16 2k ± 0.1% C29 1nF C6 100nF
GND -1V8 GND GND

+3V3 C31 100nF +3V3
TLV333AIM5/TR U1 R13 180k ± 0.1%
AC-N-OUT-2 R20 2k ± 0.1% C12 10uF CS2
R9 5m R31 12k ± 0.1% C32 1nF R25 12k ± 0.1% R12 33k ± 0.1%
AC-N R26 2k ± 0.1% C33 1nF C30 100nF
GND -1V8 GND GND

+3V3 C35 100nF +3V3
TLV333AIM5/TR U3 R22 180k ± 0.1%
AC-N-OUT-3 R35 2k ± 0.1% C13 10uF CS3
R18 5m R57 12k ± 0.1% C36 1nF R55 12k ± 0.1% R21 33k ± 0.1%
AC-N R56 2k ± 0.1% C37 1nF C34 100nF
GND -1V8 GND GND

+3V3 C39 100nF +3V3
TLV333AIM5/TR U5 R28 180k ± 0.1%
AC-N-OUT-4 R58 2k ± 0.1% C15 10uF CS4
R24 5m R61 12k ± 0.1% C40 1nF R59 12k ± 0.1% R27 33k ± 0.1%
AC-N R60 2k ± 0.1% C41 1nF C38 100nF
GND -1V8 GND GND

RF Communication

U12 RFM69CW
MISO 8 NSS 7 RFM-SEL
DIO0 9 SCK 6 RFM-SCK
DIO2 10 MOSI 5 RFM-MOSI
RFM-MISO DIO1 11 DIO3 4 R42 +3V3
DIO5 12 GND 3
RFM-RESET RESET 13 3.3V 2 1 ANT C19 100nF C18 10uF
GND 14 ANA 1
GND

Isolated FTDI Interface

+3V3 U4 R50 560
DTR R51 1K ± 1% GND
R45 560 U14 R49 1K ± 1% FTDI
TX I-DTR 1
U15 R48 560 I-TX 2
R47 1K ± 1% I-RX 3
RX I-5V 4
GND I-GND 5
I-RX 6

+3V3 X1 12MHz XTL1
GND C26 22pF C25 22pF XTL2
XTL2 GND
UDPI +3V3 UDPI
GND

U13 AVR128DB48 E/6LX

SW1 1 PA5 49 EP
SW2 2 PA6 48 PA4
SW3 3 PA7 47 PA3
TX 4 PB0 46 PA2
RX 5 PB1 45 PA1(XTALHF2) XTL2
LED 6 PB2 44 PA0(XTALHF1) XTL1
7 PB3 43 GND
RFM-RESET 8 PB4 42 VDD
RFM-SEL 9 PB5 41 UPDI UDPI
RFM-MOSI 10 PC0 40 PF6 RESET +3V3
RFM-MISO 11 PC1 39 PF5
RFM-SCK 12 PC2 38 PF4
13 PC3 37 PF3
+3V3 14 VDDIO2 36 PF2
15 GND 35 PF1(XTAL32K2)
16 PC4 34 PF0(XTAL32K1)
17 PC5 33 PE3
18 PC6 32 PE2
19 PC7 31 PE1
VSENSE 20 PD0 30 PE0
CS1 21 PD1 29 GND
CS2 22 PD2 28 AVDD
CS3 23 PD3 27 PD7
CS4 24 PD4 26 PD6
25 PD5 VREFA

SW1 SW2 SW3 LED
R44 10k LED1
GND

+3V3 +3V3 +3V3
C20 100nF C21 100nF C22 100nF C23 1uF
GND GND GND GND

+3V3
R43 10k
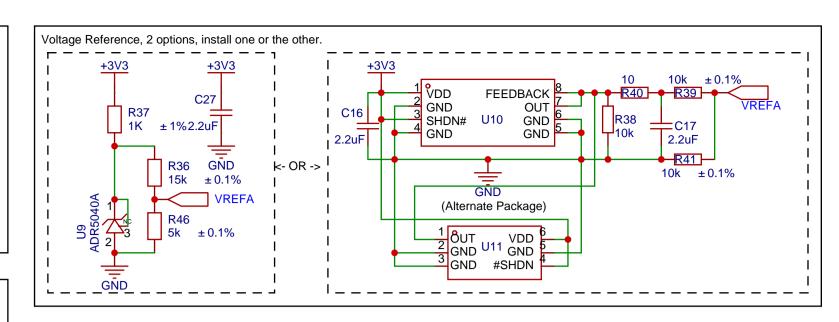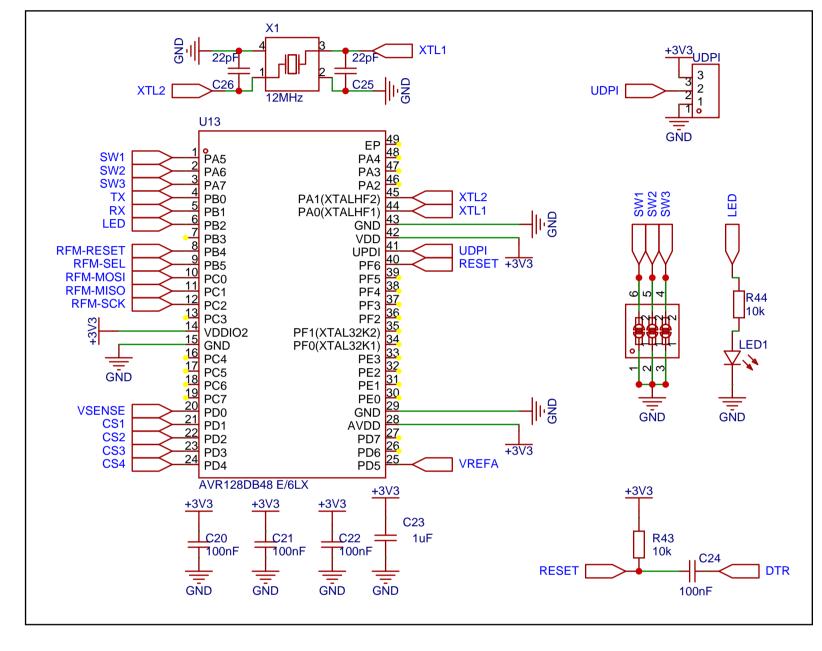RESET C24 100nF DTR

V1.0 - Initial design.

V1.1 - First Build (It Works!!!)
  - Switched to differential current applifier configuration

V1.2
  - Fixed reversed FTDI TX/RX pins and names now make more sense
  - Fixed copper region connection to shunt resistors
  - Adjusted current gain from 8 to 6 (Previous gain forgot to account for RMS conversion)
  - Removed analog pin protection (I dont think its required with this topology)
  - Added reset line for RFM module

Designer	brandon3055	
Created	2022-08-24	
Last Edited	2022-09-23	
Version	v1.2	Gitgub

emonMicro

https://github.com/brandon3055