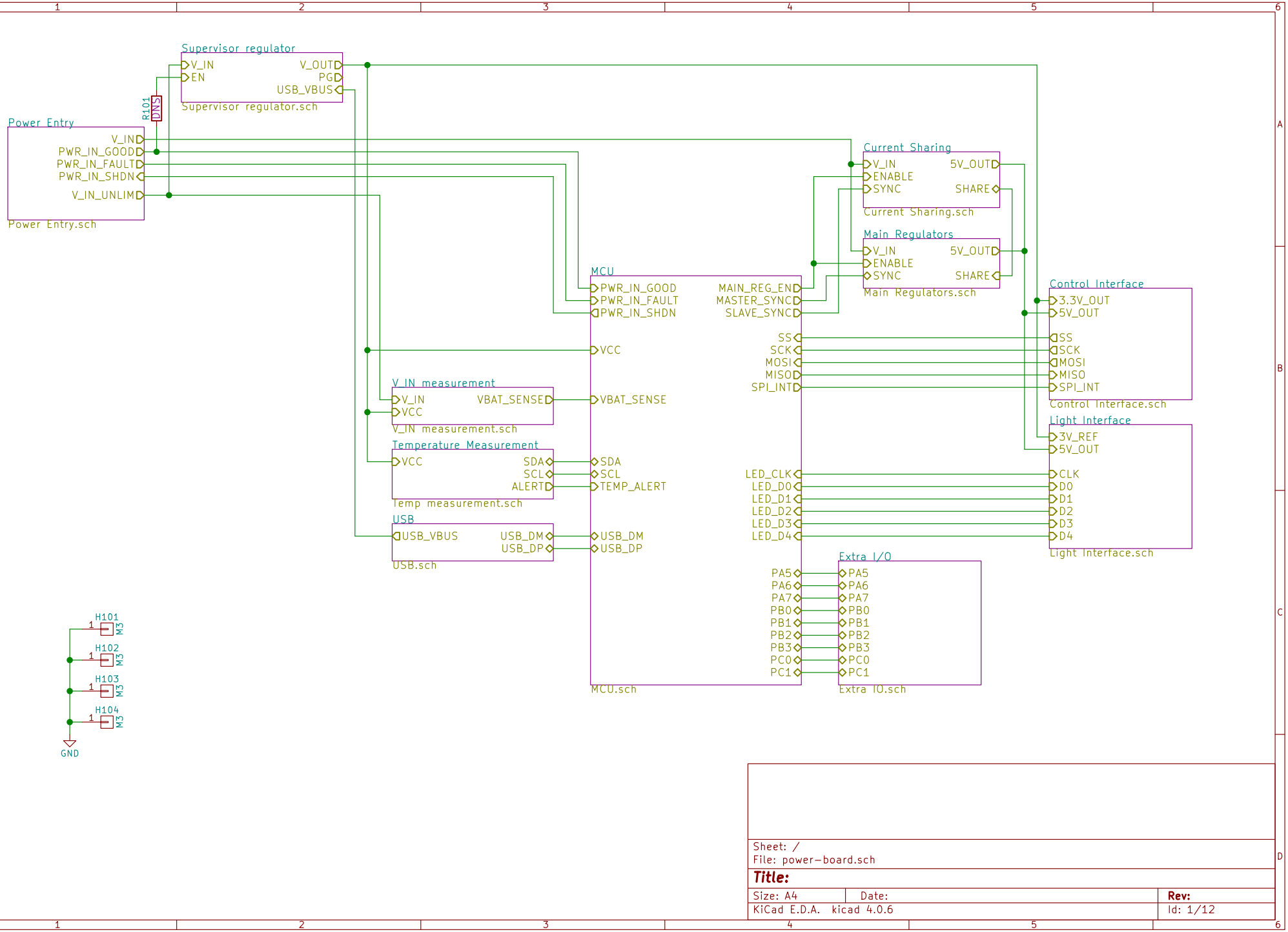
Supervisor regulator
V_IN
EN
V_OUT
PG
USB_VBUS
Supervisor regulator.sch
R101
DNS
Power Entry
V_IN
PWR_IN_GOOD
PWR_IN_FAULT
PWR_IN_SHDN
V_IN_UNLIM
Power Entry.sch
Current Sharing
V_IN
ENABLE
SYNC
5V_OUT
SHARE
Current Sharing.sch
Main Regulators
V_IN
ENABLE
SYNC
5V_OUT
SHARE
Main Regulators.sch
MCU
PWR_IN_GOOD
PWR_IN_FAULT
PWR_IN_SHDN
MAIN_REG_EN
MASTER_SYNC
SLAVE_SYNC
VCC
SS
SCK
MOSI
MISO
SPI_INT
VBAT_SENSE
SDA
SCL
TEMP_ALERT
USB_DM
USB_DP
LED_CLK
LED_D0
LED_D1
LED_D2
LED_D3
LED_D4
PA5
PA6
PA7
PB0
PB1
PB2
PB3
PC0
PC1
MCU.sch
Control Interface
3.3V_OUT
5V_OUT
SS
SCK
MOSI
MISO
SPI_INT
Control Interface.sch
Light Interface
3V_REF
5V_OUT
CLK
D0
D1
D2
D3
D4
Light Interface.sch
V_IN measurement
V_IN
VCC
VBAT_SENSE
V_IN measurement.sch
Temperature Measurement
VCC
SDA
SCL
ALERT
Temp measurement.sch
USB
USB_VBUS
USB_DM
USB_DP
USB.sch
Extra I/O
PA5
PA6
PA7
PB0
PB1
PB2
PB3
PC0
PC1
Extra IO.sch
H101
H102
H103
H104
M3
GND
Sheet: /
File: power-board.sch
Title:
Size: A4
Date:
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KiCad E.D.A. kicad 4.0.6
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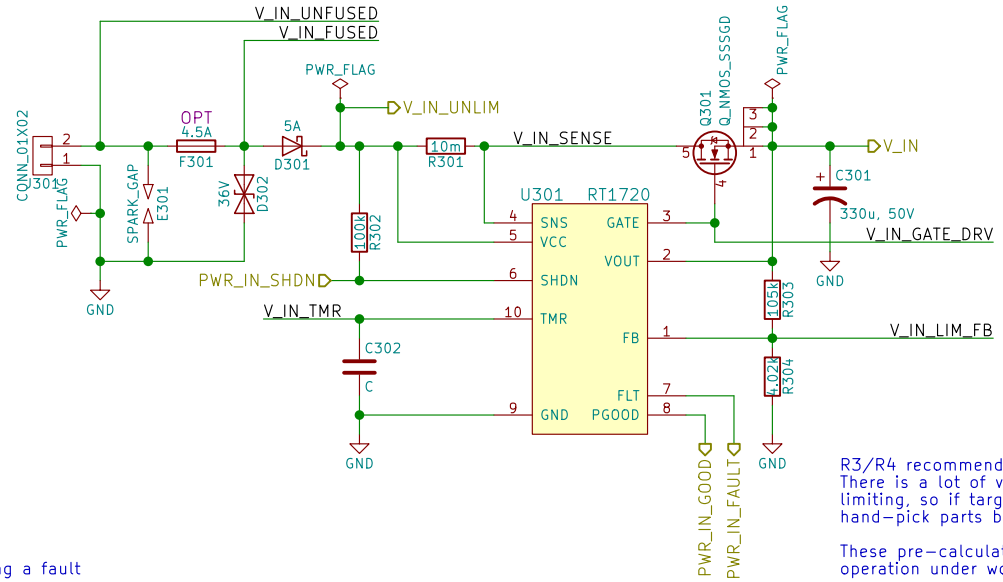

C1 controls the time delay between detecting a fault
and disconnecting the load. Specifically:
t_FAULT = C1 * 1.4V / 25uA
For example, a 1uF capacitor sets the fault timer to 56ms.

R2 sets the input current limit:
I_LIM = 50 mV / R2
For example, a 5 mOhm R2 would set the input current limit to 10A.
This should mainly target inrush current limiting; the LMZ devices
will limit steady-state current themselves.

R3 and R4 set the output overvoltage threshold. Any time the FB
terminal is over 1.25V (typical), an OV fault condition will be detected.
Q1 will be used to regulate the output voltage in this case, and if the
condition persists long enough the fault timer will shut the output off.

FB pin will sink 0.3 uA typical / 1 uA max, so the divider will need
to have low enough impedance to limit error to an acceptable level.

Q1 should be selected carefully based on criteria listed in the RT1720
datasheet and the requirements of the end application

FLT and PGOOD outputs are open-drain and may safely be pulled
up to about 12V. Leakage currents are 2 uA max.

If SHDN is used, be aware that it is normally pulled up to the full input
voltage. If limiting its voltage externally, ensure the on-state is over
2.5V and the off state is below 0.5V. Typical input current at 3V is 0.4 uA.

R3/R4 recommended values (based on 1% resistors):
There is a lot of variation in the specified performance of the voltage
limiting, so if targeting a highly accurate limit, you will likely have to
hand-pick parts based on the FB performance of the particular unit.

These pre-calculated figures err on the low side, to ensure safe
operation under worst-case device parameters.

20V limit (LMZ220xx): R3 = 97.6k, R4 = 6.81k
36V limit (LMZ36xx): R3 = 105k, R4 = 4.02k

Power entry, overvoltage/overcurrent/reverse-voltage protection,
inrush current limiting

Sheet: /Power Entry/
File: Power Entry.sch

Title:

Size: A4	Date:	**Rev:**
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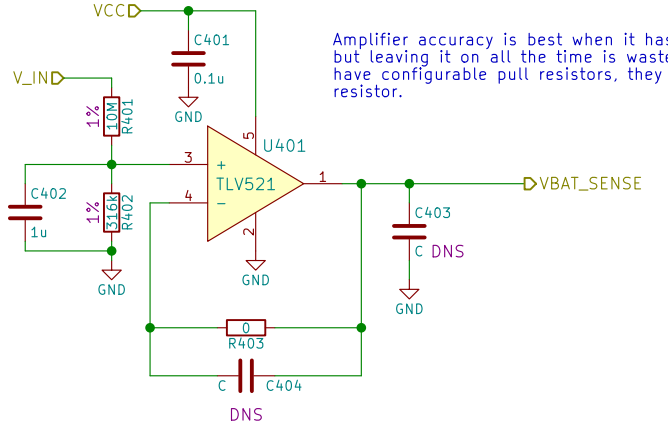

Amplifier accuracy is best when it has a small load (10 kohm, for example), but leaving it on all the time is wasteful. If the microcontroller GPIOs have configurable pull resistors, they can be used instead of this load resistor.

Configured to output 1.1V when V_IN = 36V, with RC constant around 1.25s. Use relatively large resistors and make sure to clean flux thoroughly to maintain accurate resistance.
Ensure divider bypass capacitor has extremely low leakage (just 3 nA leakage current would reduce accuracy by about 1%)

Note that this entire circuit is optional, and may be omitted if relying on precise UVLO configuration of the main output regulator.

Sheet: /V_IN measurement/ File: V_IN measurement.sch		
Title:		
Size: A4	Date:	**Rev:**
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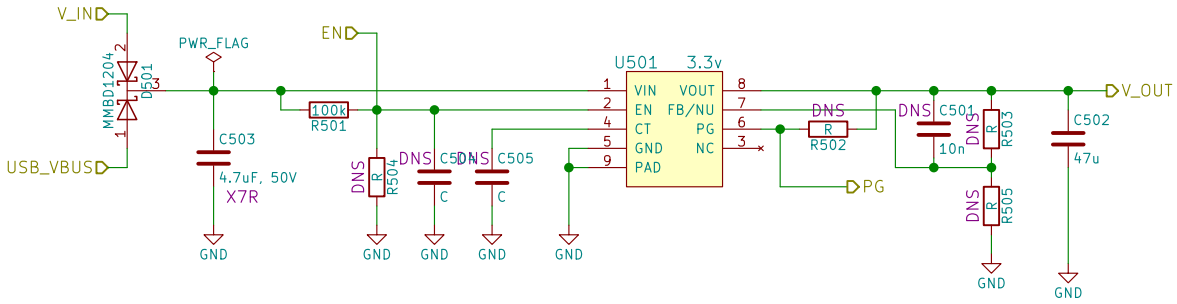
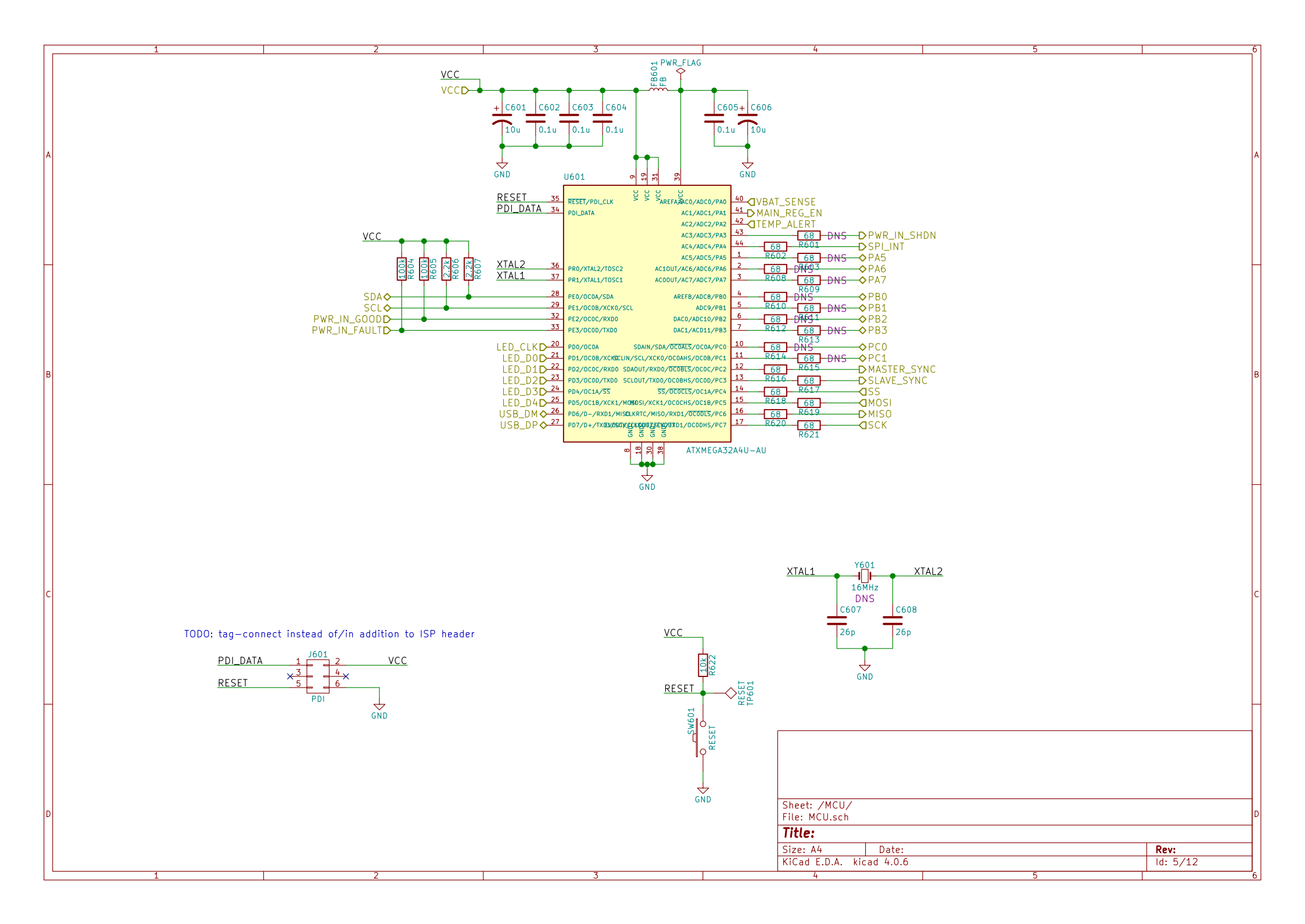


Sheet: /Supervisor regulator/		
File: Supervisor regulator.sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad 4.0.6		Id: 4/12


VCC
PWR_FLAG
FB601
FB
C601
10u
C602
0.1u
C603
0.1u
C604
0.1u
C605
0.1u
C606
10u
GND
U601
RESET
PDI_DATA
XTAL2
XTAL1
SDA
SCL
PWR_IN_GOOD
PWR_IN_FAULT
LED_CLK
LED_D0
LED_D1
LED_D2
LED_D3
LED_D4
USB_DM
USB_DP
VBAT_SENSE
MAIN_REG_EN
TEMP_ALERT
PWR_IN_SHDN
SPI_INT
PA5
PA6
PA7
PB0
PB1
PB2
PB3
PC0
PC1
MASTER_SYNC
SLAVE_SYNC
SS
MOSI
MISO
SCK
ATXMEGA32A4U-AU
R601
R602
R603
R608
R609
R610
R611
R612
R613
R614
R615
R616
R617
R618
R619
R620
R621
R604
R605
R606
R607
100K
2.2k
68
DNS
TODO: tag-connect instead of/in addition to ISP header
J601
PDI
PDI_DATA
RESET
R622
10K
SW601
RESET
TP601
Y601
16MHz
C607
C608
26p
XTAL1
XTAL2
Sheet: /MCU/
File: MCU.sch
Title:
Size: A4
Date:
Rev:
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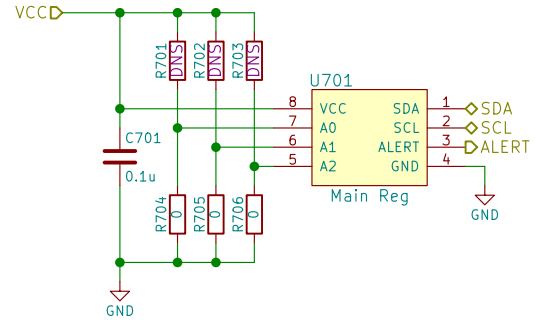

Configured for address 0. A[0..2] have internal pull-down resistors, so the external ones are optional but recommended by the datasheet.

Sheet: /Temperature Measurement/ File: Temp measurement.sch		
Title:		
Size: A4	Date:	**Rev:**
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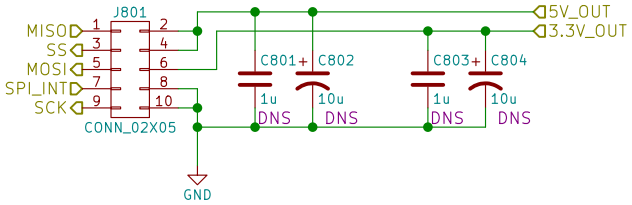
TODO: ESD protection



Sheet: /Control Interface/ File: Control Interface.sch		
Title:		
Size: A4	Date:	**Rev:**
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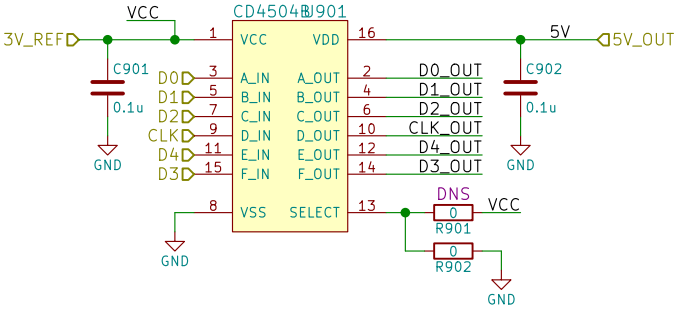

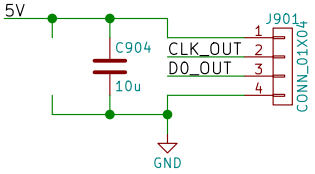

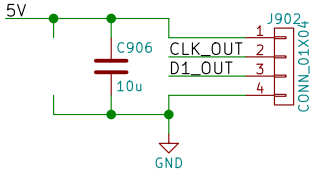

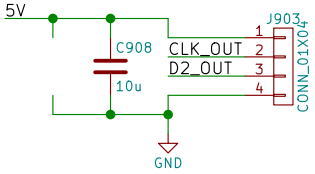

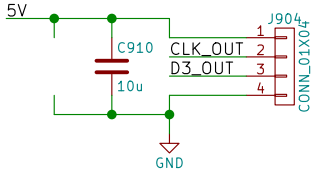

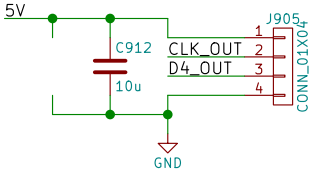

TODO: ESD Protection

Sheet: /Light Interface/
File: Light Interface.sch

Title:

Size: A4	Date:	**Rev:**
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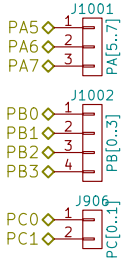
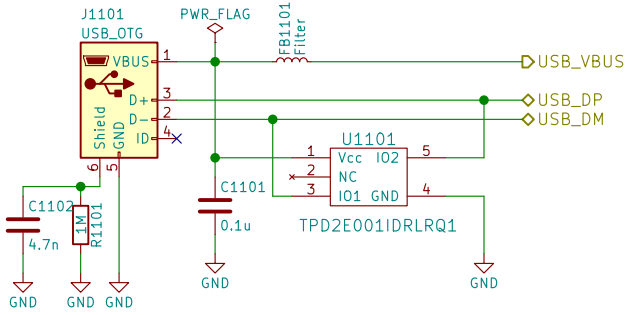


Sheet: /Extra I/O/		
File: Extra IO.sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad 4.0.6		Id: 9/12



Sheet: /USB/		
File: USB.sch		
Title:		
Size: A4	Date:	**Rev:**
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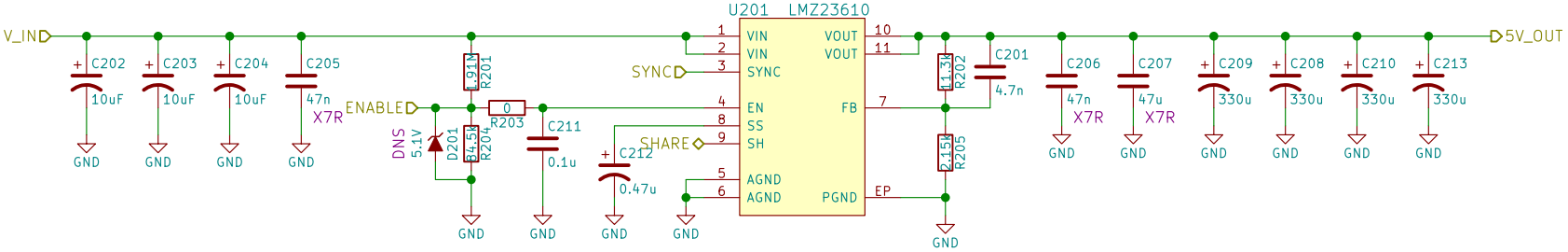
Sheet: /Current Sharing/ File: Current Sharing.sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. kicad 4.0.6		Id: 11/12

Basic design parameters:
V_IN: 15V – 21V typical (5x 3.7V Li-ion pack)
V_OUT: 5V
I_OUT: 10A

Consult LMZ23610 datasheet when selecting input and output capacitors



Total input capacitance should be at least 30uF*, more is OK.
Much more important is input ripple current handling, which should be at least 5A total.

* to maintain about 250 mV input ripple voltage

EN divider:
If controlling via microcontroller, ignore assigned values and select something appropriate to the GPIO drive characteristics. Values listed in schematic are configured to select a 15V UVLO with 1V hysteresis.

Calculated (ideal) thresholds:
V_EN(rising): 16.00V
V_EN(falling): 14.99V
Maximum EN pin voltage (V_IN=36V): 2.87V (so no Zener diode required)

Sheet: /Main Regulators/		
File: Main Regulators.sch		
Title:		
Size: A4	Date:	**Rev:**
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