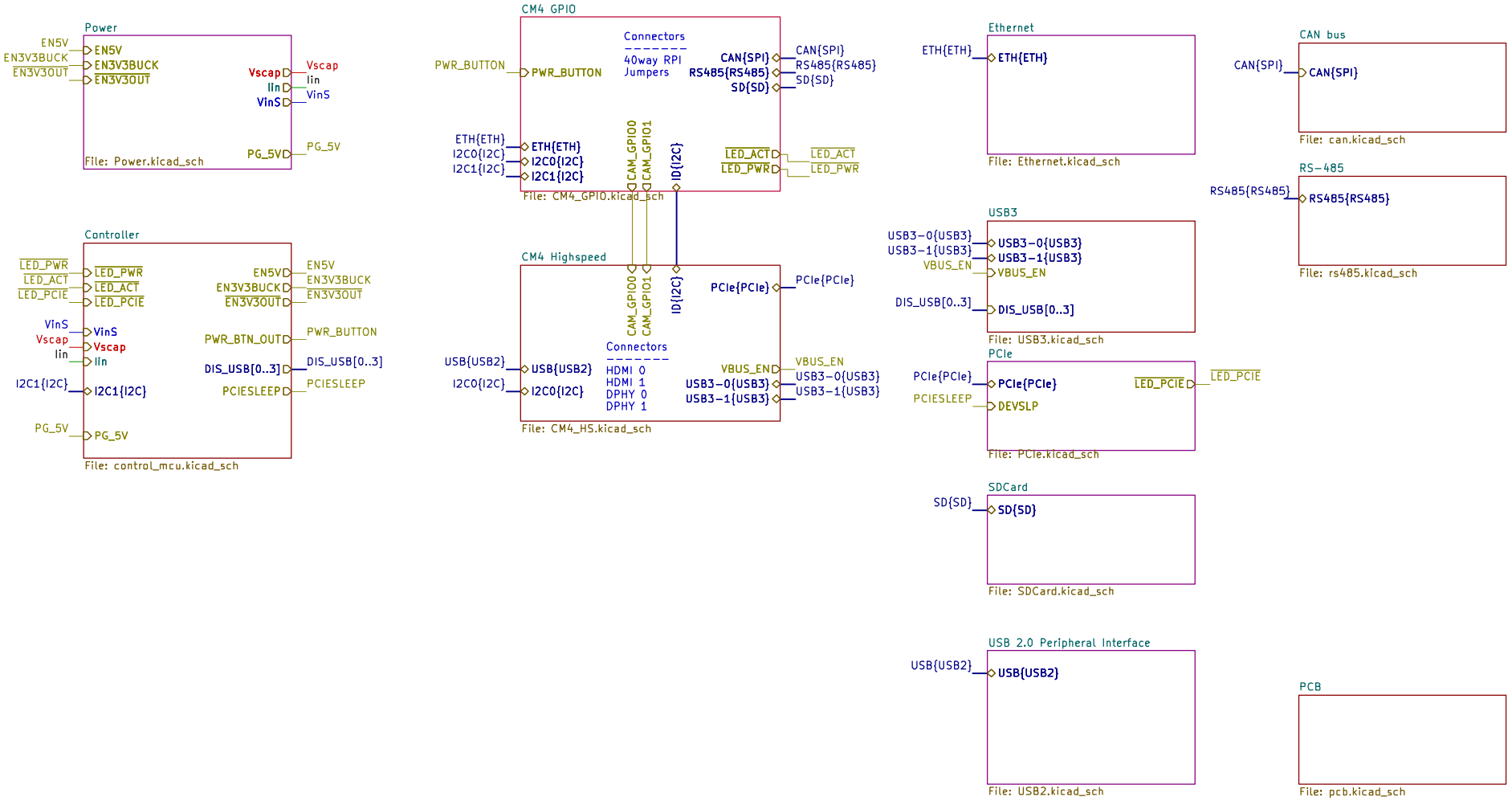

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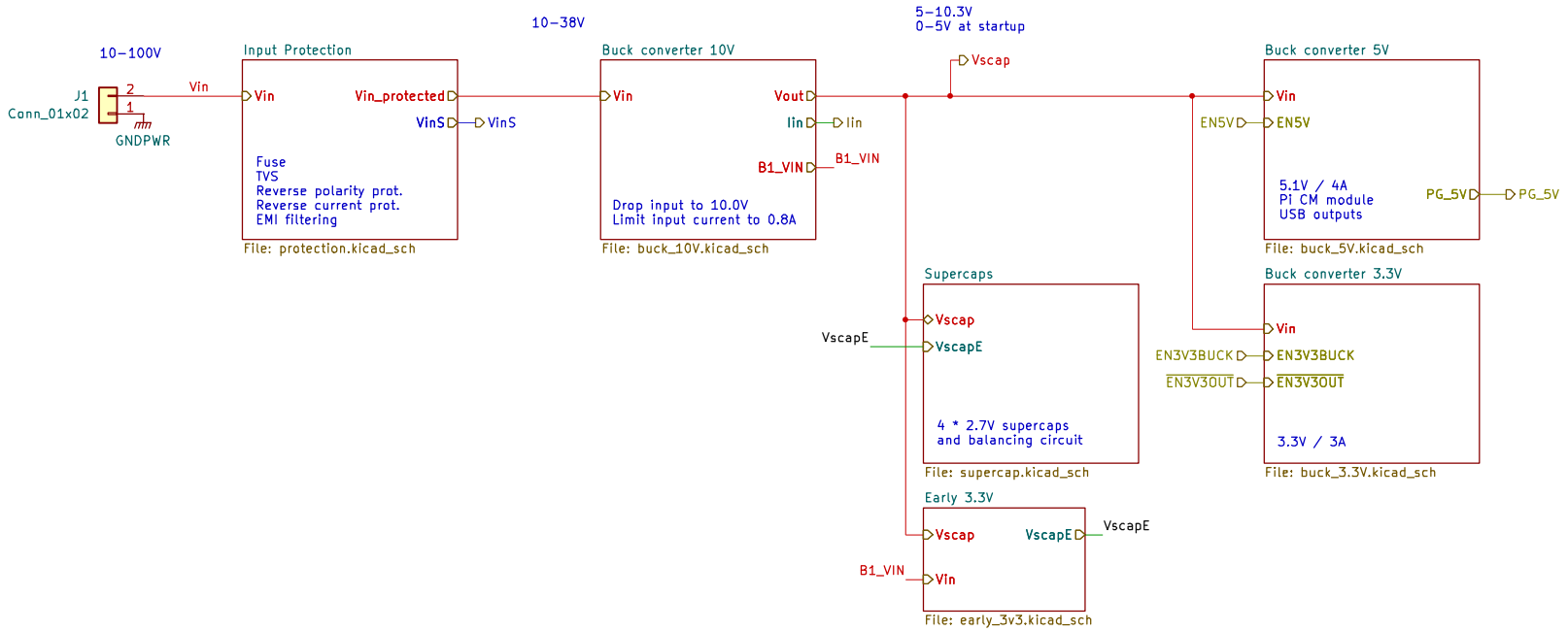
Hat Labs Oy

Sheet: /
File: HALPI2.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	Rev: v0.6.0
KiCad E.D.A. 9.0.6-rc2		Id: 1/38



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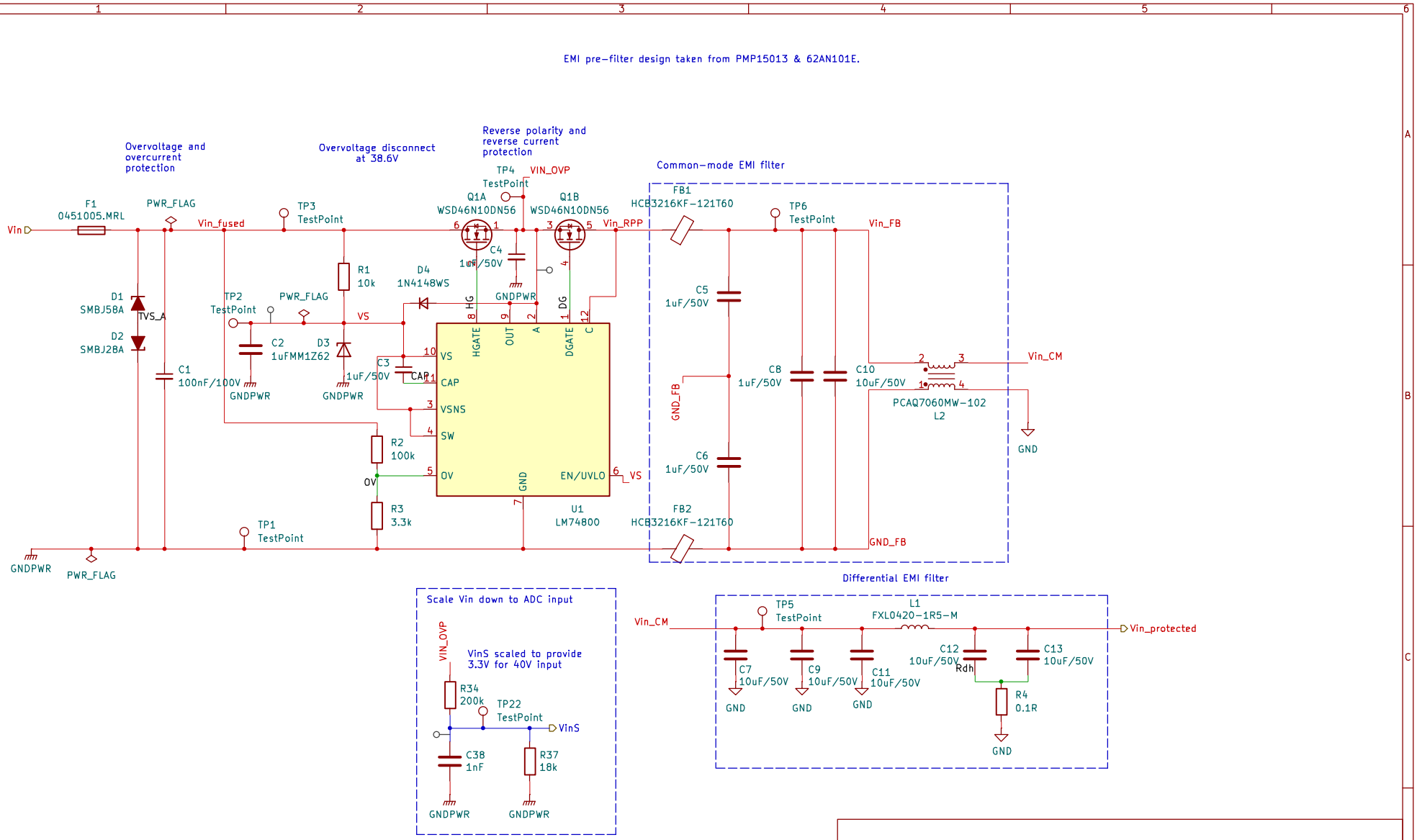
Hat Labs Oy

Sheet: /Power/
File: Power.kicad_sch

Title: HALPI2

Size: A4	Date: 2025–10–07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6–rc2		Id: 2/38


EMI pre-filter design taken from PMP15013 & 62AN101E.
Overvoltage and overcurrent protection
Overvoltage disconnect at 38.6V
Reverse polarity and reverse current protection
Common-mode EMI filter
Vin
F1
0451005.MRL
PWR_FLAG
Vin_fused
TP3
TestPoint
TP4
VIN_OVP
Q1A
WSD46N10DN56
Q1B
WSD46N10DN56
Vin_RPP
FB1
HCB3216KF-121T60
TP6
TestPoint
Vin_FB
R1
10k
D4
1N4148WS
C4
1uF/50V
GNDPWR
D1
SMBJ58A
TVS_A
D2
SMBJ28A
TP2
TestPoint
PWR_FLAG
VS
C5
1uF/50V
C1
100nF/100V
C2
1uFMM1Z62
D3
C3
1uF/50V
CAP
HGATE
OUT
DGATE
VSNS
SW
OV
EN/UVLO
GND
U1
LM74800
R2
100k
R3
3.3k
C8
1uF/50V
C10
10uF/50V
GND_FB
C6
1uF/50V
FB2
HCB3216KF-121T60
Vin_CM
PCAQ7060MW-102
L2
TP1
TestPoint
GNDPWR
PWR_FLAG
Scale Vin down to ADC input
VIN_OVP
VinS scaled to provide 3.3V for 40V input
R34
200k
TP22
TestPoint
VinS
C38
1nF
R37
18k
Differential EMI filter
TP5
TestPoint
L1
FXL0420-1R5-M
Vin_protected
C7
10uF/50V
C9
10uF/50V
C11
10uF/50V
C12
10uF/50V
Rdh
C13
10uF/50V
R4
0.1R
Overvoltage limit 38.6V
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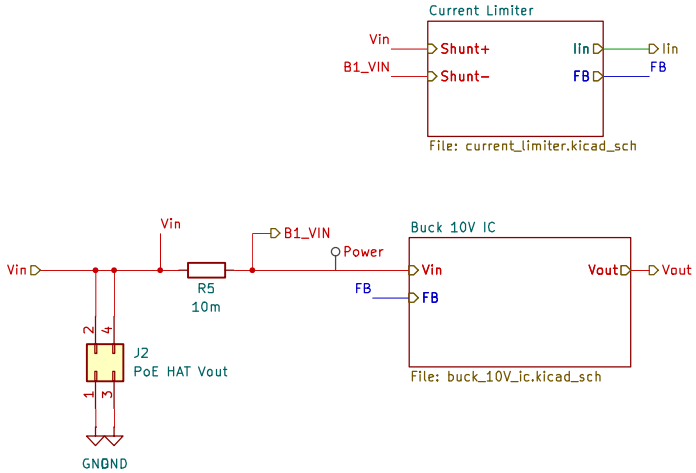
Hat Labs Oy
Sheet: /Power/Input Protection/
File: protection.kicad_sch
Title: HALPI2
Size: A4
Date: 2025-10-07
Rev: v0.6.0
KiCad E.D.A. 9.0.6-rc2
Id: 3/38



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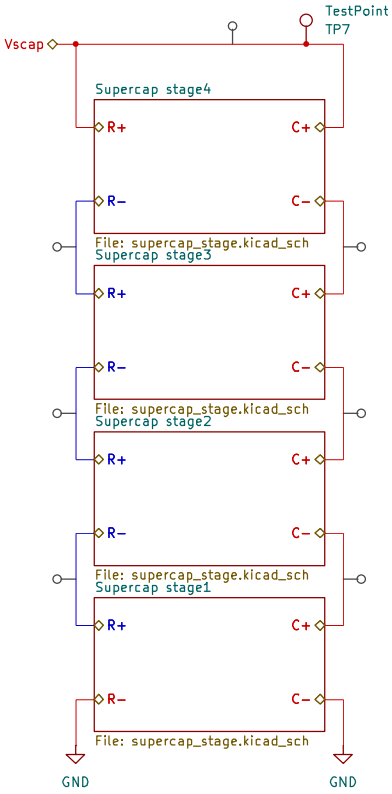
Hat Labs Oy

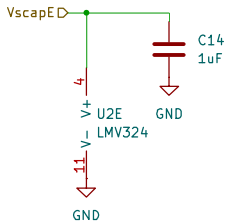
Sheet: /Power/Buck converter 10V/
File: buck_10V.kicad_sch

Title: HALPI2

Size: A4	Date: 2025−10−07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6−rc2		Id: 4/38

Supercapacitor balancing circuit modeled after
https://www.eevblog.com/forum/renewable-energy/supercapacitor-balancer/





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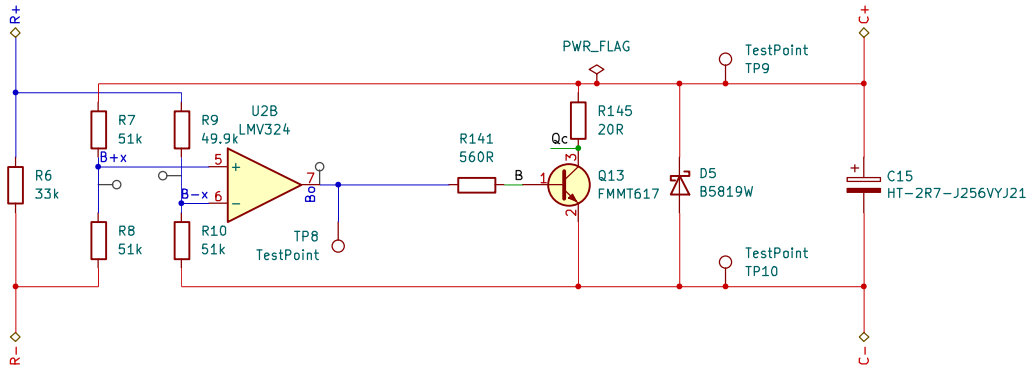
Hat Labs Oy

Sheet: /Power/Supercaps/
File: supercap.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	Rev: v0.6.0
KiCad E.D.A. 9.0.6-rc2		Id: 5/38



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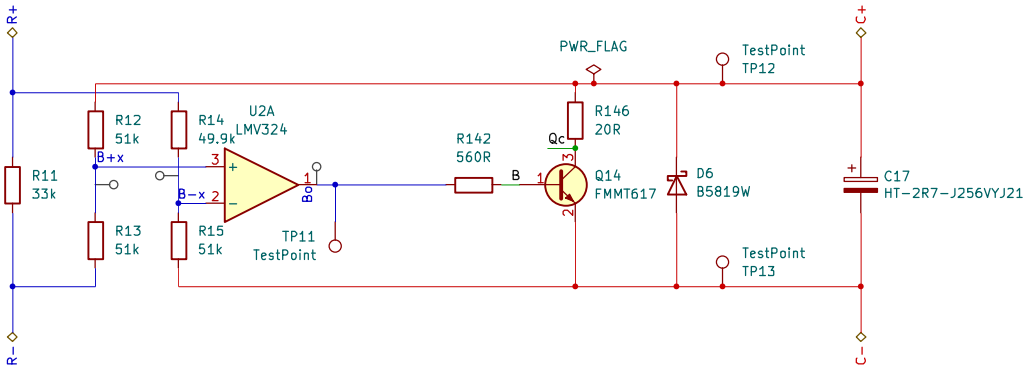
Hat Labs Oy

Sheet: /Power/Supercaps/Supercap stage1/
File: supercap_stage.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 6/38



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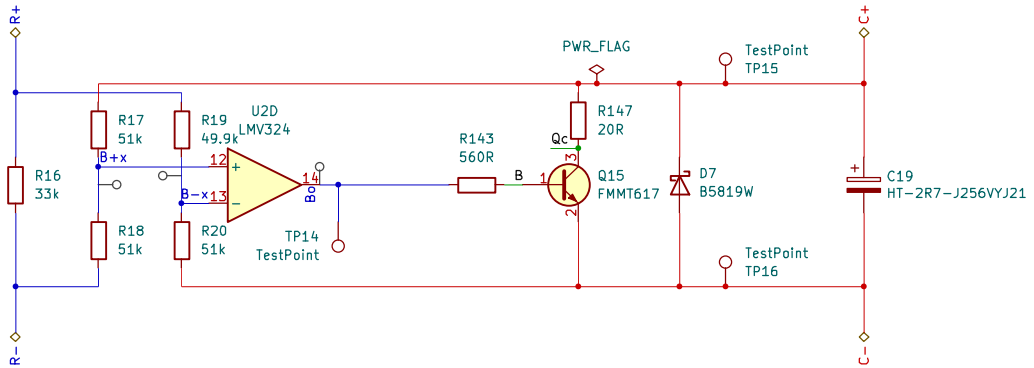
Hat Labs Oy

Sheet: /Power/Supercaps/Supercap stage2/
File: supercap_stage.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 7/38



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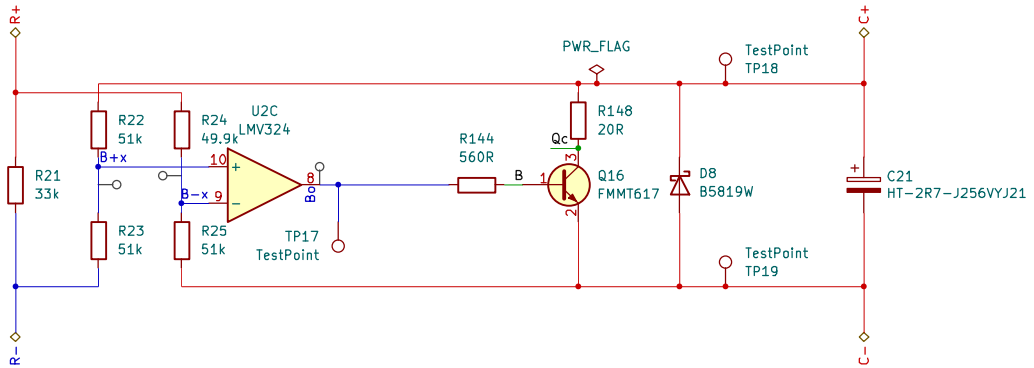
Sheet: /Power/Supercaps/Supercap stage3/
File: supercap_stage.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 8/38



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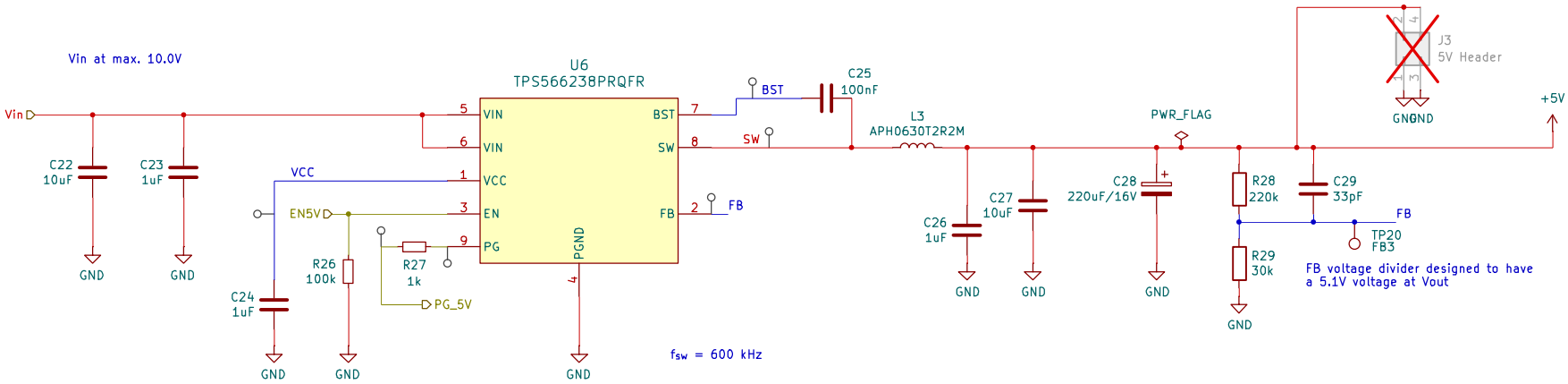
Sheet: /Power/Supercaps/Supercap stage4/
File: supercap_stage.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 9/38

Buck converter dropping the supercap voltage down to 5V for the CM4/5 module input and USBs



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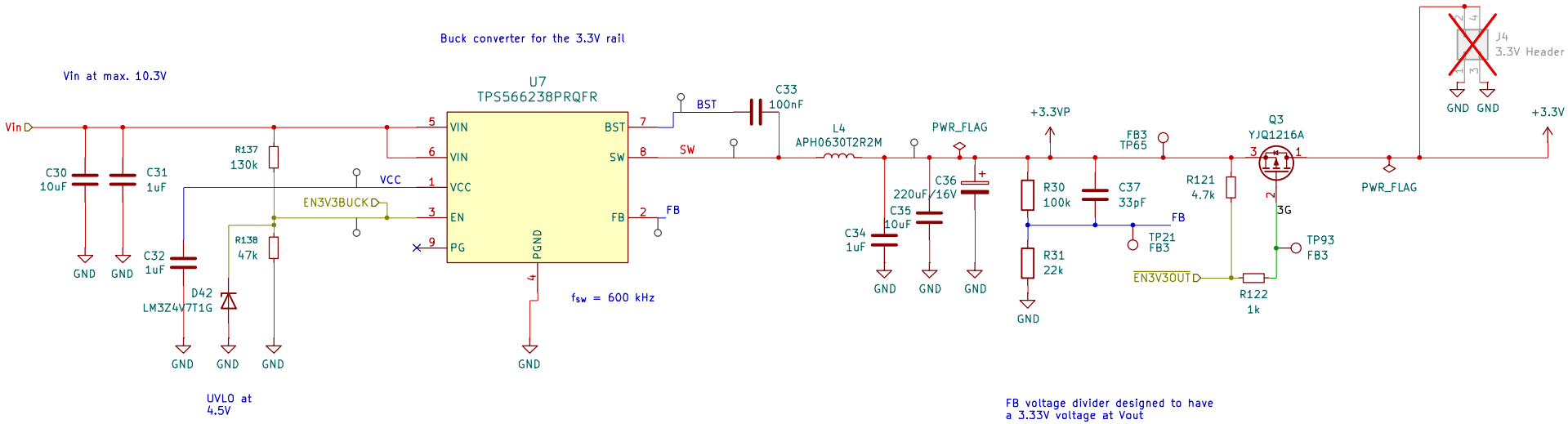
Sheet: /Power/Buck converter 5V/
File: buck_5V.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 10/38



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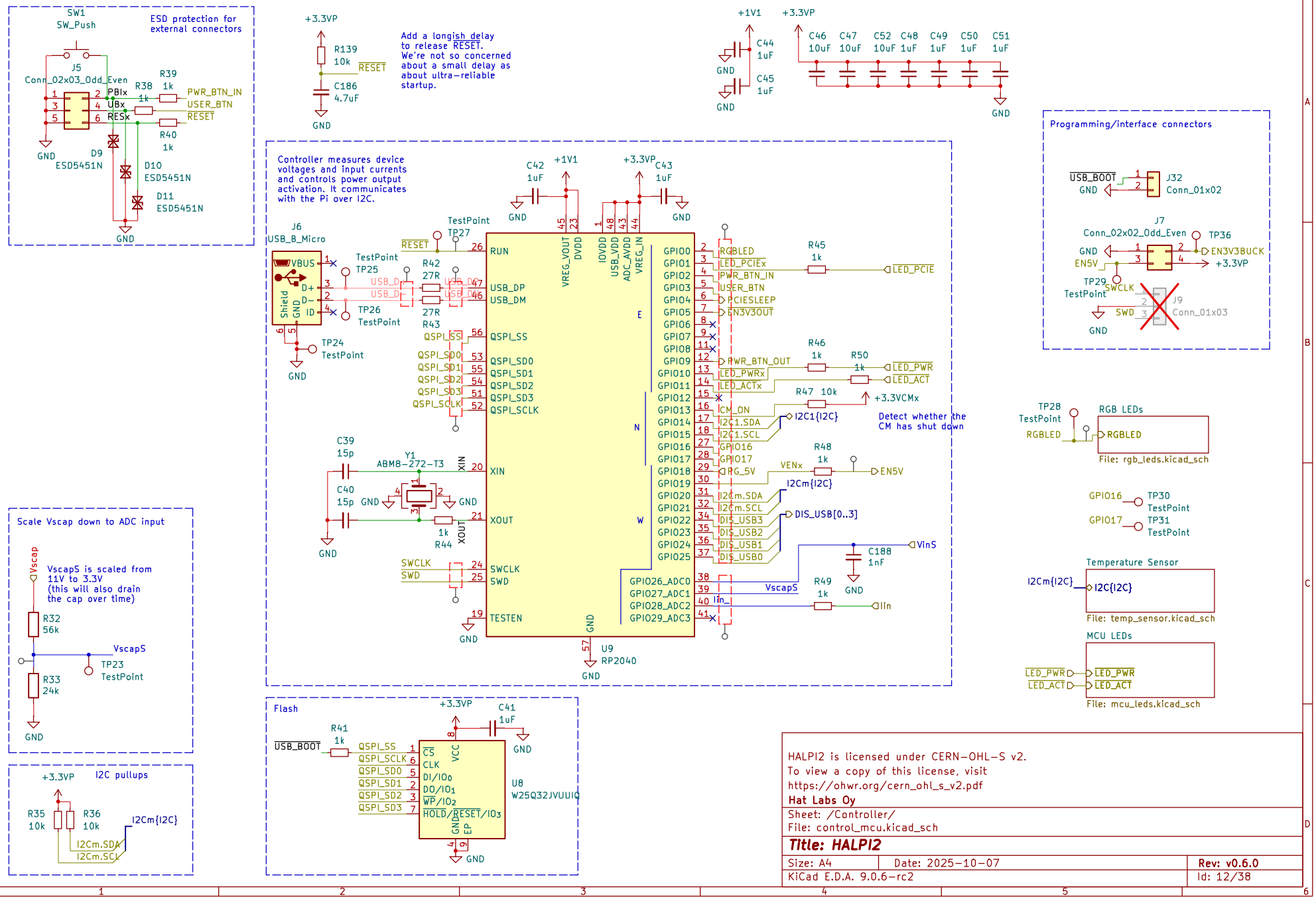
Sheet: /Power/Buck converter 3.3V/
File: buck_3.3V.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 11/38


ESD protection for external connectors
SW1
SW_Push
J5
Conn_02x03_Odd_Even
PBIx
UBx
RESx
R38 1k
R39 1k
R40 1k
PWR_BTN_IN
USER_BTN
RESET
D9 ESD5451N
D10 ESD5451N
D11 ESD5451N
GND
+3.3VP
R139 10k
RESET
C186 4.7uF
Add a longish delay to release RESET. We're not so concerned about a small delay as about ultra-reliable startup.
+1V1
+3.3VP
C44 1uF
C45 1uF
C46 10uF
C47 10uF
C52 10uF
C48 1uF
C49 1uF
C50 1uF
C51 1uF
Controller measures device voltages and input currents and controls power output activation. It communicates with the Pi over I2C.
C42 1uF
C43 1uF
J6
USB_B_Micro
VBUS
D+
D-
ID
Shield
GND
TP24 TestPoint
TP25 TestPoint
TP26 TestPoint
TP27 TestPoint
R42 27R
R43 27R
USB_D+
USB_D-
RESET
QSPI_SS
QSPI_SD0
QSPI_SD1
QSPI_SD2
QSPI_SD3
QSPI_SCLK
C39 15p
C40 15p
Y1 ABM8-272-T3
R44 1k
XIN
XOUT
SWCLK
SWD
TESTEN
RUN
USB_DP
USB_DM
VREG_VOUT
DVDD
IOVDD
USB_VDD
ADC_AVDD
VREG_IN
GPIO0 RGBLED
GPIO1 LED_PCIEx
GPIO2 PWR_BTN_IN
GPIO3 USER_BTN
GPIO4 PCIESLEEP
GPIO5 EN3V3OUT
GPIO9 PWR_BTN_OUT
GPIO10 LED_PWRx
GPIO11 LED_ACTx
GPIO12 CM_ON
GPIO13 I2C1.SDA
GPIO14 I2C1.SCL
GPIO16
GPIO17
GPIO18 PG_5V
GPIO20 I2Cm.SDA
GPIO21 I2Cm.SCL
GPIO22 DIS_USB3
GPIO23 DIS_USB2
GPIO24 DIS_USB1
GPIO25 DIS_USB0
GPIO26_ADC0 VscapS
GPIO27_ADC1 Iin
GPIO28_ADC2
GPIO29_ADC3
R45 1k
R46 1k
R50 1k
R47 10k
R48 1k
R49 1k
LED_PCIE
LED_PWR
LED_ACT
+3.3VCMx
Detect whether the CM has shut down
I2C1{I2C}
I2Cm{I2C}
DIS_USB[0..3]
EN5V
VinS
C188 1nF
Iin
U9
RP2040
Programming/interface connectors
USB_BOOT
J32
Conn_01x02
J7
Conn_02x02_Odd_Even
TP36
EN3V3BUCK
TP29 TestPoint
SWCLK
SWD
J9
Conn_01x03
TP28 TestPoint
RGBLED
RGB LEDs
File: rgb_leds.kicad_sch
TP30 TestPoint
TP31 TestPoint
Temperature Sensor
File: temp_sensor.kicad_sch
MCU LEDs
File: mcu_leds.kicad_sch
Scale Vscap down to ADC input
Vscap
VscapS is scaled from 11V to 3.3V (this will also drain the cap over time)
R32 56k
R33 24k
TP23 TestPoint
I2C pullups
R35 10k
R36 10k
I2Cm.SDA
I2Cm.SCL
Flash
R41 1k
C41 1uF
U8
W25Q32JVUUIQ
CS
CLK
DI/IO0
DO/IO1
WP/IO2
HOLD/RESET/IO3
VCC
GND
EP
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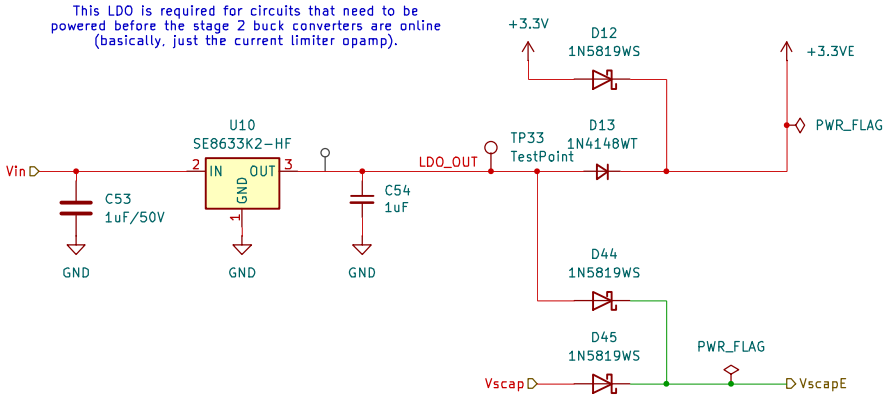
Hat Labs Oy
Sheet: /Controller/
File: control_mcu.kicad_sch
Title: HALPI2
Size: A4
Date: 2025-10-07
KiCad E.D.A. 9.0.6-rc2
Rev: v0.6.0
Id: 12/38



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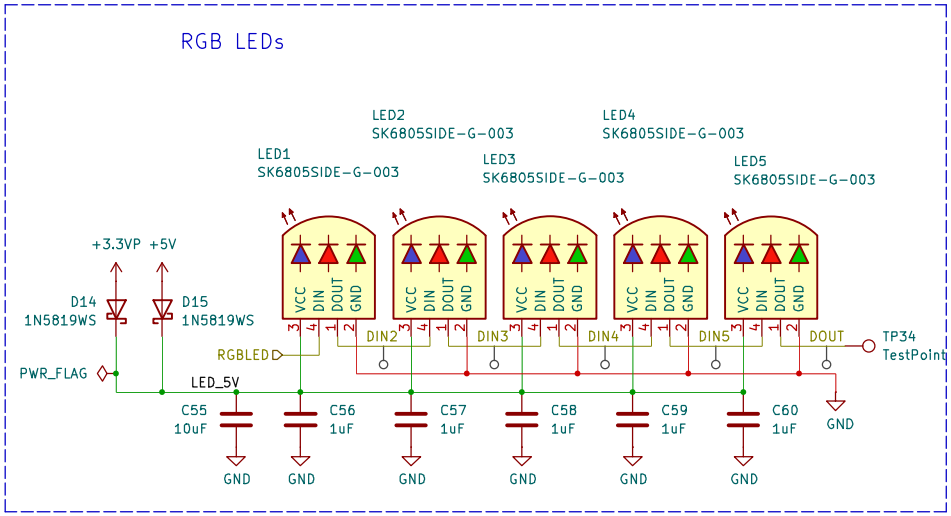
Hat Labs Oy

Sheet: /Power/Early 3.3V/
File: early_3v3.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 13/38



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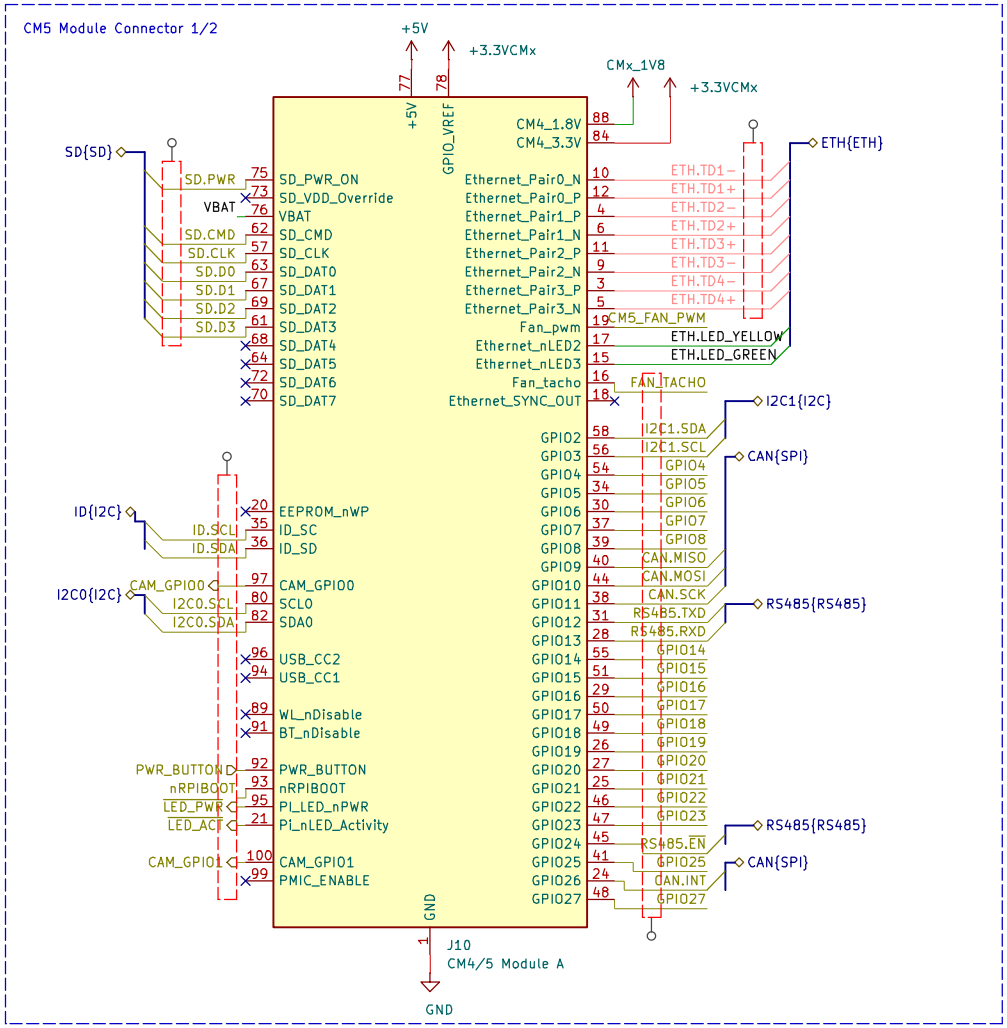
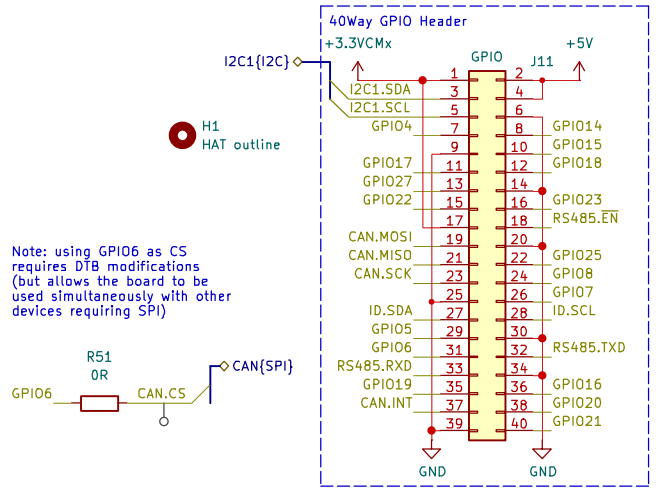
Hat Labs Oy

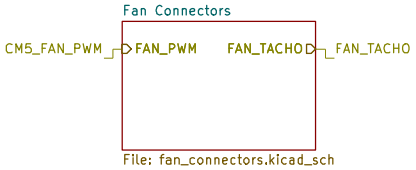
Sheet: /Controller/RGB LEDs/
File: rgb_leds.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 14/38







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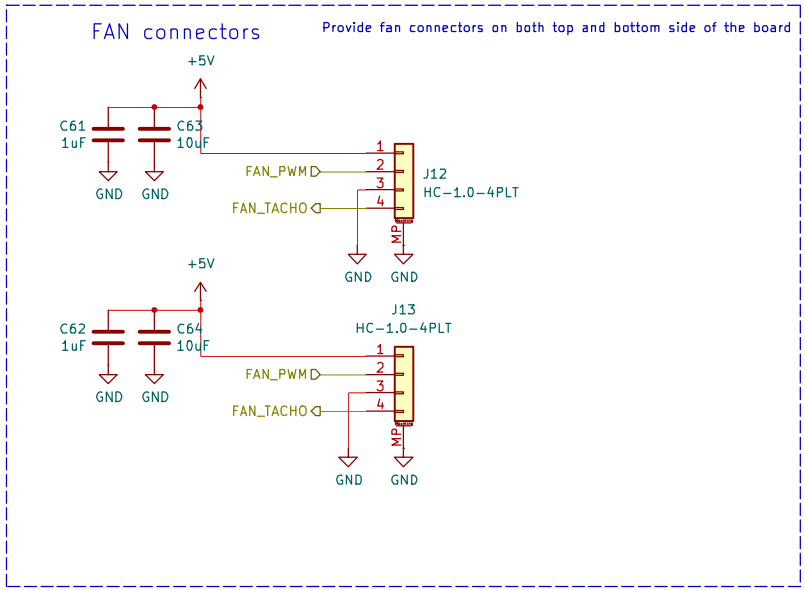
Hat Labs Oy

Sheet: /CM4 GPIO/
File: CM4_GPIO.kicad_sch

Title: HALPI2

Size: A4	Date: 2025−10−07	Rev: v0.6.0
KiCad E.D.A. 9.0.6−rc2		Id: 16/38



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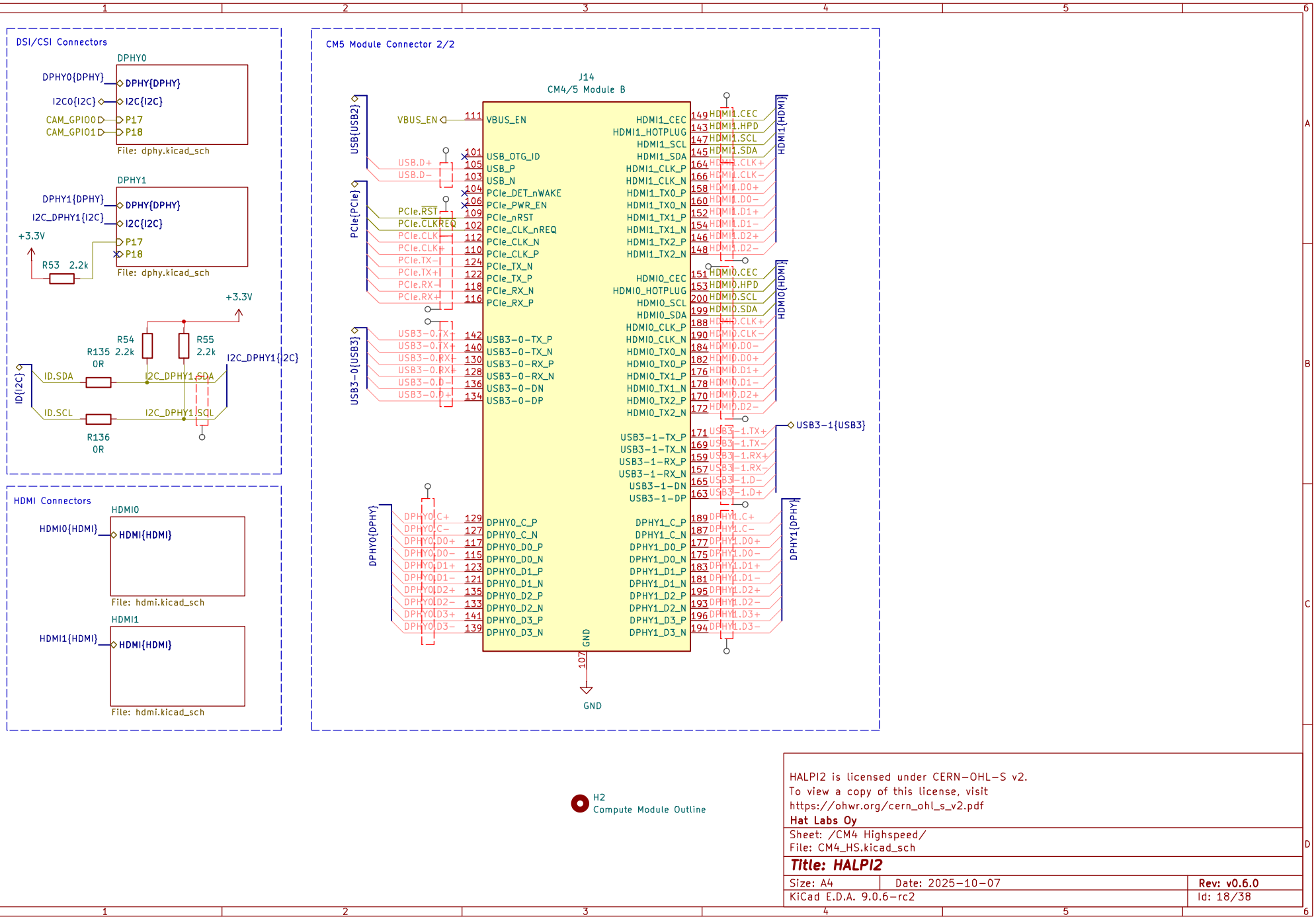
Hat Labs Oy

Sheet: /CM4 GPIO/Fan Connectors/
File: fan_connectors.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 17/38



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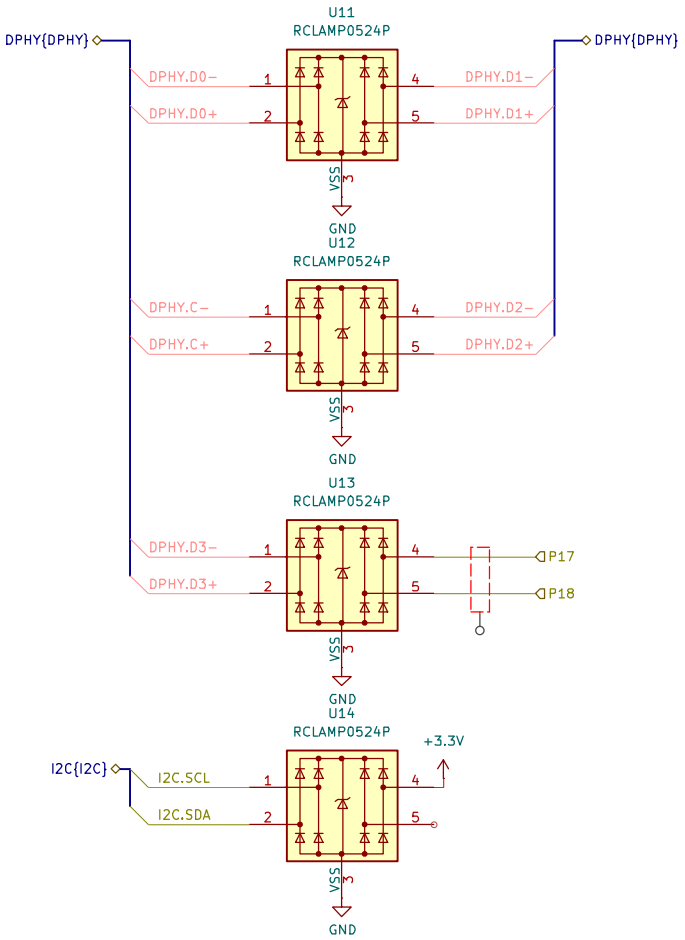
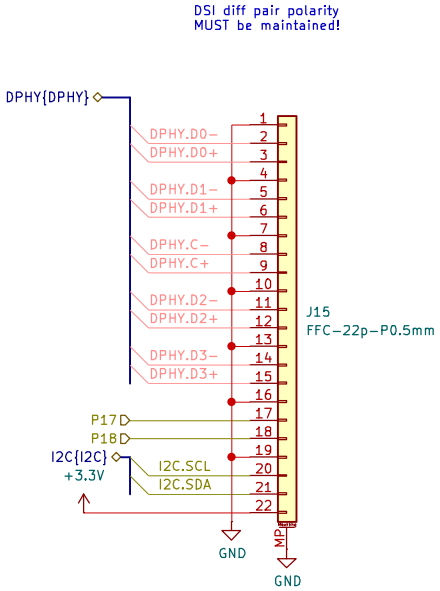
Hat Labs Oy

Sheet: /CM4 Highspeed/
File: CM4_HS.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 18/38





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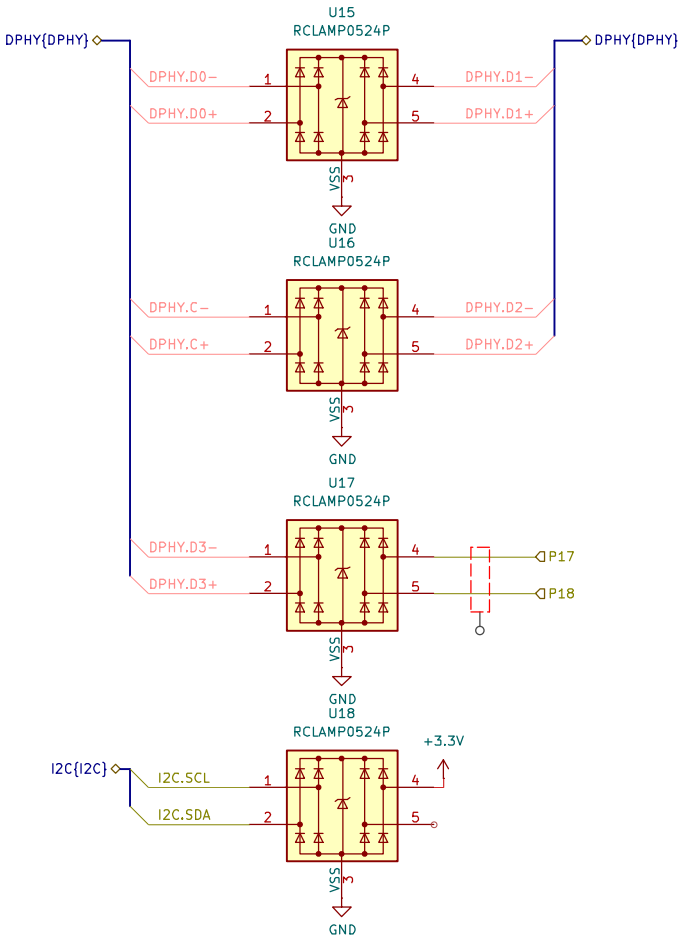
Hat Labs Oy

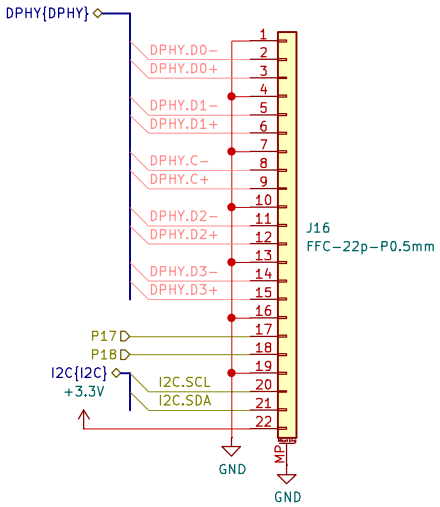
Sheet: /CM4 Highspeed/DPHY0/
File: dphy.kicad_sch

Title: HALPI2

Size: A4	Date: 2025−10−07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6−rc2		Id: 19/38



DSI diff pair polarity
MUST be maintained!



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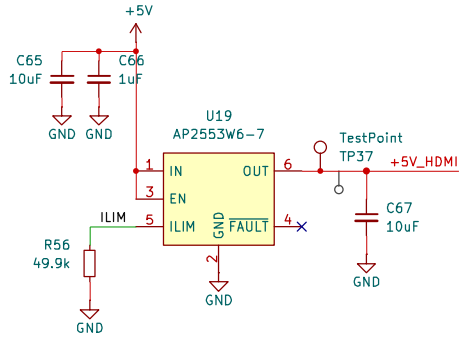
Hat Labs Oy

Sheet: /CM4 Highspeed/DPHY1/
File: dphy.kicad_sch

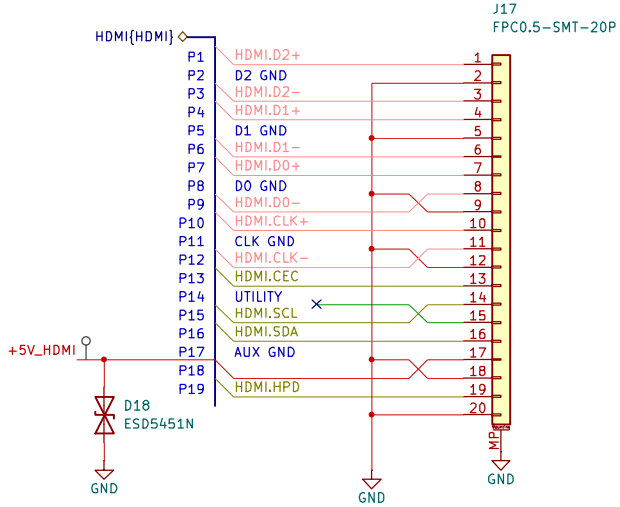
Title: HALPI2

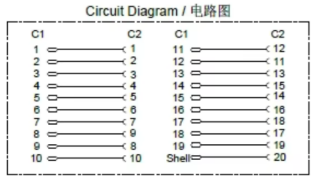
Size: A4	Date: 2025−10−07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6−rc2		Id: 20/38

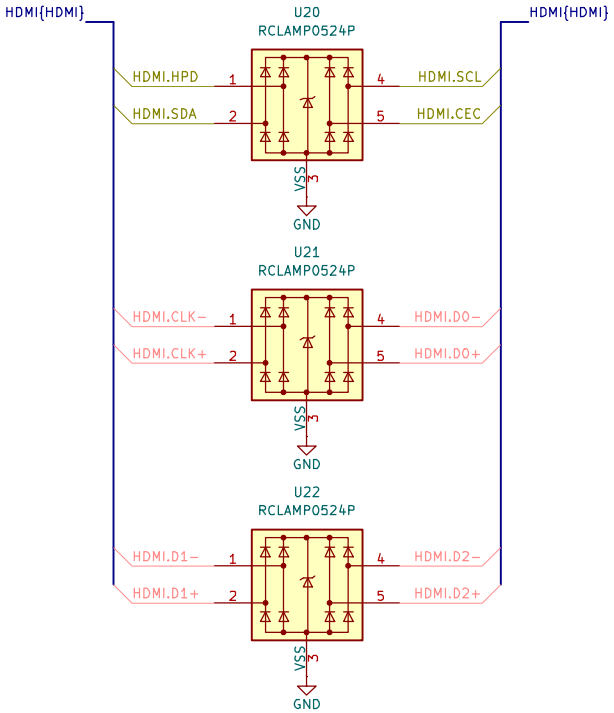
Current limiting



HDMI diff pair polarity
MUST be maintained.







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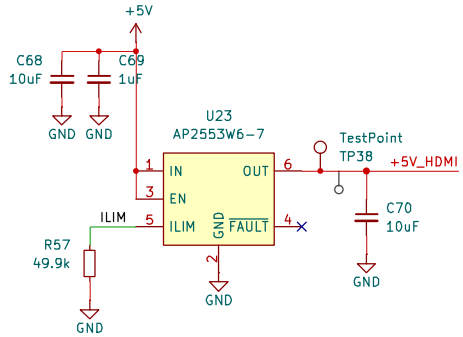
Hat Labs Oy

Sheet: /CM4 Highspeed/HDMI0/
File: hdmi.kicad_sch

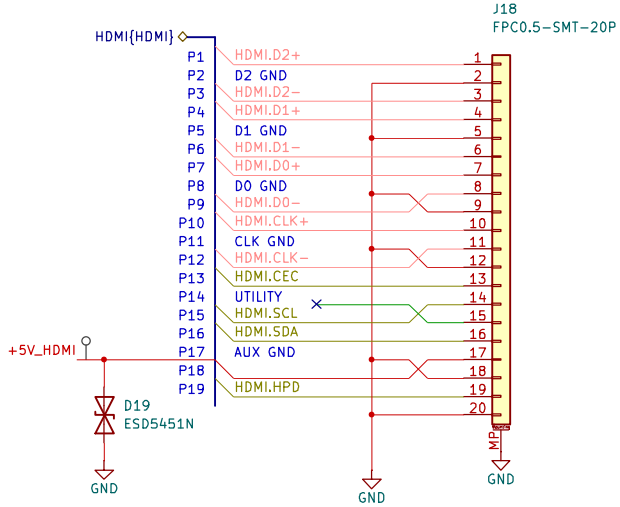
Title: HALPI2

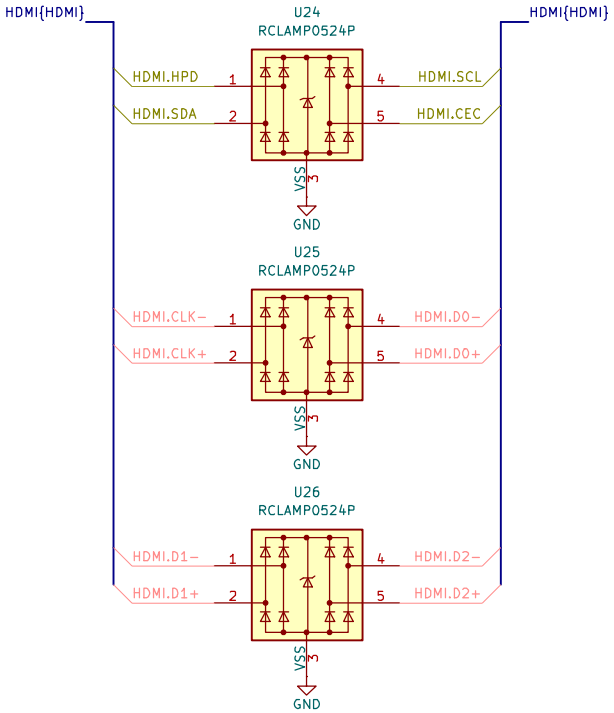
Size: A4	Date: 2025-10-07	Rev: v0.6.0
KiCad E.D.A. 9.0.6-rc2		Id: 21/38

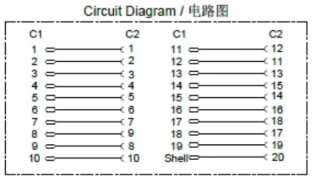
Current limiting



HDMI diff pair polarity
MUST be maintained.







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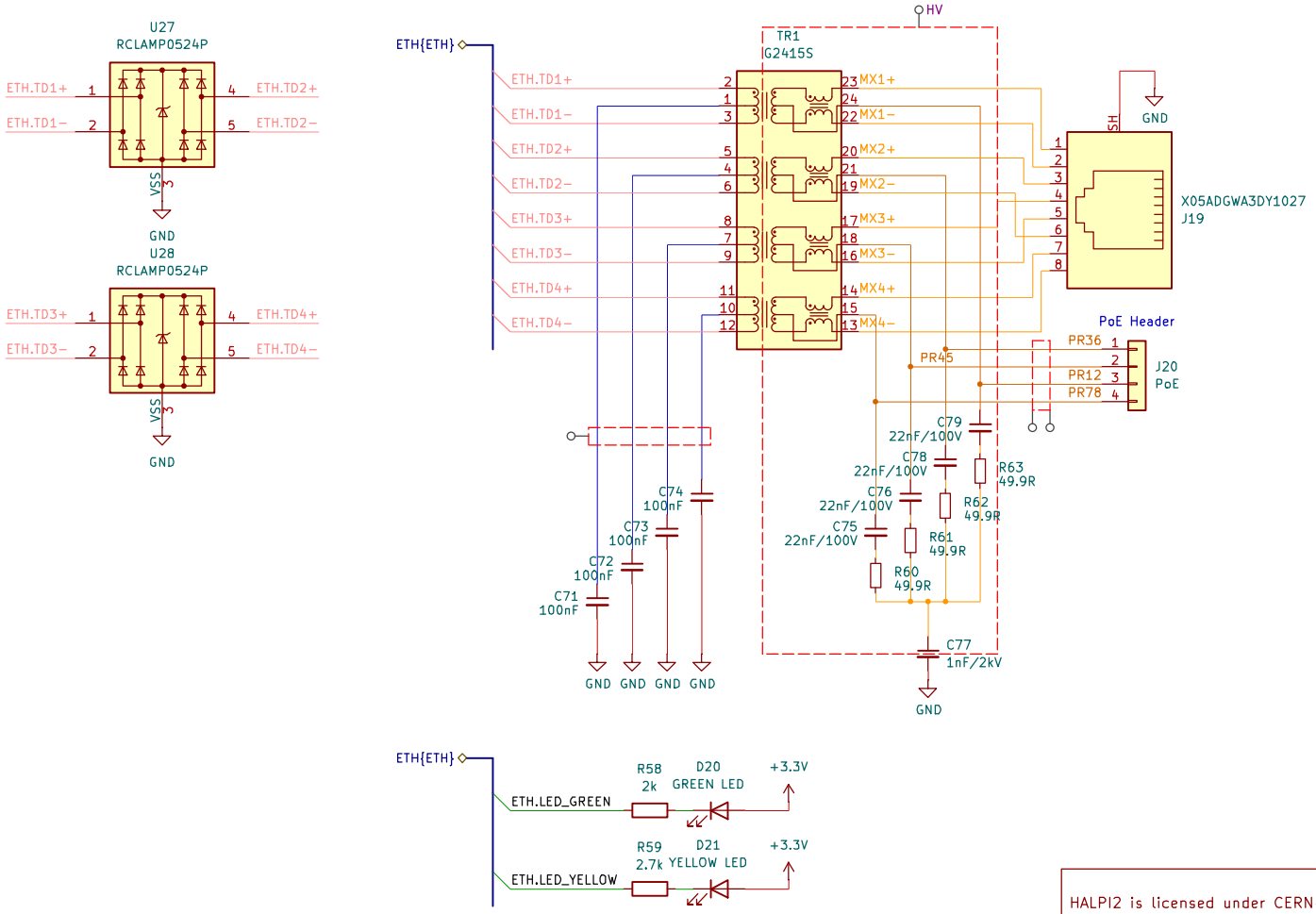
Hat Labs Oy

Sheet: /CM4 Highspeed/HDMI1/
File: hdmi.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	Rev: v0.6.0
KiCad E.D.A. 9.0.6-rc2		Id: 22/38



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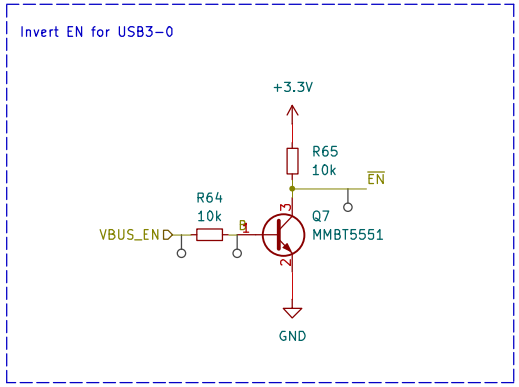
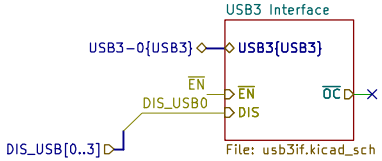
Hat Labs Oy

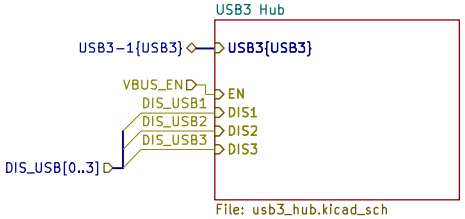
Sheet: /Ethernet/
File: Ethernet.kicad_sch

Title: HALPI2

Size: A4	Date: 2025−10−07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6−rc2		Id: 23/38







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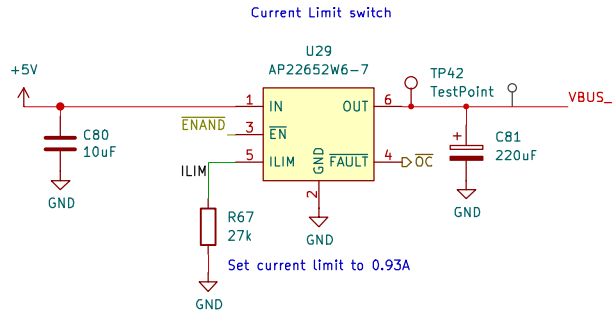
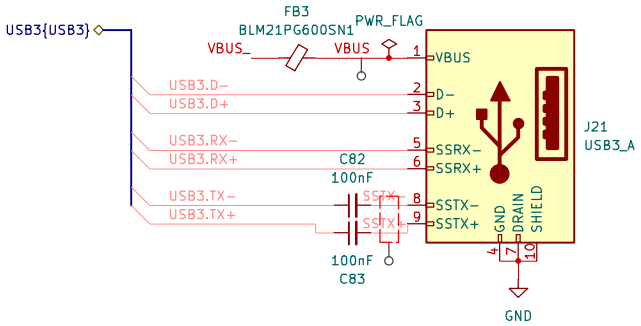
Hat Labs Oy

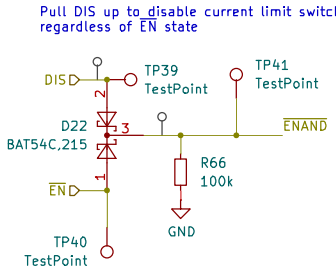
Sheet: /USB3/
File: USB3.kicad_sch

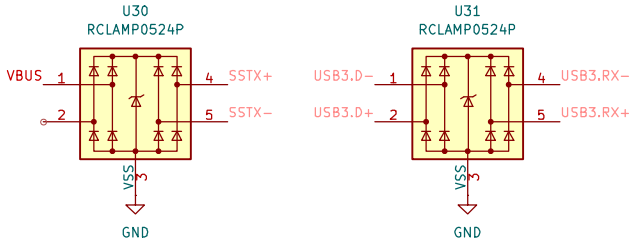
Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 24/38









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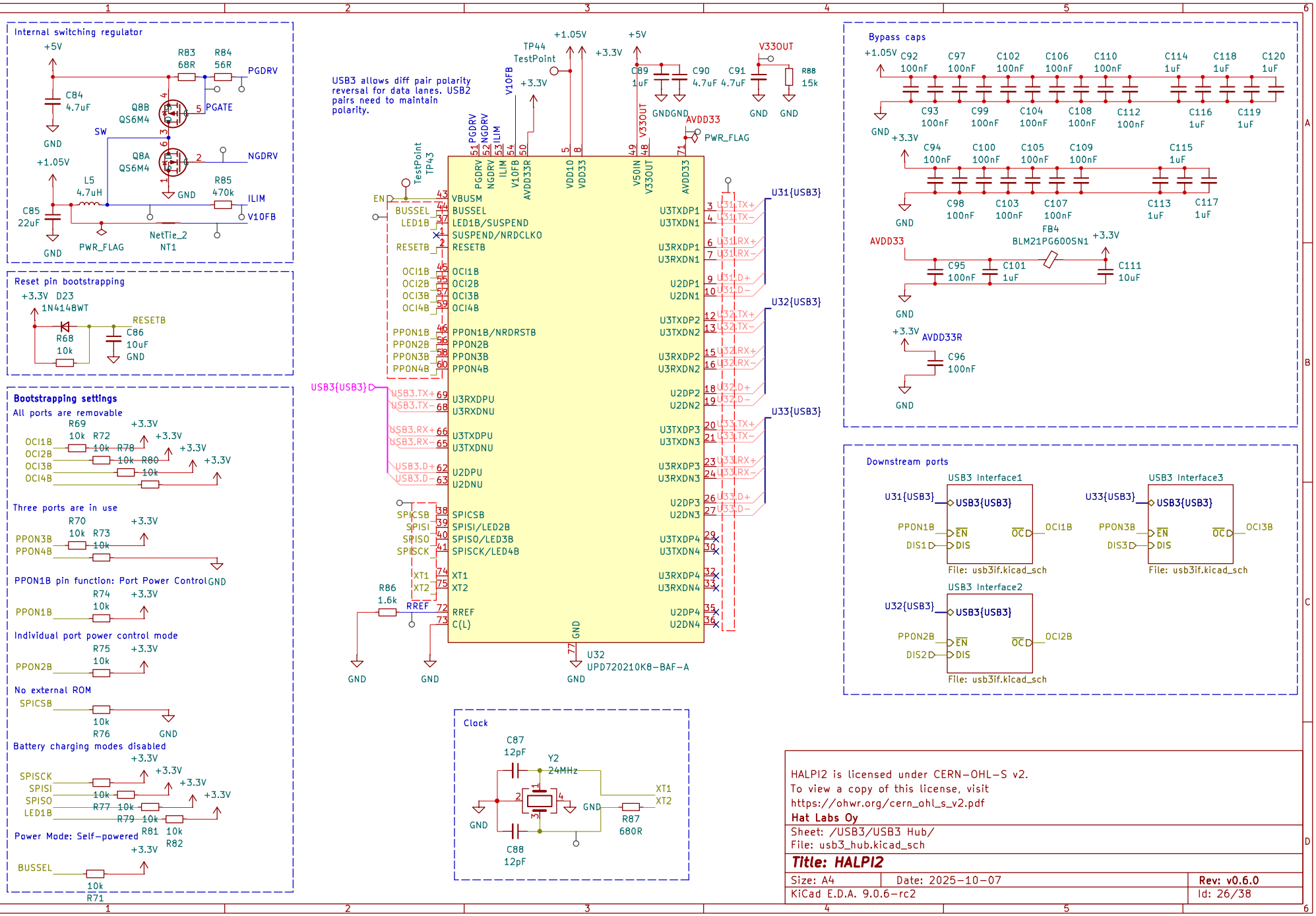
Sheet: /USB3/USB3 Interface/
File: usb3if.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	Rev: v0.6.0
KiCad E.D.A. 9.0.6-rc2		Id: 25/38



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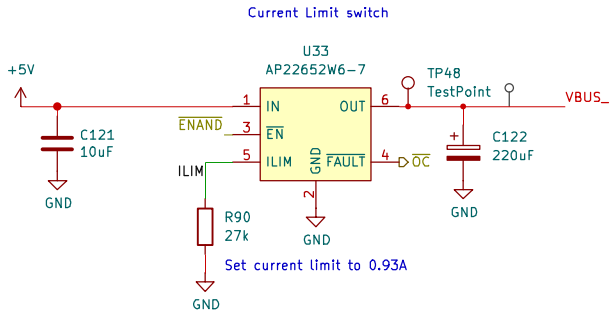
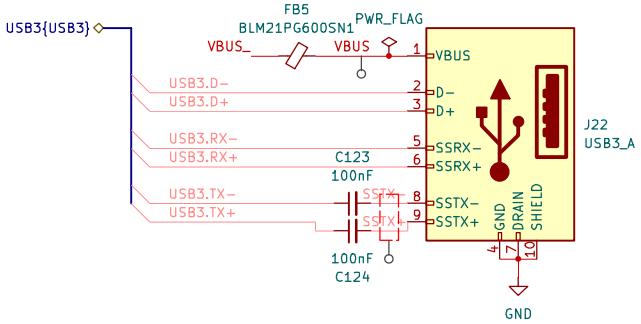
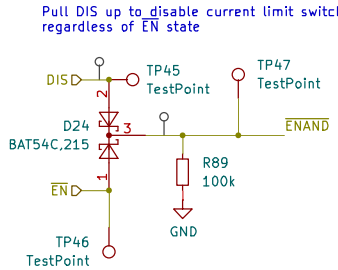
Sheet: /USB3/USB3 Hub/
File: usb3_hub.kicad_sch

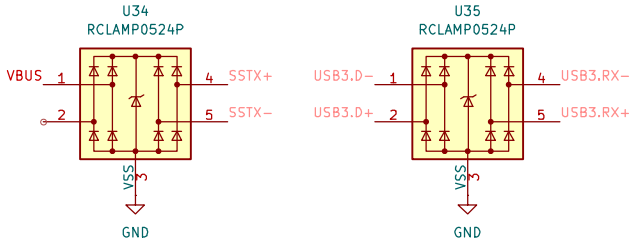
Title: HALPI2

Size: A4	Date: 2025-10-07	Rev: v0.6.0
KiCad E.D.A. 9.0.6-rc2		Id: 26/38









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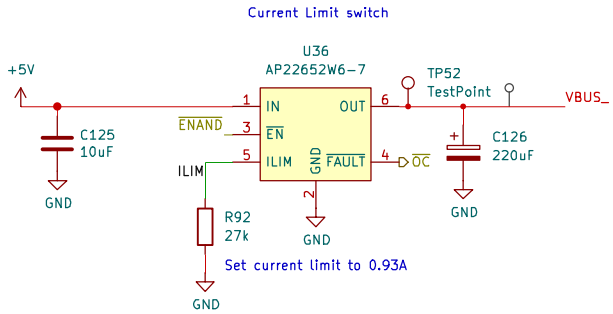
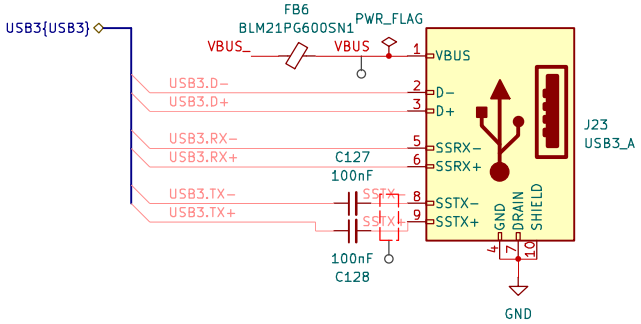
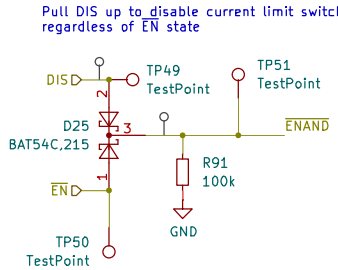
Sheet: /USB3/USB3 Hub/USB3 Interface1/
File: usb3if.kicad_sch

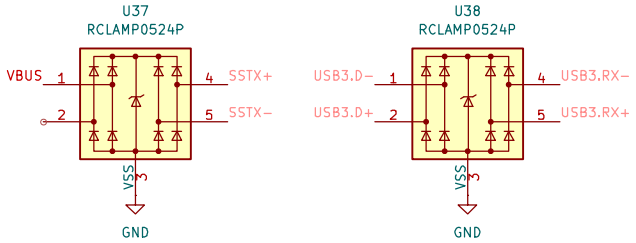
Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 27/38









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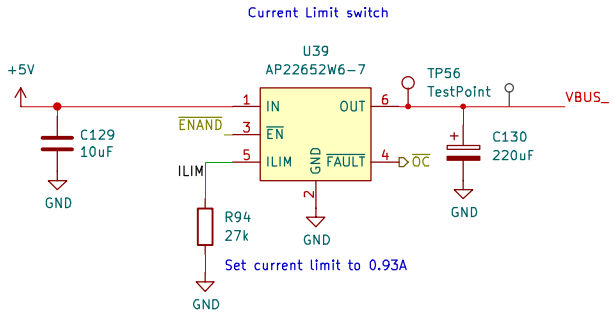
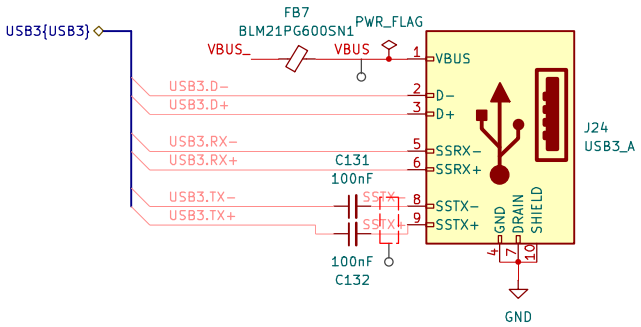
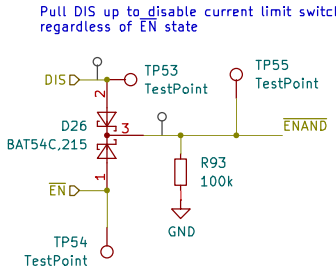
Sheet: /USB3/USB3 Hub/USB3 Interface2/
File: usb3if.kicad_sch

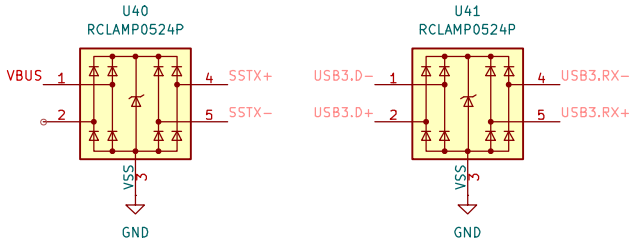
Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 28/38









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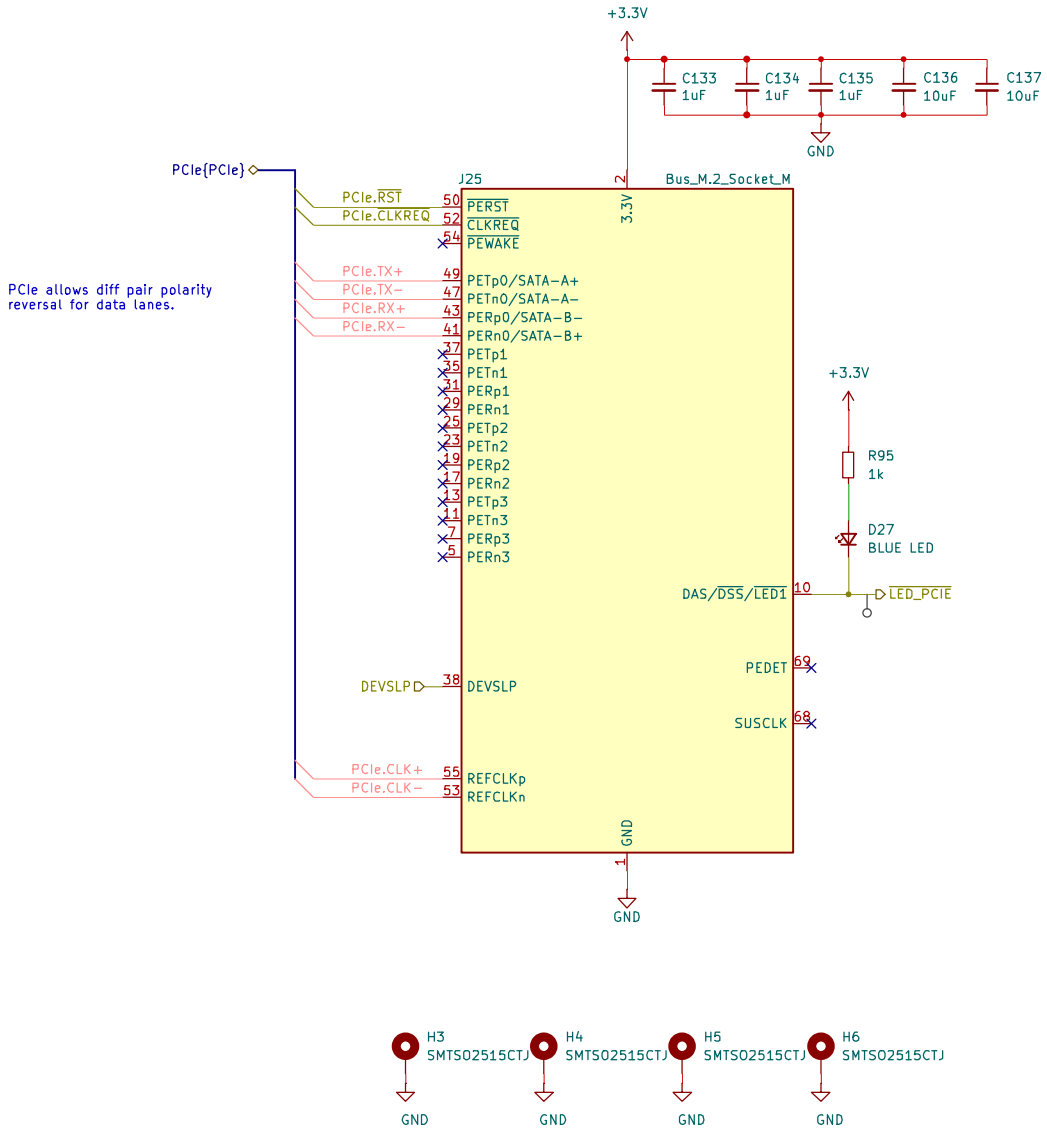
Sheet: /USB3/USB3 Hub/USB3 Interface3/
File: usb3if.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 29/38



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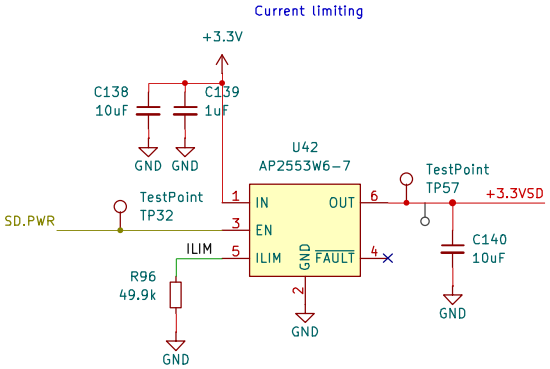
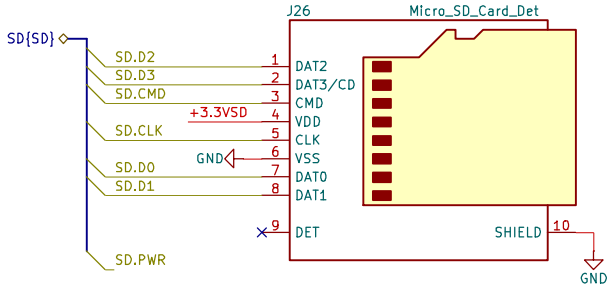
Sheet: /PCIe/
File: PCIe.kicad_sch

Title: HALPI2

Size: A4	Date: 2025−10−07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6−rc2		Id: 30/38





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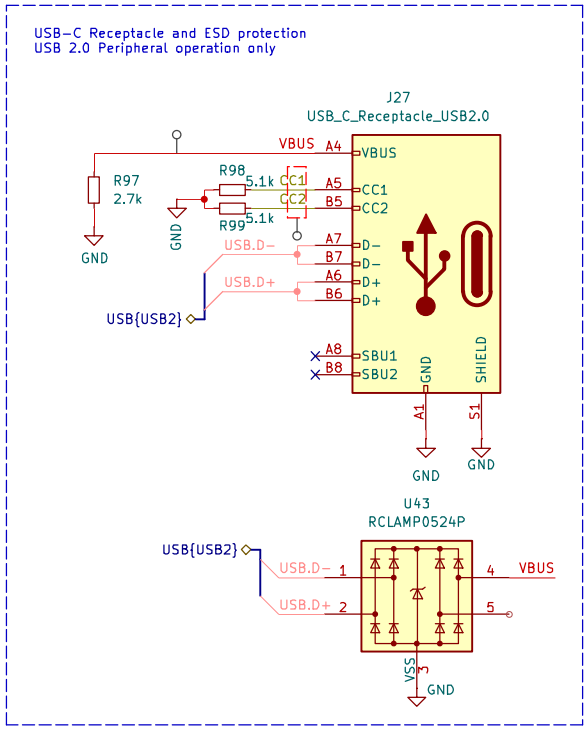
Sheet: /SDCard/
File: SDCard.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 31/38



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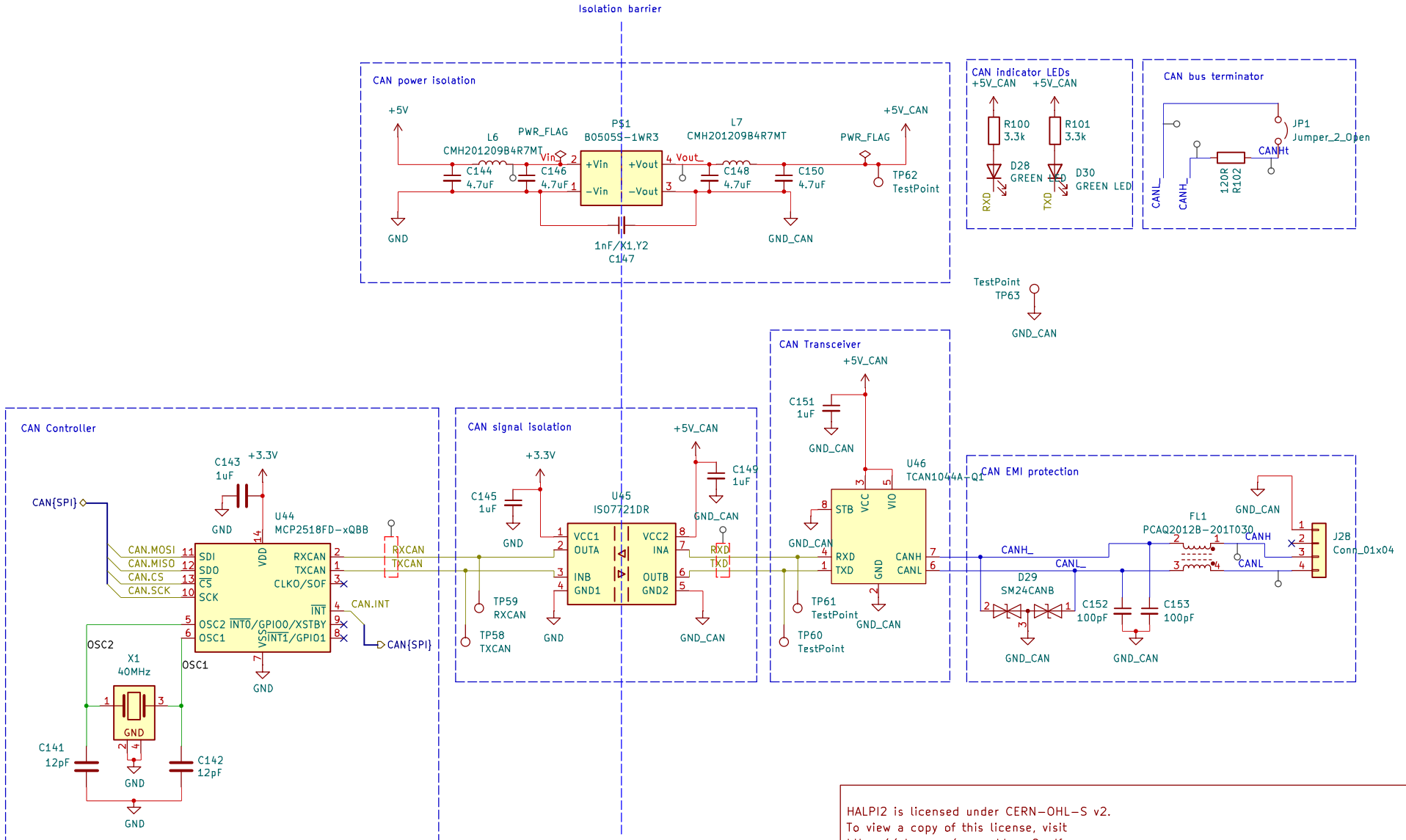
Sheet: /USB 2.0 Peripheral Interface/
File: USB2.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 32/38



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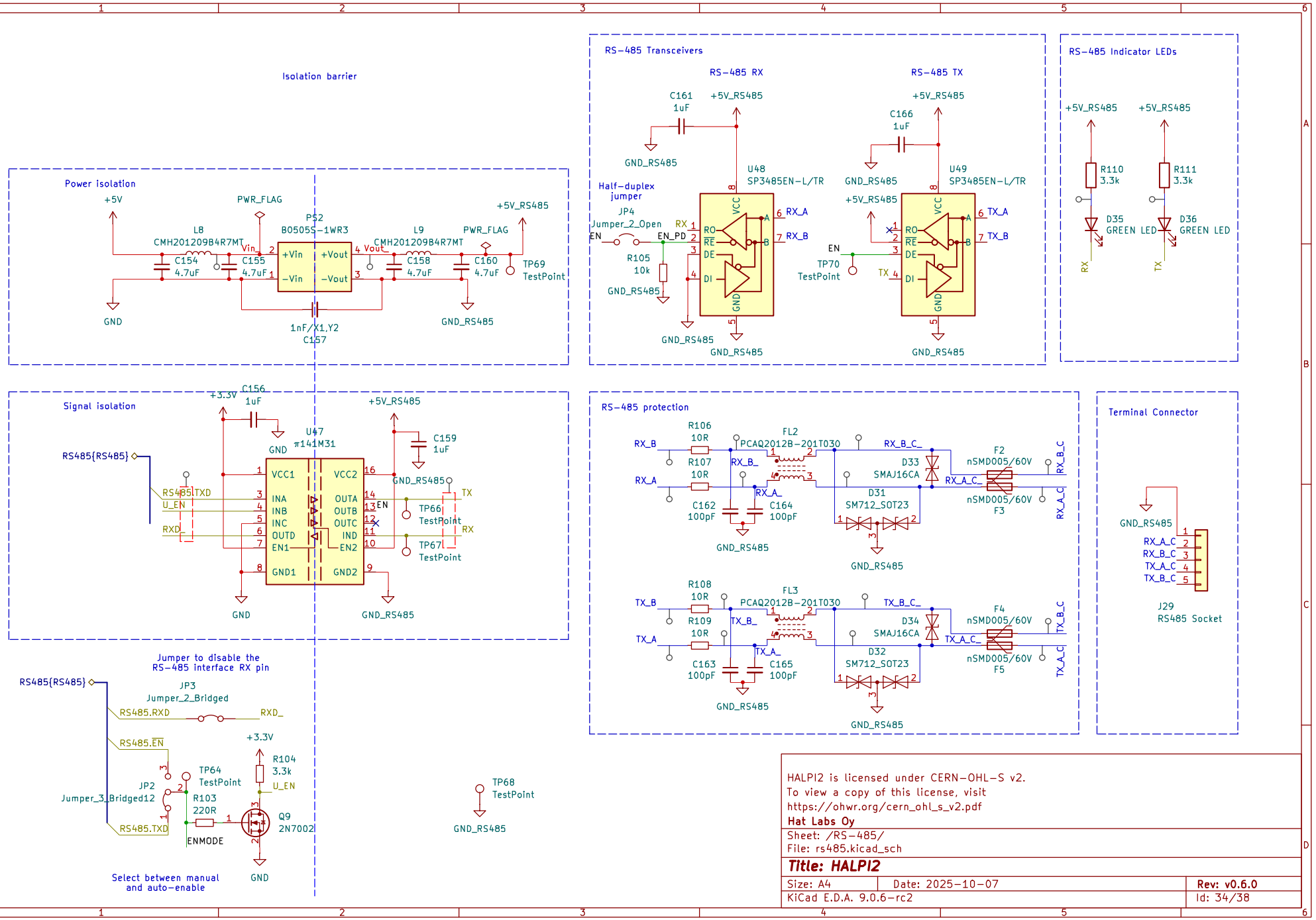
Hat Labs Oy

Sheet: /CAN bus/
File: can.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	Rev: v0.6.0
KiCad E.D.A. 9.0.6-rc2		Id: 33/38



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Hat Labs Oy

Sheet: /RS-485/
File: rs485.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 34/38

Mounting nut for PoE HAT

H17
SMTSO2515CTJ

GND

Mounting nuts for HAT corners

H18
SMTSO2515CTJ

H19
SMTSO2515CTJ

H20
SMTSO2515CTJ

H21
SMTSO2515CTJ

Mounting nuts for CM5 corners

H22
SMTSO2530CTJ

H23
SMTSO2530CTJ

H24
SMTSO2530CTJ

H25
SMTSO2530CTJ

+3.3V +5V

Conn_01x03
J30

GND

+3.3V +5V

Conn_01x03
J31

GND

+3.3V +5V

Conn_01x03
J33

GND

+3.3V +5V

Conn_01x03
J34

GND

TP71
TestPoint
TP72
TestPoint
TP73
TestPoint
TP74
TestPoint
TP75
TestPoint
TP76
TestPoint
TP77
TestPoint
TP78
TestPoint
TP79
TestPoint
TP80
TestPoint
TP81
TestPoint
TP82
TestPoint
TP83
TestPoint
TP84
TestPoint
TP85
TestPoint

GND

Board end mounting holes

H7
MountingHole

H8
MountingHole

H9
MountingHole

H10
MountingHole

H11
MountingHole

H12
MountingHole

GND GND

Board corner mounting holes

H13
MountingHole

H14
MountingHole

H15
MountingHole

H16
MountingHole

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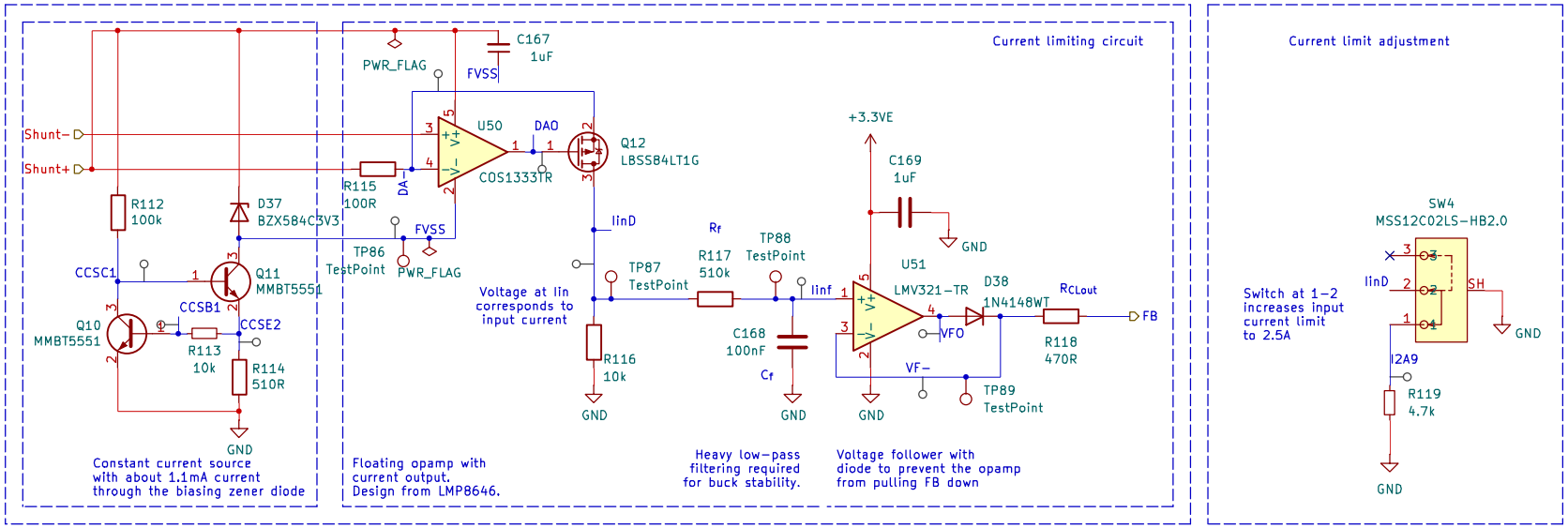
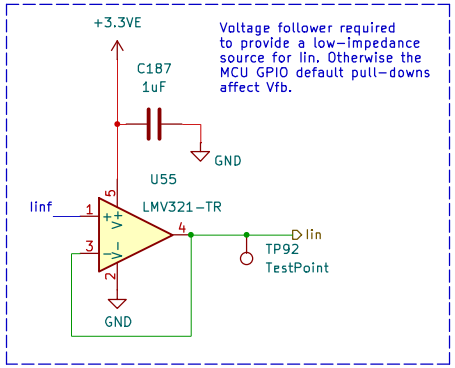
Sheet: /PCB/
File: pcb.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	Rev: v0.6.0
KiCad E.D.A. 9.0.6-rc2		Id: 35/38





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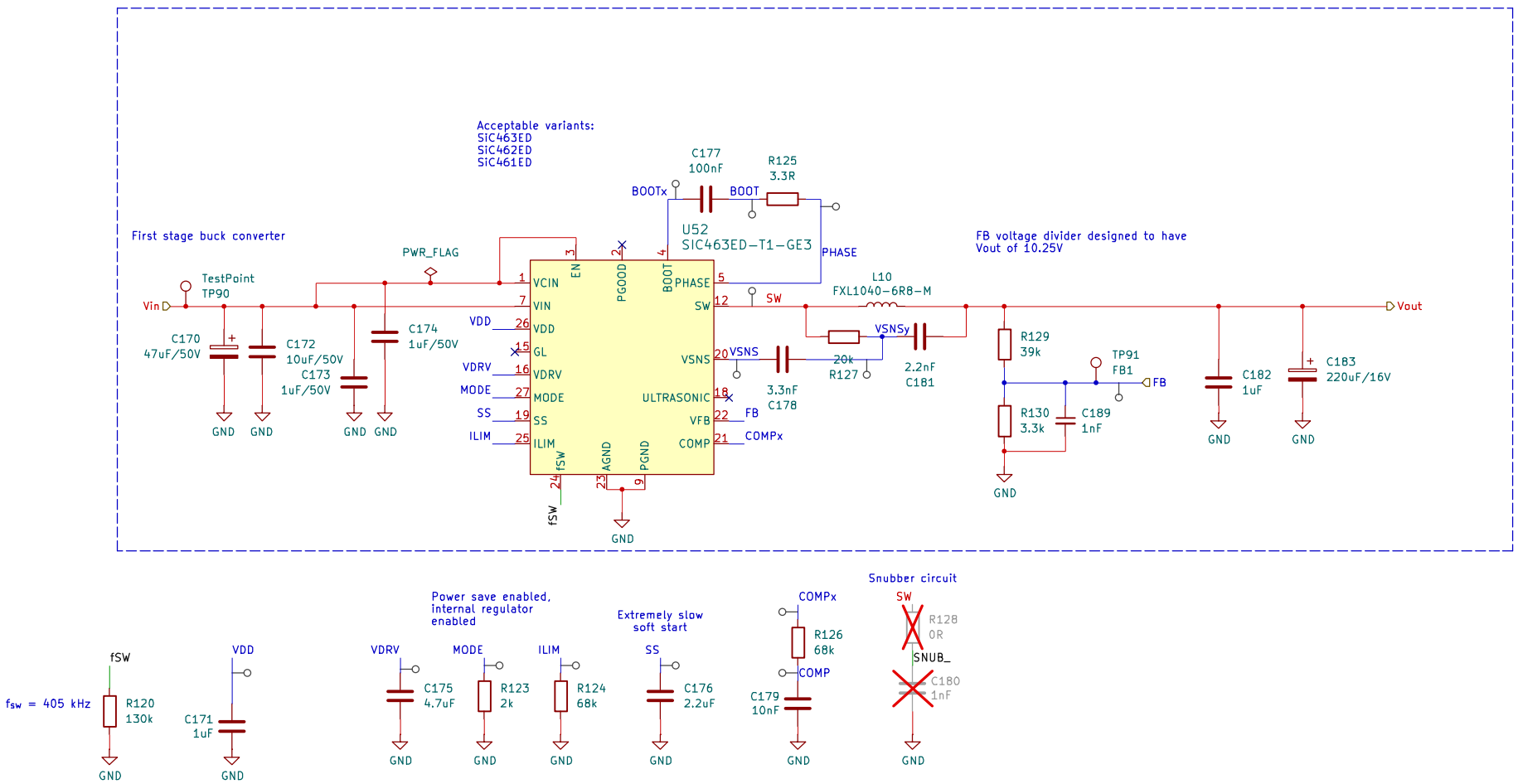
Sheet: /Power/Buck converter 10V/Current Limiter/
File: current_limiter.kicad_sch

Title: HALPI2

Size: A4	Date: 2025−10−07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6−rc2		Id: 36/38



NOTE: If the converter is configured with a different SiC46x variant, ILIM must be adjusted as well (even for the same output current value).

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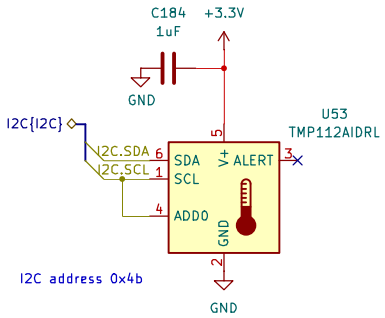
Sheet: /Power/Buck converter 10V/Buck 10V IC/
File: buck_10V_ic.kicad_sch

Title: HALPI2

Size: A4	Date: 2025-10-07	**Rev: v0.6.0**
KiCad E.D.A. 9.0.6-rc2		Id: 38/38



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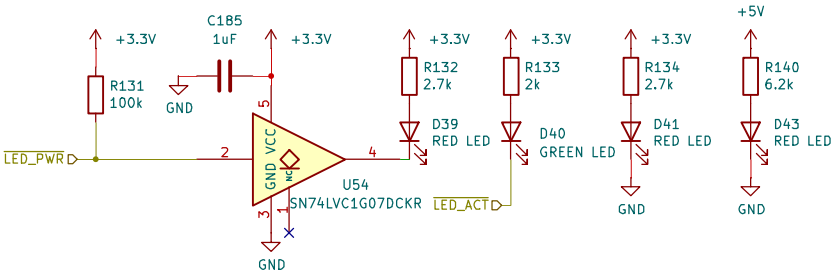

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