Sheet: 5VPSU

File: 5V_PSU.sch

Sheet: F_MPPT

File: Feifunk_MPPT.sch

Sheet: Paralleling_connection

File: Parallel.sch

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File: UWC Rural Project.sch

Title:

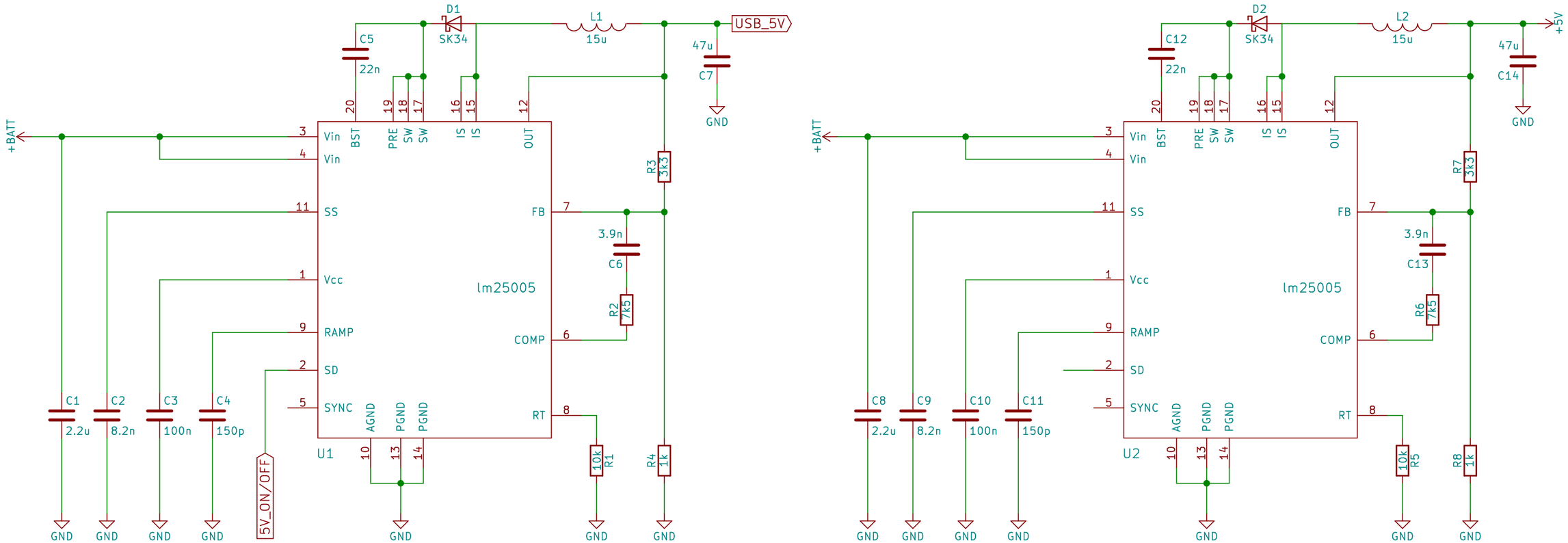
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad 4.0.6		Id: 1/4

USB Non-priority Load

Non-priority has a SD pin wired to the microcontroller to shut down power if the battery is low.

Always on Load

Always active power supply. Supplies the Microcontroller plus Opamps/other compoenents.
Has a high (92.5%@9Vinput) effenciency. See design PDF.



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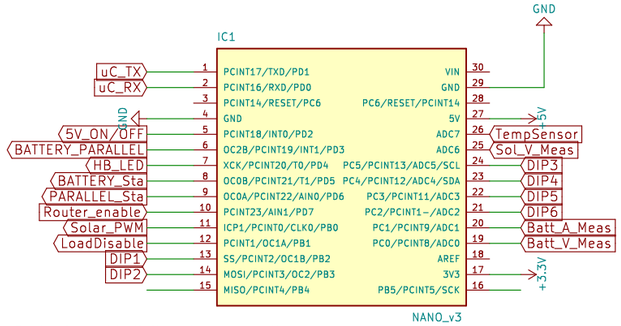


Microcontroller - Arduino (and clones) Nano v3

Each of the 14 digital pins on the Nano can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip.

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Nano has 8 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the analogReference() function. Analog pins 6 and 7 cannot be used as digital pins. Additionally, some pins have specialized functionality:

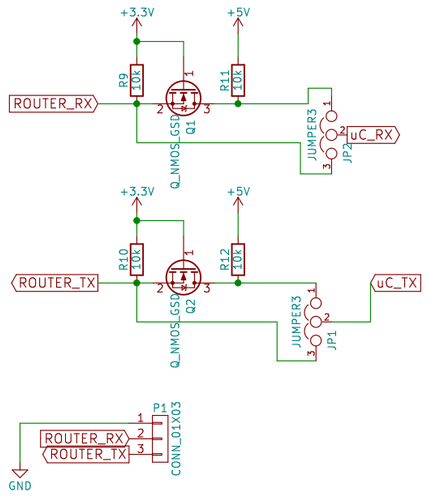
I2C: A4 (SDA) and A5 (SCL). Support I2C (TWI) communication using the Wire library (documentation on the Wiring website).

There are a couple of other pins on the board:
AREF. Reference voltage for the analog inputs. Used with analogReference().

Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

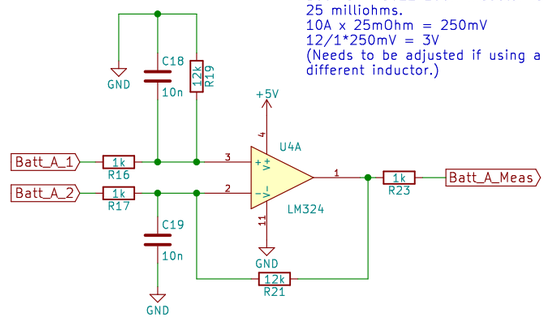
Bidirectional Level Shifter 3.3V to 5V

Uses the built in 3.3V regulator from the FTDI chip on the nanov3. Current should be very low so should be fine.



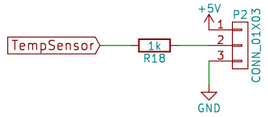
Battery A measurements

CALCULATIONS
Max amps of 10A. Resistance through Bourns PM5022 10uH inductor is 25 milliohms.
10A x 25mOhm = 250mV
12/1*250mV = 3V
(Needs to be adjusted if using a different inductor.)

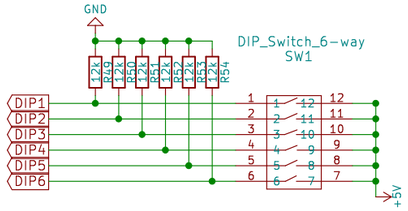


Temperature Sensor

CALCULATIONS
Depending on the temperature sensor, no scaling needed.

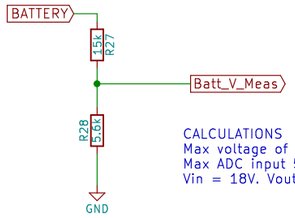


Configuration Selection



Battery Voltage Sense

Simple voltage divider should be fine since battery voltage is always known. Might need to add a simple calibration variable to the EEPROM to ensure accuracy.

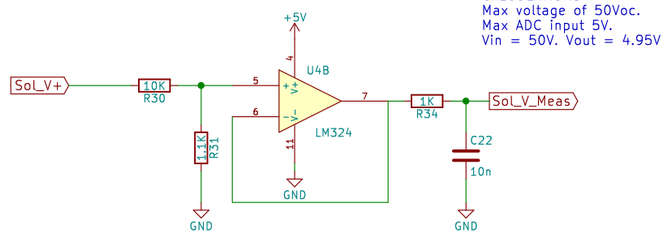


CALCULATIONS
Max voltage of 18V
Max ADC input 5V.
Vin = 18V. Vout = 4.893V

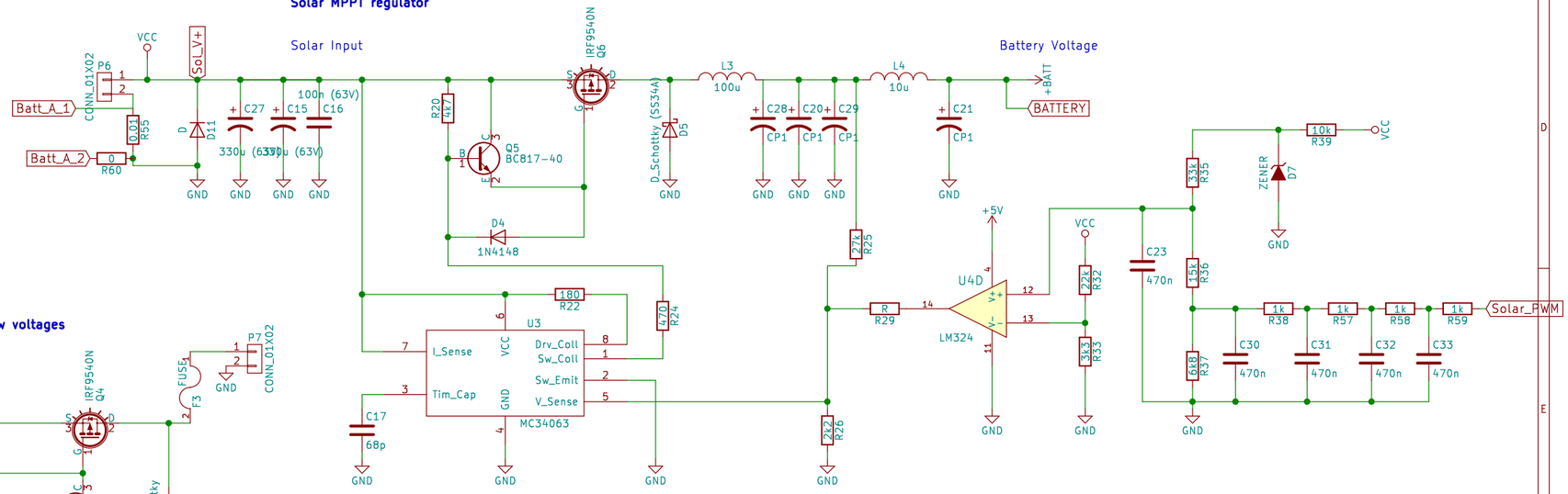
Solar Panel Voltage Sense

Use an Opamp here to protect the Microcontroller. If someone connects an high-voltage solar panel, try protect the microcontroller.

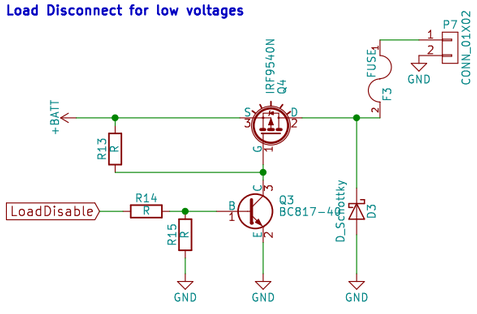
CALCULATIONS
Max voltage of 50Voc.
Max ADC input 5V.
Vin = 50V. Vout = 4.95V



Solar MPPT regulator



Load Disconnect for low voltages

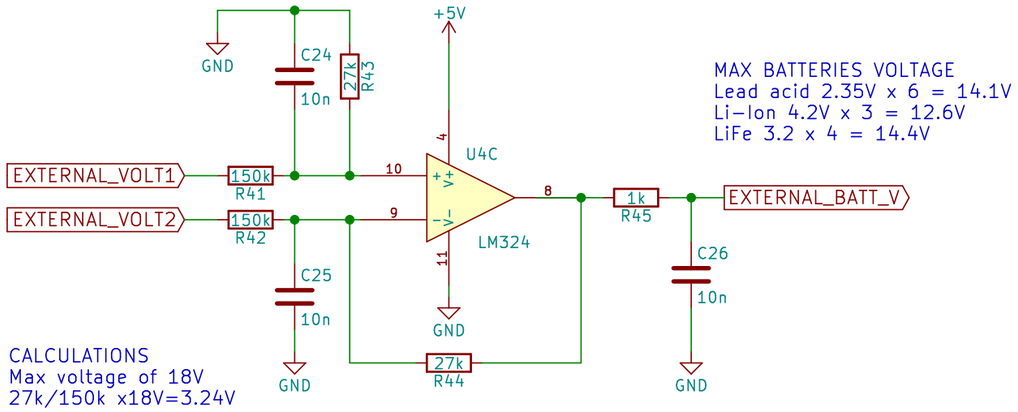


Partly based on Freifunk MPPT OPen Source design by Elektra.
https://github.com/elektra42/freifunk-open-mppt/

Sheet: /F_MPPT/	
File: Feifunk_MPPT.sch	
Title: Freifunk-Open-MPP-Solar-Tracker	
Size: A3	Date: 3 nov 2016
KiCad E.D.A. kicad 4.0.6	Id: 3/4
	Rev:

External Connection

Circuit below monitors the voltage on the INCOMING port, and scales appropriately for microcontroller. Prefer Opamp to voltage divider due to the external ports.

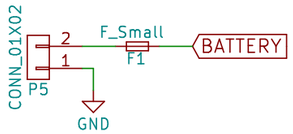


MAX BATTERIES VOLTAGE
Lead acid 2.35V x 6 = 14.1V
Li-Ion 4.2V x 3 = 12.6V
LiFe 3.2 x 4 = 14.4V

CALCULATIONS
Max voltage of 18V
27k/150k x18V=3.24V

Battery Outgoing Connection

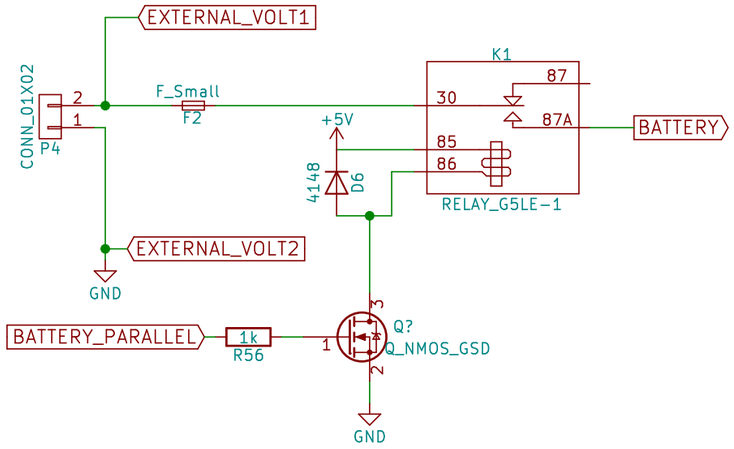
The fuse is just for protection of the battery against shorting the terminals. It can be totally over-rated and should never blow under normal operation.



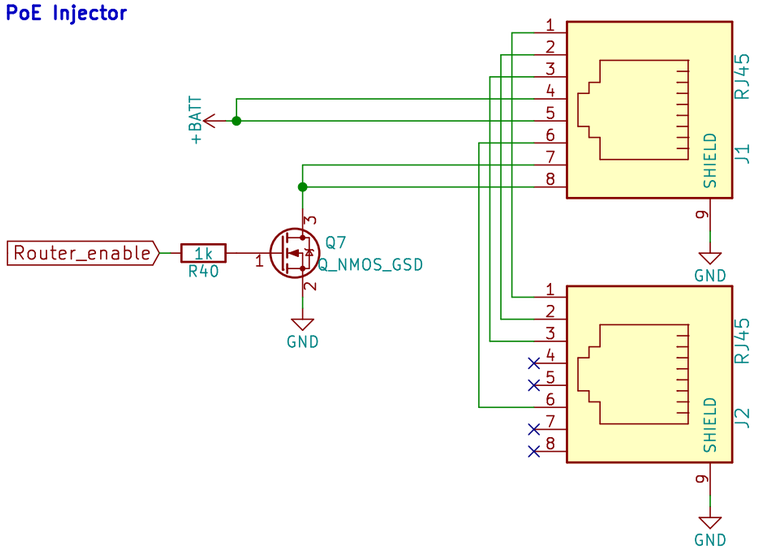
The battery can be charged via any exernal charger via this port. The external charger must do the correct voltages. Just like any cordless drill does.

Battery Incoming Connection

The relay should only be closed if battery voltages are within 0.1V of each other. This will limit any inrush current therefore the relay can only be rated for the total passthrough current.



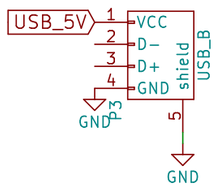
PoE Injector



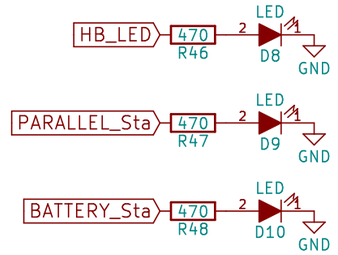
USB connector

It is for practical purposes impossible to make a truly universal charger using any combination of unchanging shorts or resistors on the USB charger or target device data lines because you are contending with manufacturers who are attempting to stop you doing exactly what you are trying to do. For example, Apple implement a number of charging control schemes using various combinations of resistor dividers, arranged so that only a "matching" power supply and target equipment will work together.

See https://electronics.stackexchange.com/questions/123172/what-is-the-ideal-way-to-handle-data-pins-d-and-d-on-a-usb-power-adapter-to-be



Status LEDs



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Size: A4 | Date: | **Rev:**
KiCad E.D.A. kicad 4.0.6 | Id: 4/4