MCU

power_USB

USB_D_N ——— USB_D_N

USB_D_P ——— USB_D_P

File: power_USB.kicad_sch

Required supply voltages for the fronend:

+5VA
-5VA

Curr_measurement

J1
1   IN+

J2
1   IN-

Analog_out ——— Analog_in

Stage_1_out ——— Stage_1_in

File: Curr_measurement.kicad_sch

File: MCU.kicad_sch

Vref

+3V3 VDDA

VBAT VDD VDD VDD VDDA

VREF+ PA0 Stage_1_In
PG10 PA1 Analog_In
PF0 PA2
PF1 PA3
PC13 PA4
PC14 PA5
PC15 PA6
PB0 PA7
PB1 PA8
PB2 PA9
PB3 PA10
PB4 PA11
PB5 PA12
PB6 PA13 SWDIO
PB7 PA14 SWCLK
PB8 PA15
PB9
PB10
PB11
PB12
PB13
PB14
PB15

VSS VSSA

GND

U11
STM32G431C6Tx

NRST

Y1
8MHz

R25
22R

C29
15p

C31
15p

C30 4.7u
C32 100n
C33 100n
C34 100n
C35 1u
C36 100n
C37 1u
C38 100n

+3V3 +3V3 VDDA Vref

GND GND

10k
R1 BOOT0

GND
+3V3

LED
D3

1.5k

+3V3 +3V3

D4 D_Schottky
D6 D_Schottky
D5 D_Schottky
D7 D_Schottky

GND GND

+3V3

U12
USBLC6-2P6

USB_D_N
USB_D_P

GND

+3V3

RESET NRST

SWCLK/TCK SWCLK
SWDIO/TMS SWDIO
SWO/TDO
NC/TDI

VTref

GNDDetect
GND

J4
Conn_ARM_JTAG_SWD_10

GND

Frontend_1

Frontend_1_IN+   Frontend_1_OUT

Frontend_1_IN−   Stage1_out_1

File: untitled.kicad_sch

Frontend_2

Frontend_2_IN+   Stage1_out_2

Frontend_2_IN−   Frontend_2_OUT

File: untitled2.kicad_sch

IN+

IN−

R_SENSE1
10k

C2
1n

JP1

JP2

For R_SENSE = 10k:
I = 100pA −> U_SENSE = 1uV

C4
100n

R16
DNP

GND   GND

R4
47

JP4

JP3

R2
47

C3
100n

R3
DNP

GND   GND

Stage_1_out

Analog_out

+3V3 STM32 power supply

VBUS = +9V from external battery

VBUS

J5
1
2
XT30_Male

VBUS

U7
Vin Vout
EN
NC GND
TPS7A2433DBVR

C1
2u2

GND

+3V3

C5
2u2

GND

GND

+5VA for analog section

VBUS

U8
Vin Vout
EN
NC GND
TPS7A2450DBVR

C22
2u2

GND

+5VA

C23
2u2

GND

GND
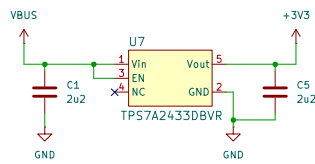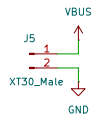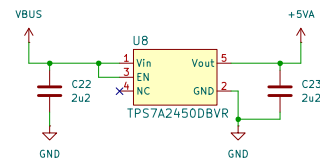
USB 2.0 Type C for data transfer only

PCB will be 2 layer, so keep USB lines very short.
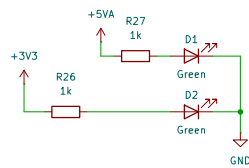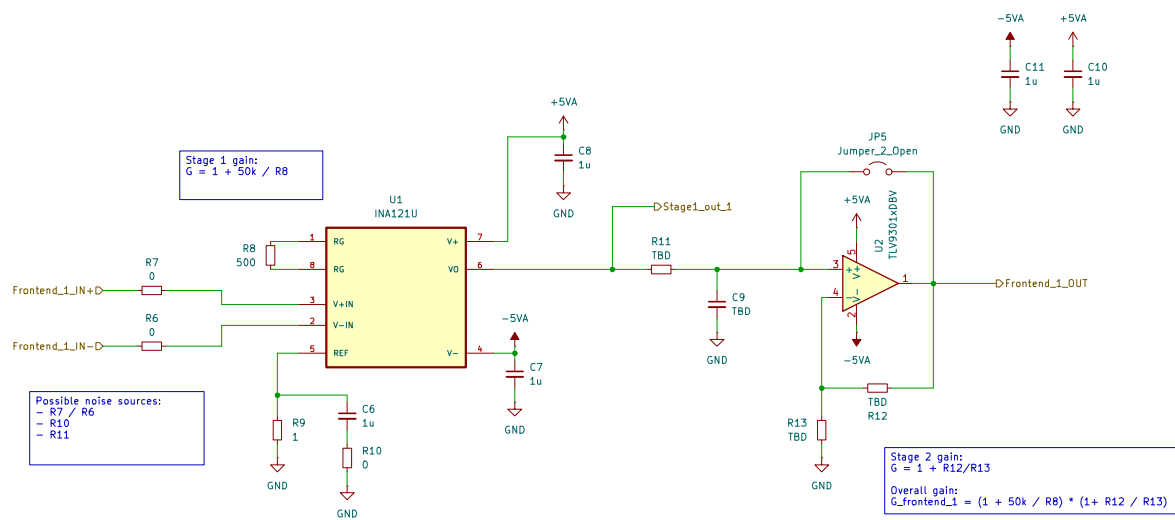Can also add DNP 100R resistor between USB lines.

J3
VBUS B4/A9
VBUS A4/B9
CC1   A5
A1/B12 CC2   B5
B1/A12 DP1   A6
DP2   B6
S1   DN1   A7
S2   DN2   B7
S3   SBU1 A8
S4   SBU2 B8
USB4110GFA

GND

GND GND

R28
5k1

R29
5k1

USB_D_P

USB_D_N

−5VA for analog section

VBUS

+5V_U9

−5VA

U10
Vin Vout
EN
NC GND
TPS7A2450DBVR

C25
2u2

GND

C26
2u2

GND

C28
1n

U9
LMC7660
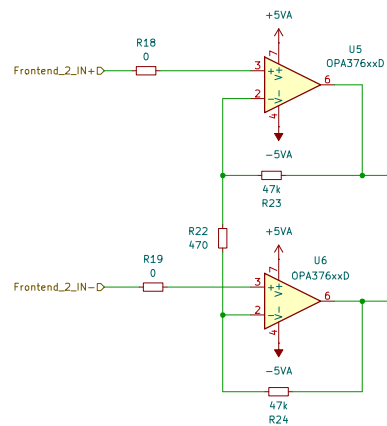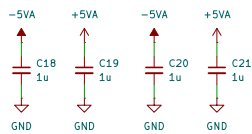V+   VOUT
OSC CAP+
LV   CAP−
GND

GND

C27
10u

C24
10u
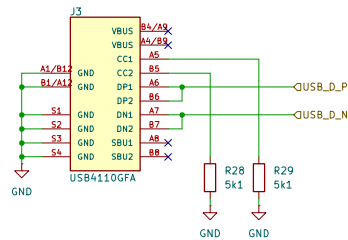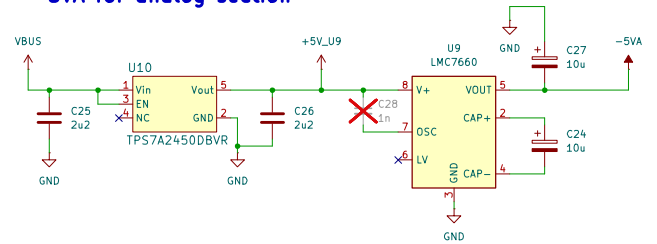
Pin 6 (LV) has to be NC for V+ >= 3.5V

Pin 8 (V+) can be connected through C28 to pin 7 (OSC) in order to slow down the internal 10kHz oscillator.
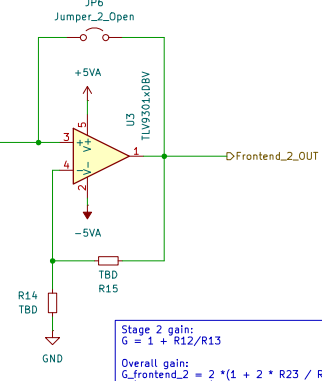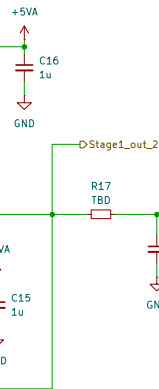
Power status LEDs
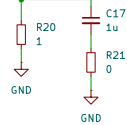
+5VA R27
1k

D1
Green

+3V3 R26
1k

D2
Green

GND

Stage 1 gain:
G = 1 + 50k / R8

Possible noise sources:
– R7 / R6
– R10
– R11

Stage 2 gain:
G = 1 + R12/R13

Overall gain:
G_frontend_1 = (1 + 50k / R8) * (1+ R12 / R13)

−5VA +5VA −5VA +5VA

C18 C19 C20 C21
1u   1u   1u   1u

GND GND GND GND

−5VA +5VA

C12 C13
1u   1u

GND GND

+5VA

R18
0

Frontend_2_IN+

U5
OPA376xxD

Stage 1 gain:
G = 2 *(1 + 2 * R23 / R22)

+5VA

C16
1u

GND

JP6
Jumper_2_Open

−5VA

+5VA

U3
TLV9301xDBV

−5VA

47k
R23

+5VA

U4
INA137UA

V+   7

IN+   3
IN−   2

OUT   6

REF   1

SENSE   5

NC   8

V−   4

Stage1_out_2

R17
TBD

C14
TBD

GND

Frontend_2_OUT

R22
470

R19
0

Frontend_2_IN−

U6
OPA376xxD

+5VA

−5VA

−5VA

C15
1u

GND

R14
TBD

TBD
R15

GND

47k
R24

Possible noise sources:
− R18 / R19
− R21
− R17

R20
1

C17
1u

R21
0

GND GND

Stage 2 gain:
G = 1 + R12/R13

Overall gain:
G_frontend_2 = 2 *(1 + 2 * R23 / R22)
* (1 + R12/R13)