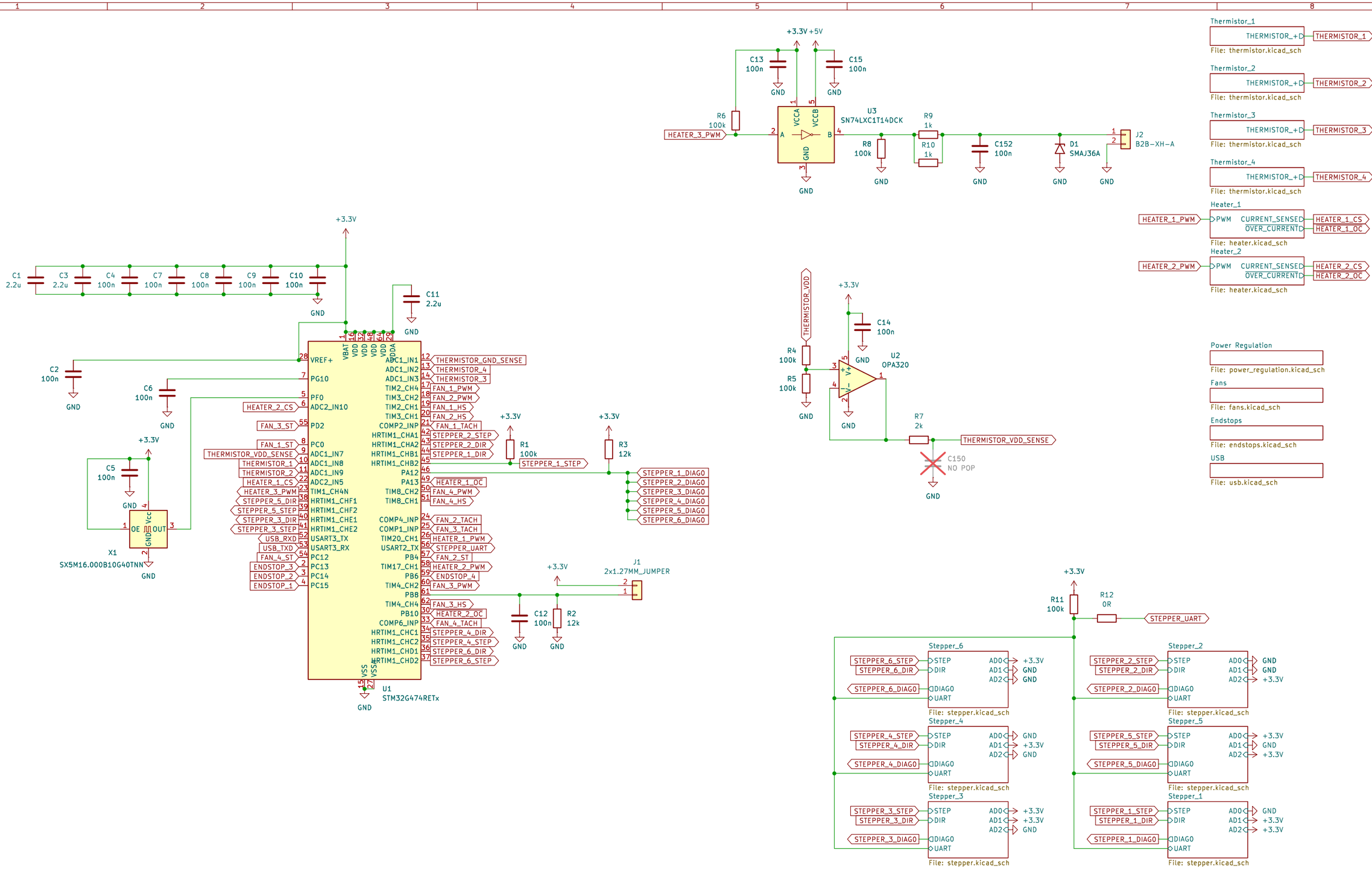
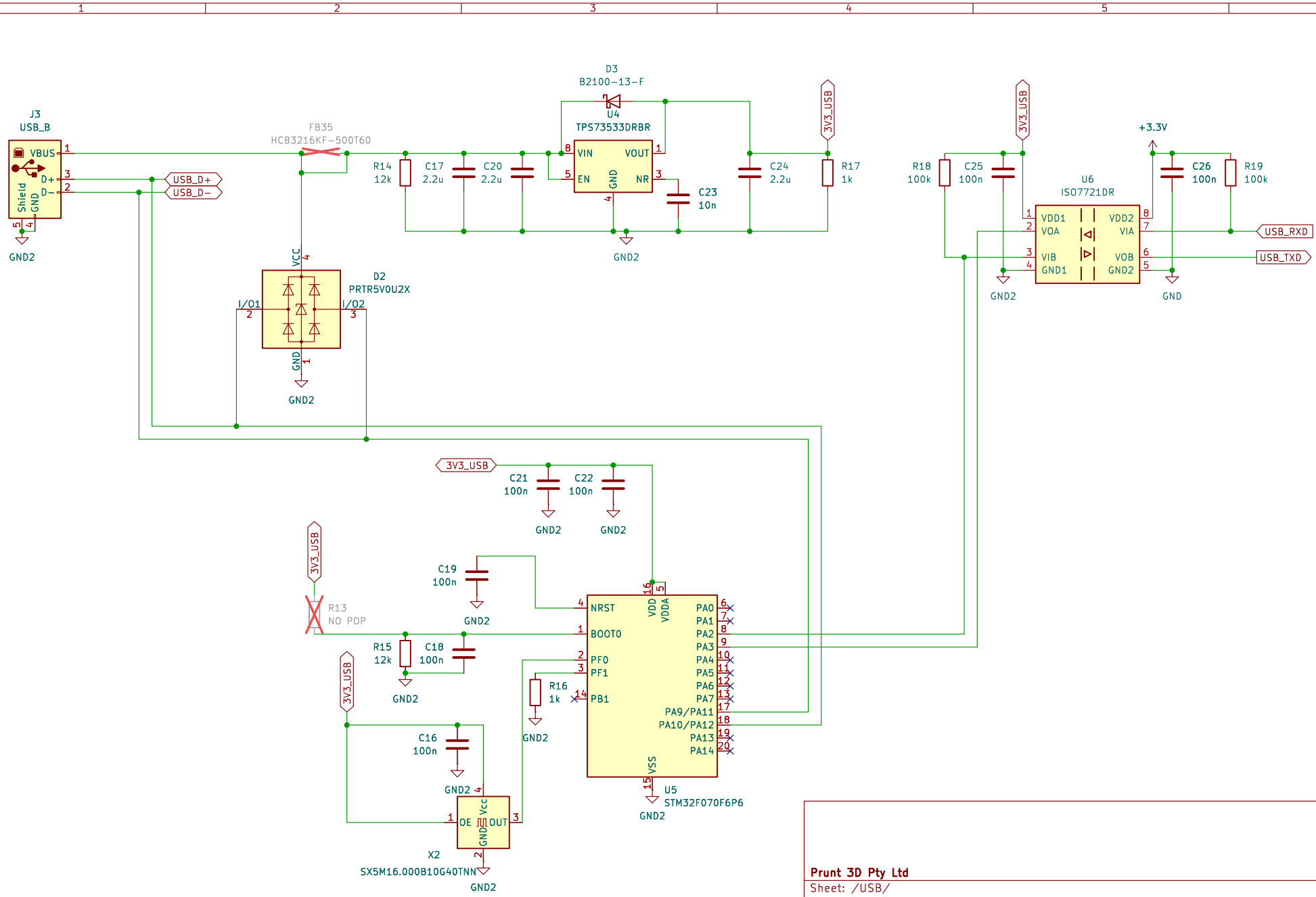
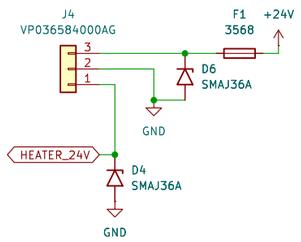
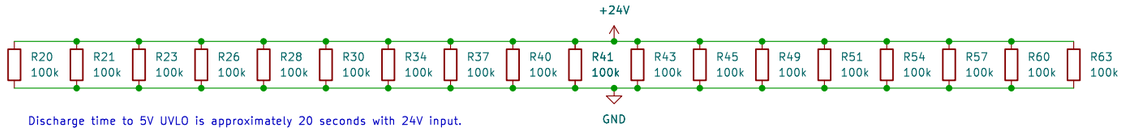
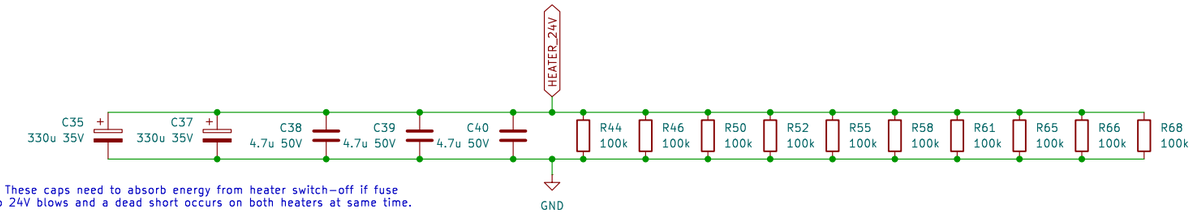

+3.3V
+5V
C13
100n
C15
100n
GND
R6
100k
HEATER_3_PWM
U3
SN74LXC1T14DCK
VCCA
VCCB
A
B
GND
R8
100k
R9
1k
R10
1k
C152
100n
D1
SMAJ36A
J2
B2B-XH-A
Thermistor_1
THERMISTOR_+
THERMISTOR_1
File: thermistor.kicad_sch
Thermistor_2
THERMISTOR_2
Thermistor_3
THERMISTOR_3
Thermistor_4
THERMISTOR_4
Heater_1
HEATER_1_PWM
PWM
CURRENT_SENSED
OVER_CURRENT
HEATER_1_CS
HEATER_1_OC
File: heater.kicad_sch
Heater_2
HEATER_2_PWM
HEATER_2_CS
HEATER_2_OC
Power Regulation
File: power_regulation.kicad_sch
Fans
File: fans.kicad_sch
Endstops
File: endstops.kicad_sch
USB
File: usb.kicad_sch
THERMISTOR_VDD
R4
100k
R5
100k
C14
100n
U2
OPA320
R7
2k
C150
NO POP
THERMISTOR_VDD_SENSE
C1
2.2u
C3
2.2u
C4
100n
C7
100n
C8
100n
C9
100n
C10
100n
C11
2.2u
C2
100n
C6
100n
C5
100n
X1
SX5M16.000B10G40TNN
U1
STM32G474RETx
VBAT
VREF+
PG10
PF0
PD2
PC0
PC12
PC13
PC14
PC15
VDD
VDDA
VSS
ADC1_IN1
ADC1_IN2
ADC1_IN3
ADC2_IN10
ADC2_IN5
ADC1_IN7
ADC1_IN8
ADC1_IN9
TIM1_CH4N
HRTIM1_CHF1
HRTIM1_CHF2
HRTIM1_CHE1
HRTIM1_CHE2
USART3_TX
USART3_RX
TIM2_CH4
TIM3_CH2
TIM2_CH1
TIM3_CH1
COMP2_INP
HRTIM1_CHA1
HRTIM1_CHA2
HRTIM1_CHB1
HRTIM1_CHB2
PA12
PA13
TIM8_CH2
TIM8_CH1
COMP4_INP
COMP1_INP
TIM20_CH1
USART2_TX
PB4
TIM17_CH1
PB6
TIM4_CH2
PB8
TIM4_CH4
PB10
COMP6_INP
HRTIM1_CHC1
HRTIM1_CHC2
HRTIM1_CHD1
HRTIM1_CHD2
THERMISTOR_GND_SENSE
THERMISTOR_4
THERMISTOR_3
FAN_1_PWM
FAN_2_PWM
FAN_1_HS
FAN_2_HS
FAN_1_TACH
STEPPER_2_STEP
STEPPER_2_DIR
STEPPER_1_DIR
STEPPER_1_STEP
HEATER_2_CS
FAN_3_ST
FAN_1_ST
THERMISTOR_VDD_SENSE
THERMISTOR_1
THERMISTOR_2
HEATER_1_CS
HEATER_3_PWM
STEPPER_5_DIR
STEPPER_5_STEP
STEPPER_3_DIR
STEPPER_3_STEP
USB_RXD
USB_TXD
FAN_4_ST
ENDSTOP_3
ENDSTOP_2
ENDSTOP_1
HEATER_1_OC
FAN_4_PWM
FAN_4_HS
FAN_2_TACH
FAN_3_TACH
HEATER_1_PWM
STEPPER_UART
FAN_2_ST
HEATER_2_PWM
ENDSTOP_4
FAN_3_PWM
FAN_3_HS
HEATER_2_OC
FAN_4_TACH
STEPPER_4_DIR
STEPPER_4_STEP
STEPPER_6_DIR
STEPPER_6_STEP
R1
100k
R3
12k
STEPPER_1_DIAG0
STEPPER_2_DIAG0
STEPPER_3_DIAG0
STEPPER_4_DIAG0
STEPPER_5_DIAG0
STEPPER_6_DIAG0
J1
2x1.27MM_JUMPER
C12
100n
R2
12k
R11
100k
R12
0R
Stepper_6
Stepper_2
Stepper_4
Stepper_5
Stepper_3
Stepper_1
STEP
DIR
DIAG0
UART
AD0
AD1
AD2
File: stepper.kicad_sch
H1
MountingHole
H2
MountingHole
H3
MountingHole
H4
MountingHole
Prunt 3D Pty Ltd
Sheet: /
File: prunt_board_3.kicad_sch
Title: Prunt Board 3
Size: A3
Date: 2025-06-02
Rev: 2
KiCad E.D.A. 9.0.2
Id: 1/17


J3
USB_B
VBUS
D+
D-
Shield
GND
USB_D+
USB_D-
GND2
FB35
HCB3216KF-500T60
D3
B2100-13-F
U4
TPS73533DRBR
VIN
VOUT
EN
GND
NR
R14
12k
C17
2.2u
C20
2.2u
C23
10n
C24
2.2u
R17
1k
3V3_USB
D2
PRTR5V0U2X
VCC
I/O1
I/O2
GND
R18
100k
C25
100n
U6
ISO7721DR
VDD1
VOA
VIB
GND1
VDD2
VIA
VOB
GND2
+3.3V
C26
100n
R19
100k
USB_RXD
USB_TXD
GND
C21
100n
C22
100n
C19
100n
R13
NO POP
R15
12k
C18
100n
R16
1k
C16
100n
NRST
BOOT0
PF0
PF1
PB1
VDD
VDDA
VSS
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PA9/PA11
PA10/PA12
PA13
PA14
U5
STM32F070F6P6
X2
SX5M16.000B10G40TNN
OE
Vcc
OUT
Prunt 3D Pty Ltd
Sheet: /USB/
File: usb.kicad_sch
Title: Prunt Board 3
Size: A4
Date: 2025-06-02
Rev: 2
KiCad E.D.A. 9.0.2
Id: 2/17





Discharge time to 5V UVLO is approximately 20 seconds with 24V input.

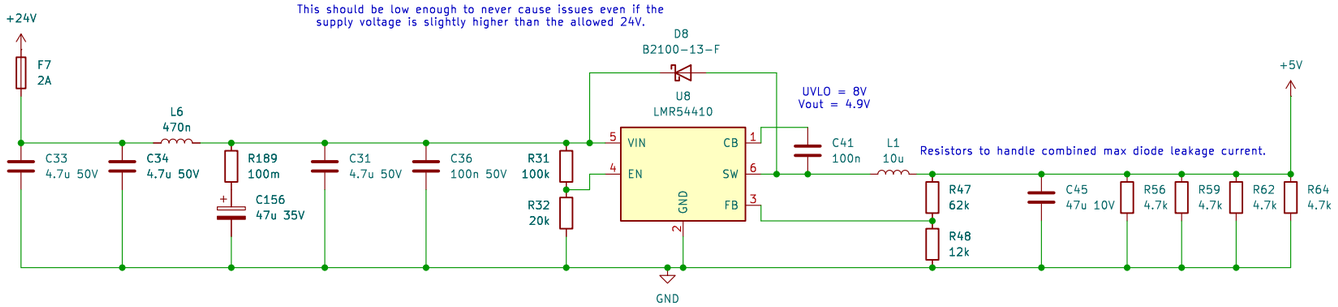


These caps need to absorb energy from heater switch-off if fuse to 24V blows and a dead short occurs on both heaters at same time.

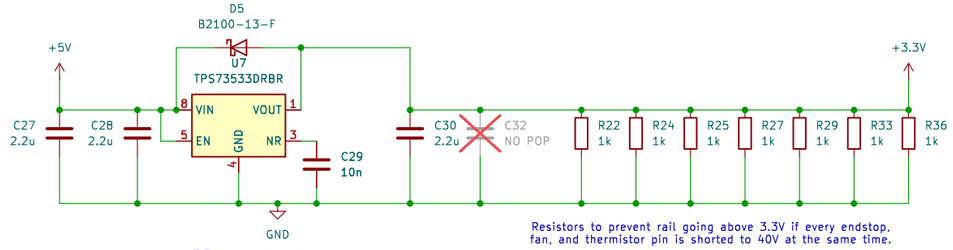
In a worst-case scenario a dead short is applied until OCP triggers and then is immediately removed. Assume the current reaches 60A:

sqrt(2.2uH×(60A)^2/660uF×2) = 5V

This should be low enough to never cause issues even if the supply voltage is slightly higher than the allowed 24V.

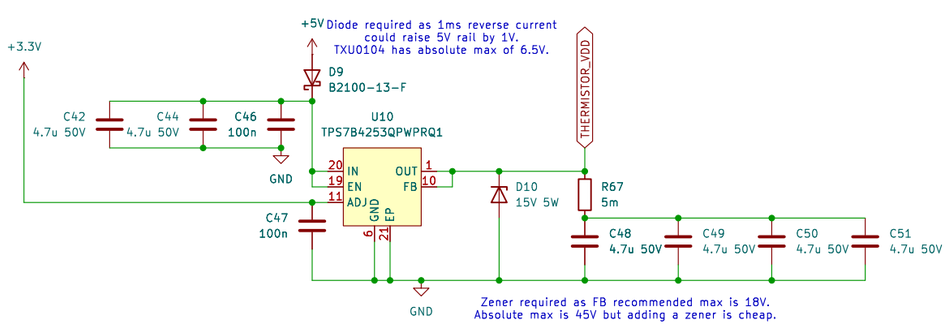


Resistors to handle combined max diode leakage current.

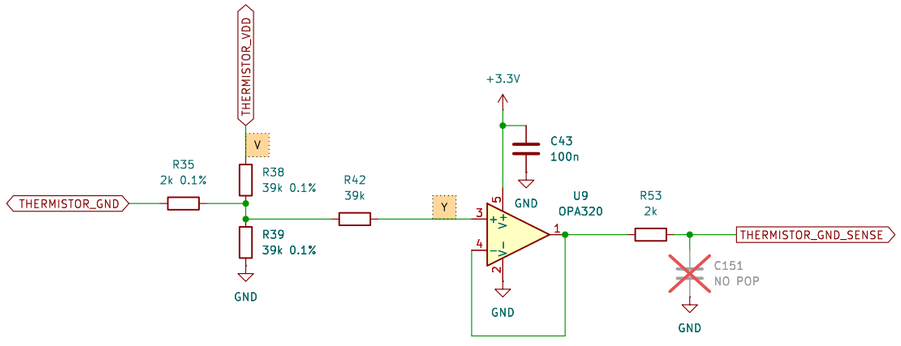


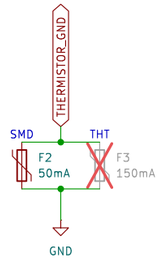
3.3V power budget:
10mA ISO7721
25mA load resistors
150mA STM32
All other components have minimal current draw

Resistors to prevent rail going above 3.3V if every endstop, fan, and thermistor pin is shorted to 40V at the same time.



Zener required as FB recommended max is 18V.
Absolute max is 45V but adding a zener is cheap.





Prunt 3D Pty Ltd

Sheet: /Power Regulation/
File: power_regulation.kicad_sch

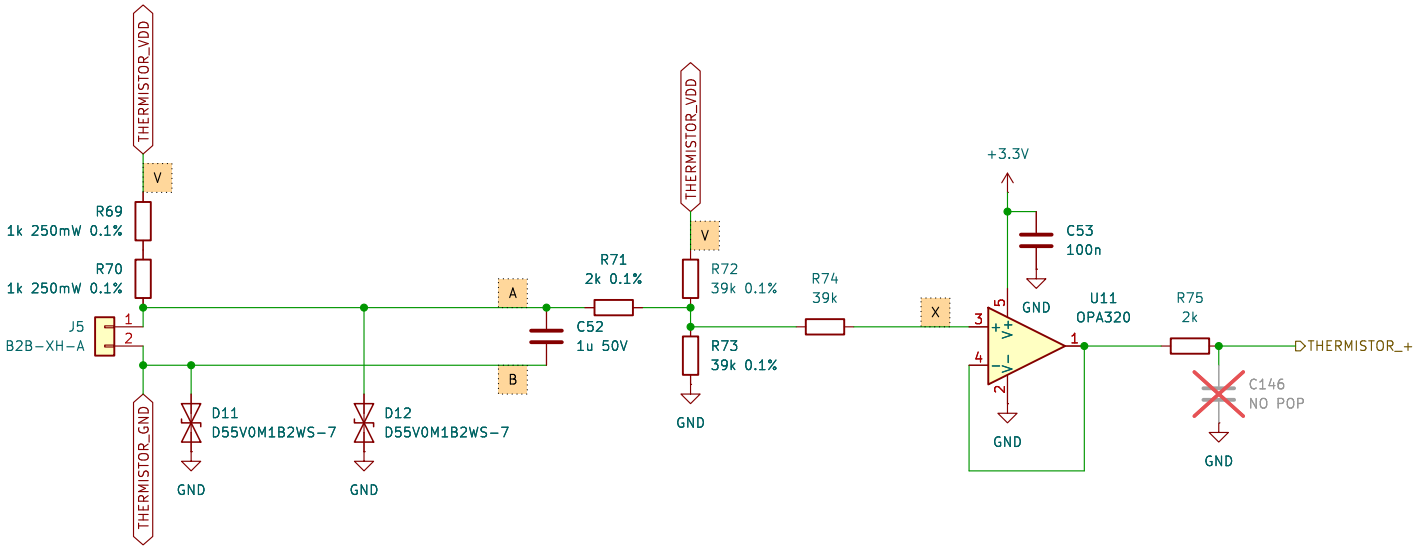
Title: Prunt Board 3

Size: A3	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 3/17

Op-amp substitutes should ideally:
- Be unity-gain stable.
- Have maximum of 150mV output swing from rails at 2k and 105°C.
- Not exhibit phase inversion if inputs are overdriven.
- Allow for 2mA overdriven or underdriven current in to each input.
- Not have high offset voltage at high common mode voltages.

Good substitutes:
- OPAx320
- OPAx325
- OPAx328
- OPAx387
- OPAx388

Possible substitutes without enough details:
- TLVx387
- AD8605
- OPA323
- OPA322 (No explicit 2k swing spec)



ESD diodes must have a very low leakage current.

KCL of input network ignoring ESD diode leakage and overdriven/underdriven op-amps.

Nodes labelled in text boxes with the same styling as this one. T is the thermistor resistance and F is the PTC fuse resistance.

```
import sympy as sym

A, B, X, Y, T, F, V = sym.symbols("A B X Y T F V")

eq1 = sym.Eq((A-B)/T + (A-X)/2000 + (A-V)/2000, 0)
eq2 = sym.Eq((B-A)/T + (B-F)/F + (B-Y)/2000, 0)
eq3 = sym.Eq((X-V)/39000 + X/39000 + (X-A)/2000, 0)
eq4 = sym.Eq((Y-V)/39000 + Y/39000 + (Y-B)/2000, 0)

print(sym.solve((eq1, eq2, eq3, eq4), (A, B, T, F)))
```

Result:
A = −2*V/39 + 43*X/39
B = −2*V/39 + 43*Y/39
T = 86000*(X − Y)/(43*V − 47*X)
F = 2000*(−2*V + 43*Y)/(45*V − 47*X − 4*Y + 78000)

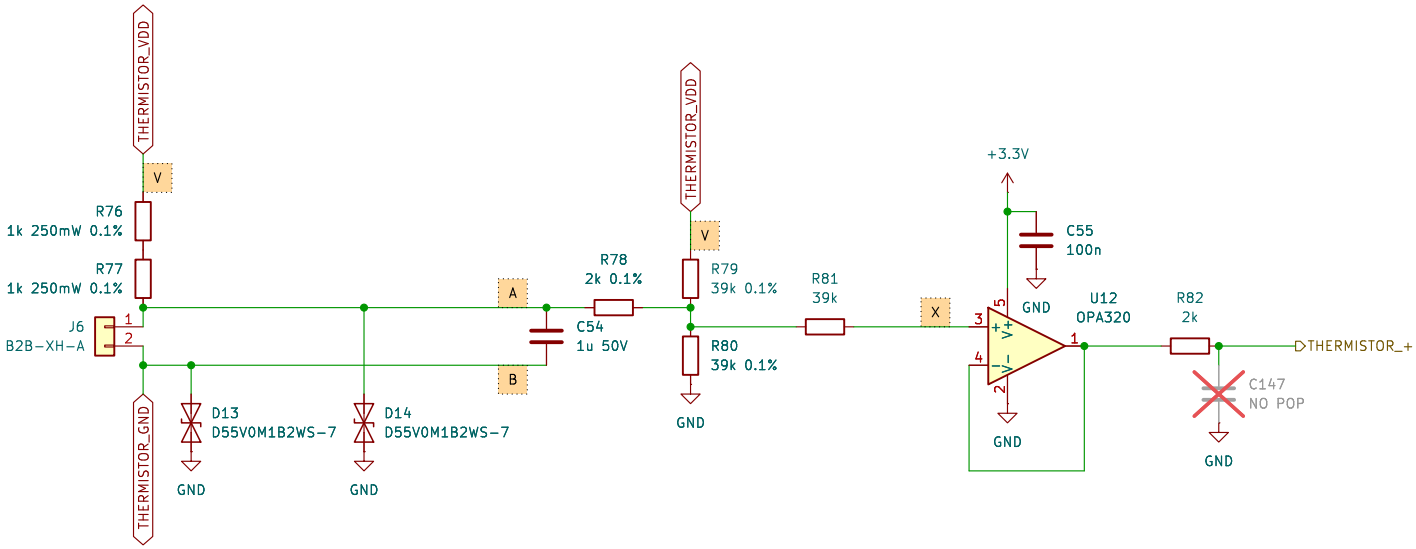
Note that F is only accurate when only a single thermistor is connected. The above can be easily modified to support finding F when all 4 thermistors are connected if required.

Prunt 3D Pty Ltd		
Sheet: /Thermistor_1/		
File: thermistor.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 4/17

Op-amp substitutes should ideally:
- Be unity-gain stable.
- Have maximum of 150mV output swing from rails at 2k and 105°C.
- Not exhibit phase inversion if inputs are overdriven.
- Allow for 2mA overdriven or underdriven current in to each input.
- Not have high offset voltage at high common mode voltages.

Good substitutes:
- OPAx320
- OPAx325
- OPAx328
- OPAx387
- OPAx388

Possible substitutes without enough details:
- TLVx387
- AD8605
- OPA323
- OPA322 (No explicit 2k swing spec)



ESD diodes must have a very low leakage current.

KCL of input network ignoring ESD diode leakage and overdriven/underdriven op-amps.

Nodes labelled in text boxes with the same styling as this one. T is the thermistor resistance and F is the PTC fuse resistance.

```
import sympy as sym

A, B, X, Y, T, F, V = sym.symbols("A B X Y T F V")

eq1 = sym.Eq((A-B)/T + (A-X)/2000 + (A-V)/2000, 0)
eq2 = sym.Eq((B-A)/T + (B-F)/F + (B-Y)/2000, 0)
eq3 = sym.Eq((X-V)/39000 + X/39000 + (X-A)/2000, 0)
eq4 = sym.Eq((Y-V)/39000 + Y/39000 + (Y-B)/2000, 0)

print(sym.solve((eq1, eq2, eq3, eq4), (A, B, T, F)))
```

Result:
A = −2*V/39 + 43*X/39
B = −2*V/39 + 43*Y/39
T = 86000*(X − Y)/(43*V − 47*X)
F = 2000*(−2*V + 43*Y)/(45*V − 47*X − 4*Y + 78000)

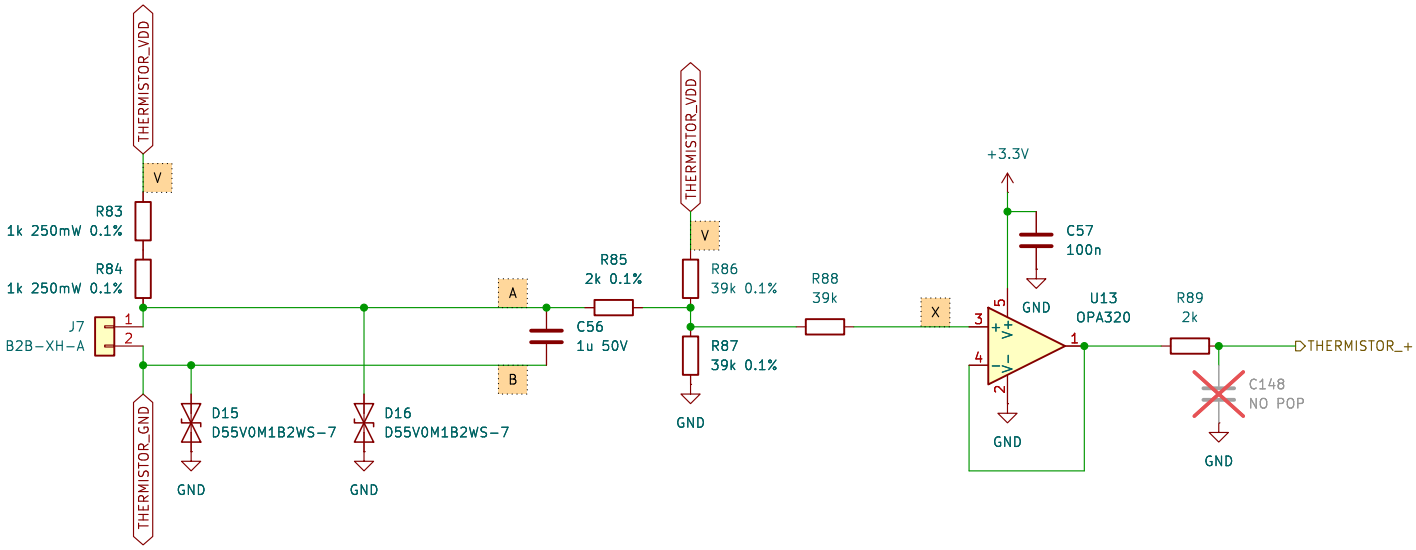
Note that F is only accurate when only a single thermistor is connected. The above can be easily modified to support finding F when all 4 thermistors are connected if required.

Prunt 3D Pty Ltd		
Sheet: /Thermistor_2/		
File: thermistor.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 5/17

Op-amp substitutes should ideally:
- Be unity-gain stable.
- Have maximum of 150mV output swing from rails at 2k and 105°C.
- Not exhibit phase inversion if inputs are overdriven.
- Allow for 2mA overdriven or underdriven current in to each input.
- Not have high offset voltage at high common mode voltages.

Good substitutes:
- OPAx320
- OPAx325
- OPAx328
- OPAx387
- OPAx388

Possible substitutes without enough details:
- TLVx387
- AD8605
- OPA323
- OPA322 (No explicit 2k swing spec)



ESD diodes must have a very low leakage current.

KCL of input network ignoring ESD diode leakage and overdriven/underdriven op-amps.

Nodes labelled in text boxes with the same styling as this one. T is the thermistor resistance and F is the PTC fuse resistance.

```
import sympy as sym

A, B, X, Y, T, F, V = sym.symbols("A B X Y T F V")

eq1 = sym.Eq((A-B)/T + (A-X)/2000 + (A-V)/2000, 0)
eq2 = sym.Eq((B-A)/T + (B-F)/F + (B-Y)/2000, 0)
eq3 = sym.Eq((X-V)/39000 + X/39000 + (X-A)/2000, 0)
eq4 = sym.Eq((Y-V)/39000 + Y/39000 + (Y-B)/2000, 0)

print(sym.solve((eq1, eq2, eq3, eq4), (A, B, T, F)))
```

Result:
A = −2*V/39 + 43*X/39
B = −2*V/39 + 43*Y/39
T = 86000*(X − Y)/(43*V − 47*X)
F = 2000*(−2*V + 43*Y)/(45*V − 47*X − 4*Y + 78000)

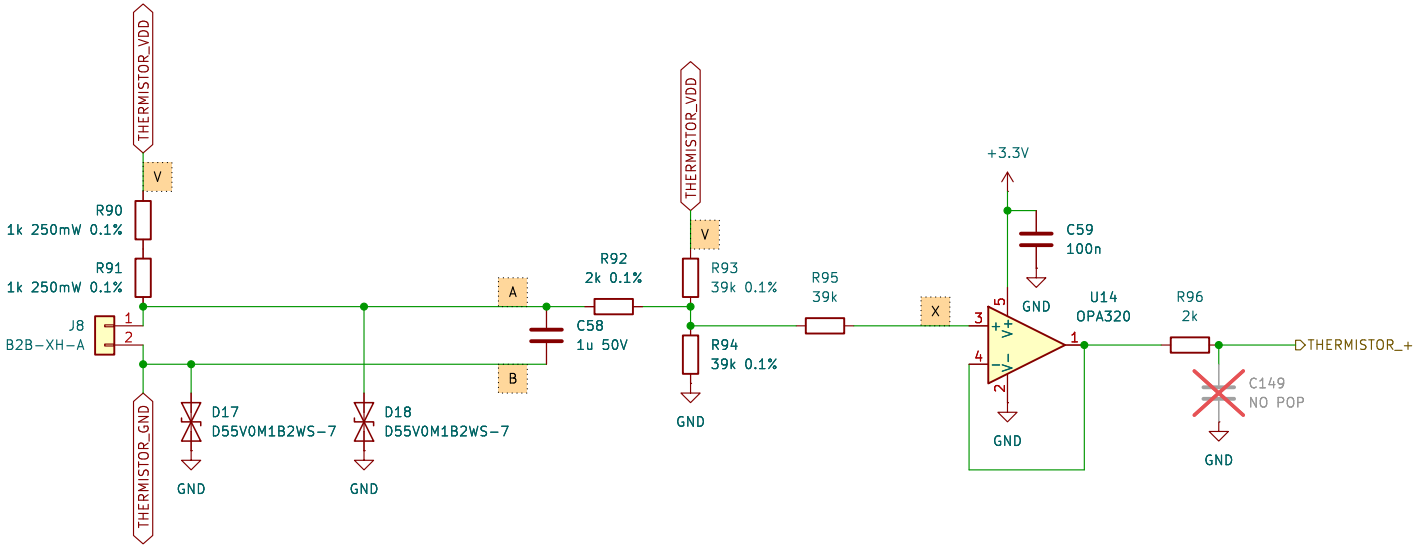
Note that F is only accurate when only a single thermistor is connected. The above can be easily modified to support finding F when all 4 thermistors are connected if required.

Prunt 3D Pty Ltd		
Sheet: /Thermistor_3/		
File: thermistor.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 6/17

Op-amp substitutes should ideally:
- Be unity-gain stable.
- Have maximum of 150mV output swing from rails at 2k and 105°C.
- Not exhibit phase inversion if inputs are overdriven.
- Allow for 2mA overdriven or underdriven current in to each input.
- Not have high offset voltage at high common mode voltages.

Good substitutes:
- OPAx320
- OPAx325
- OPAx328
- OPAx387
- OPAx388

Possible substitutes without enough details:
- TLVx387
- AD8605
- OPA323
- OPA322 (No explicit 2k swing spec)



ESD diodes must have a very low leakage current.

KCL of input network ignoring ESD diode leakage and overdriven/underdriven op-amps.

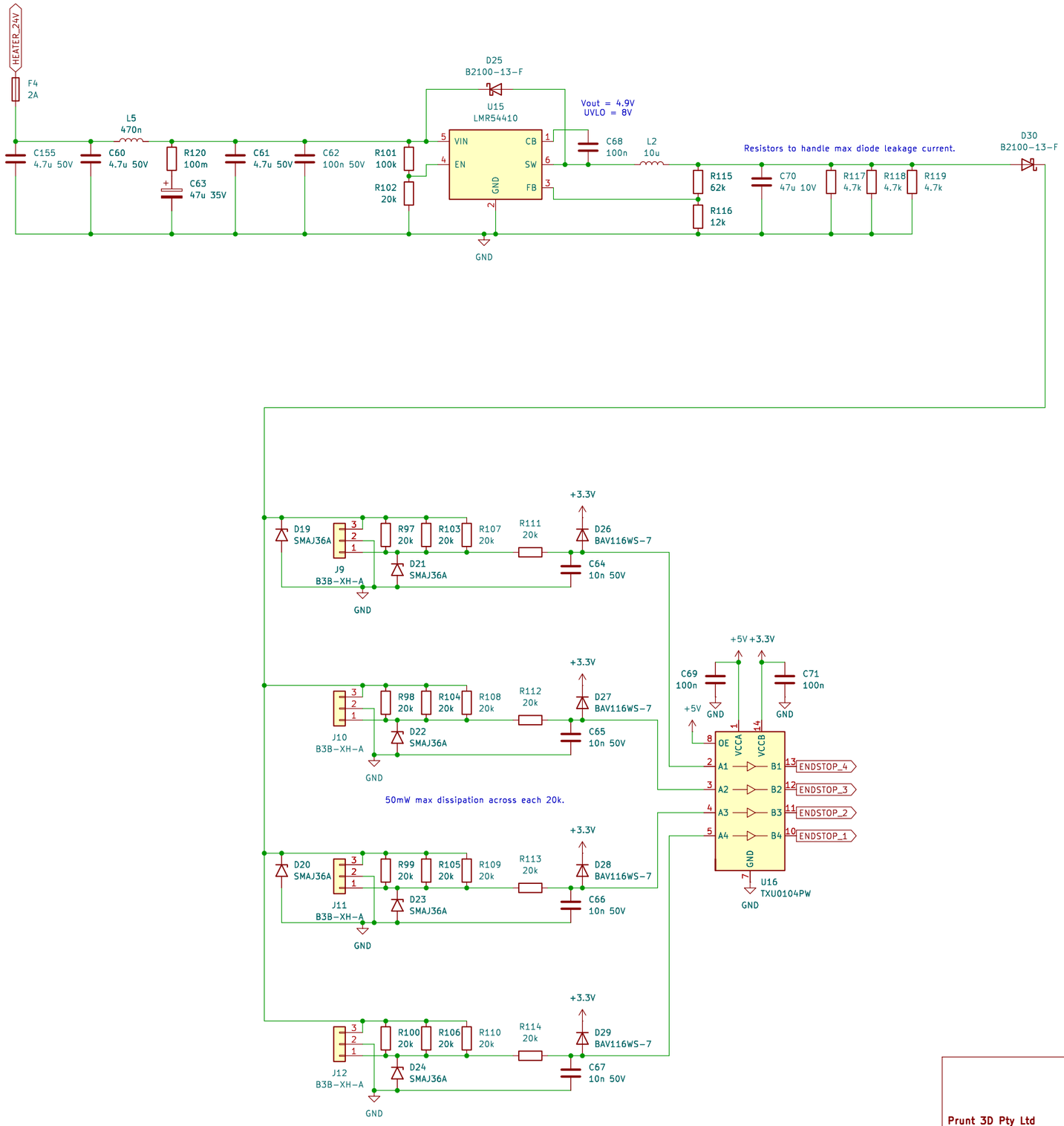
Nodes labelled in text boxes with the same styling as this one. T is the thermistor resistance and F is the PTC fuse resistance.

```
import sympy as sym

A, B, X, Y, T, F, V = sym.symbols("A B X Y T F V")

eq1 = sym.Eq((A-B)/T + (A-X)/2000 + (A-V)/2000, 0)
eq2 = sym.Eq((B-A)/T + (B-F)/F + (B-Y)/2000, 0)
eq3 = sym.Eq((X-V)/39000 + X/39000 + (X-A)/2000, 0)
eq4 = sym.Eq((Y-V)/39000 + Y/39000 + (Y-B)/2000, 0)

print(sym.solve((eq1, eq2, eq3, eq4), (A, B, T, F)))
```

Result:
A = −2*V/39 + 43*X/39
B = −2*V/39 + 43*Y/39
T = 86000*(X − Y)/(43*V − 47*X)
F = 2000*(−2*V + 43*Y)/(45*V − 47*X − 4*Y + 78000)

Note that F is only accurate when only a single thermistor is connected. The above can be easily modified to support finding F when all 4 thermistors are connected if required.

Prunt 3D Pty Ltd		
Sheet: /Thermistor_4/		
File: thermistor.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 7/17

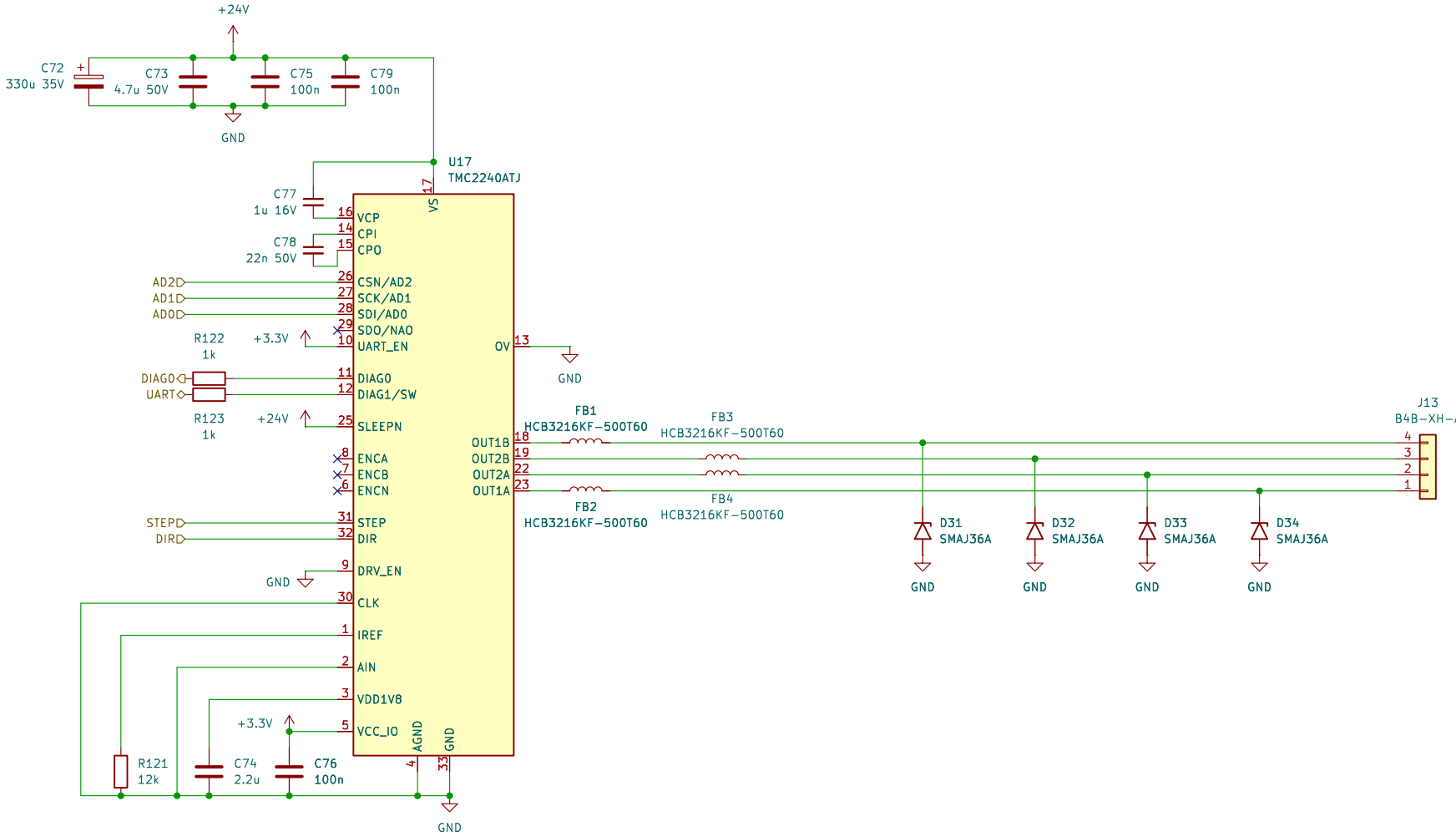


Prunt 3D Pty Ltd

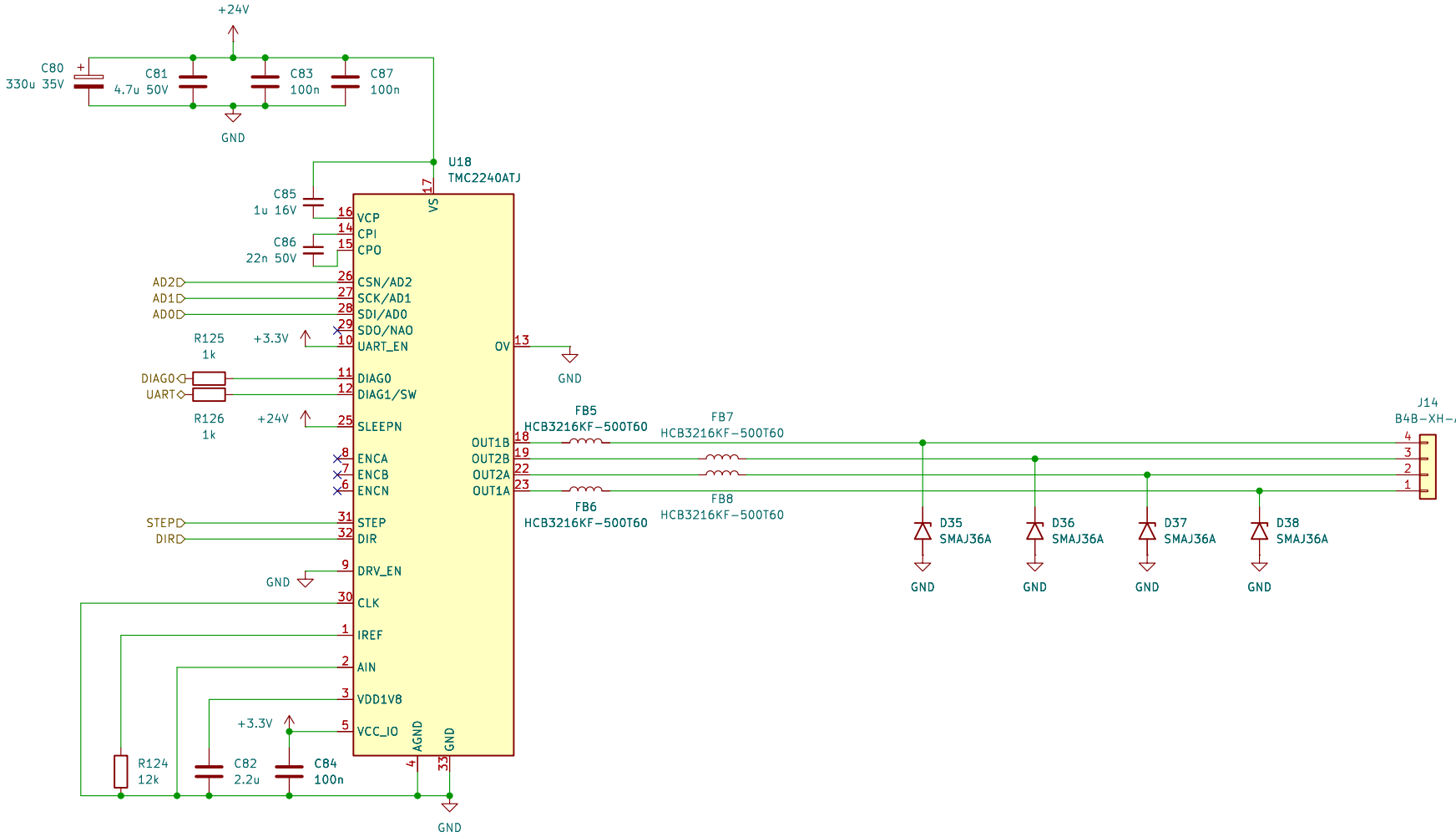
Sheet: /Endstops/
File: endstops.kicad_sch

Title: Prunt Board 3

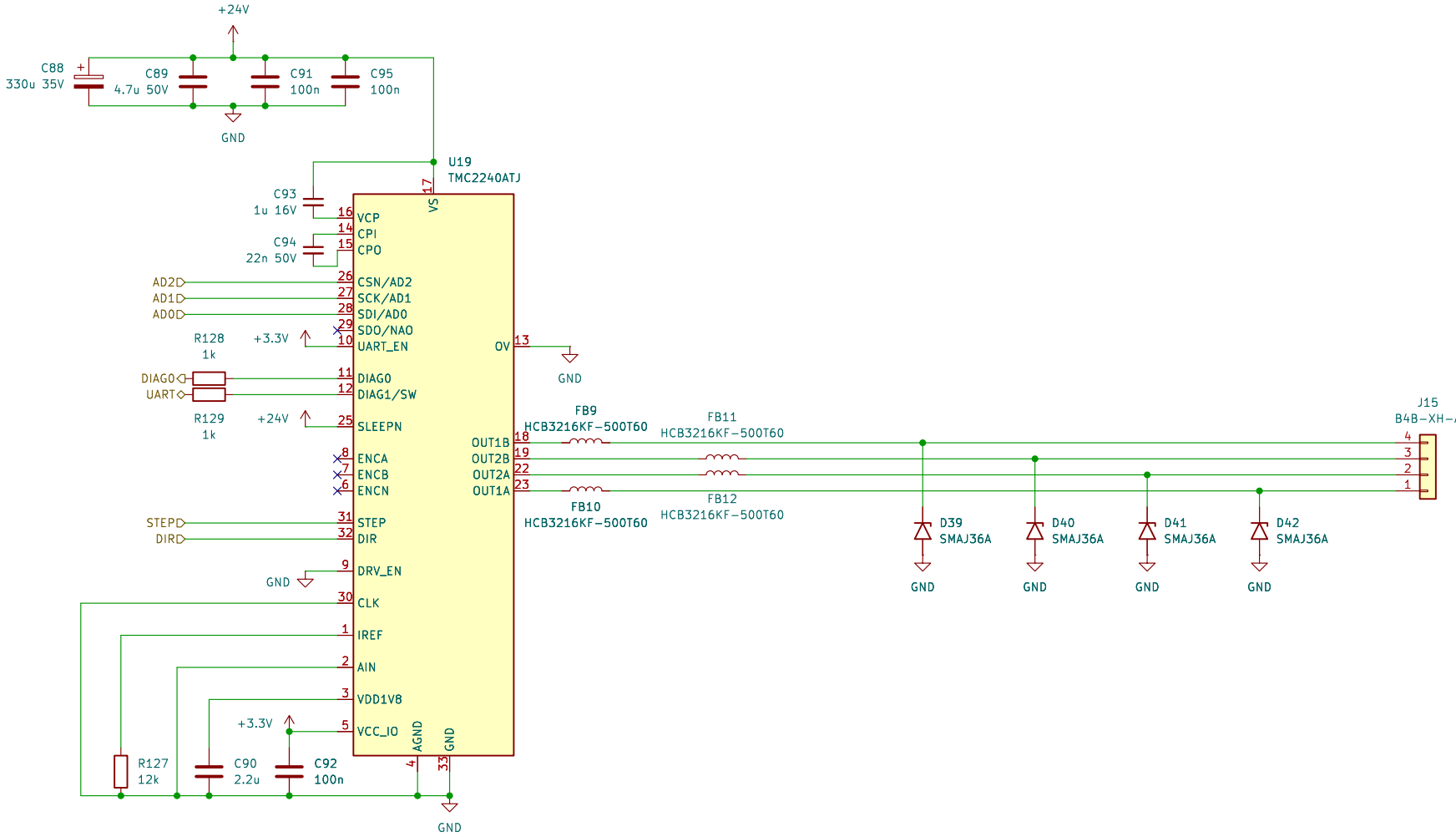
Size: A3	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 8/17



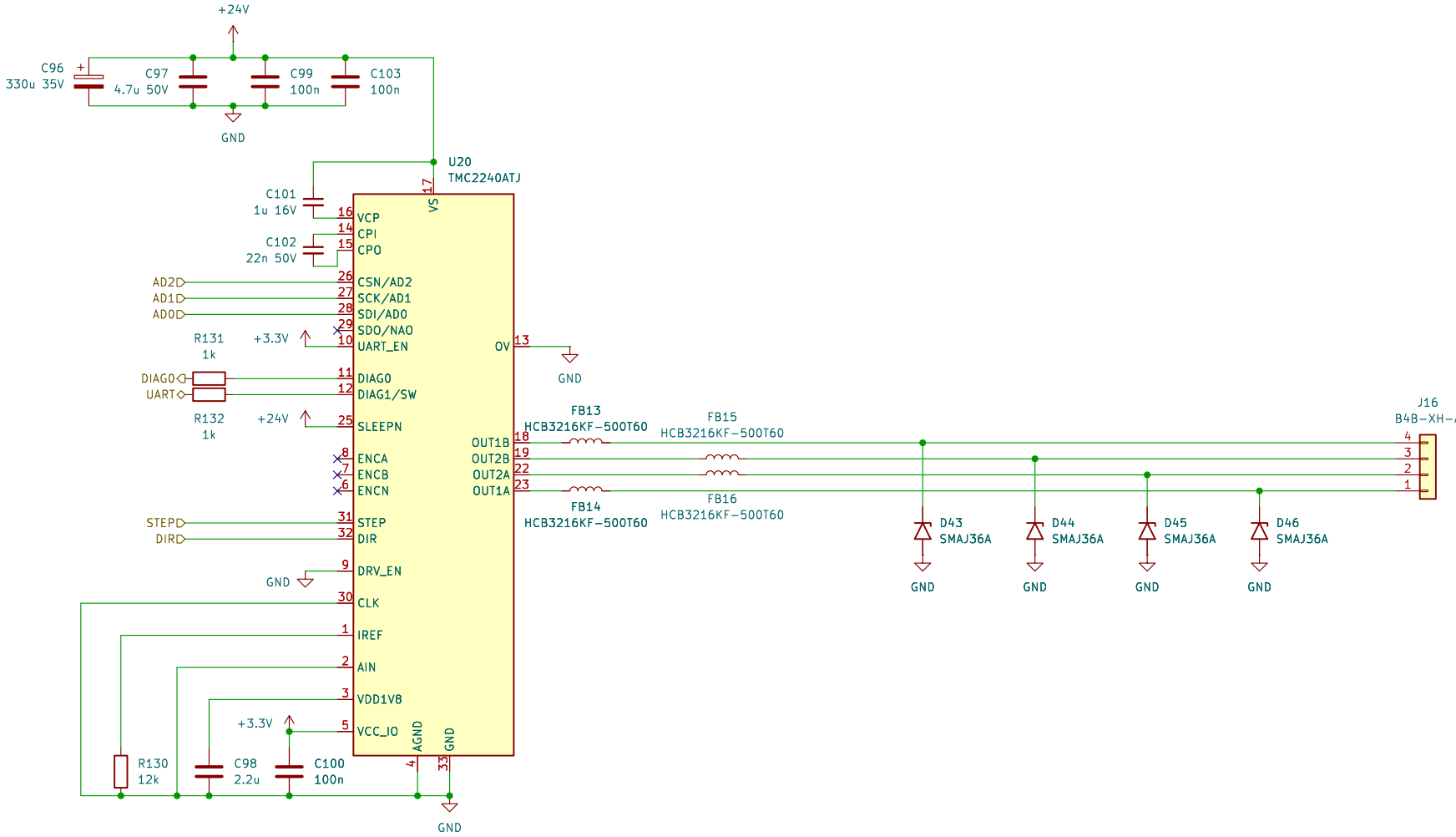
Prunt 3D Pty Ltd		
Sheet: /Stepper_1/		
File: stepper.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 9/17



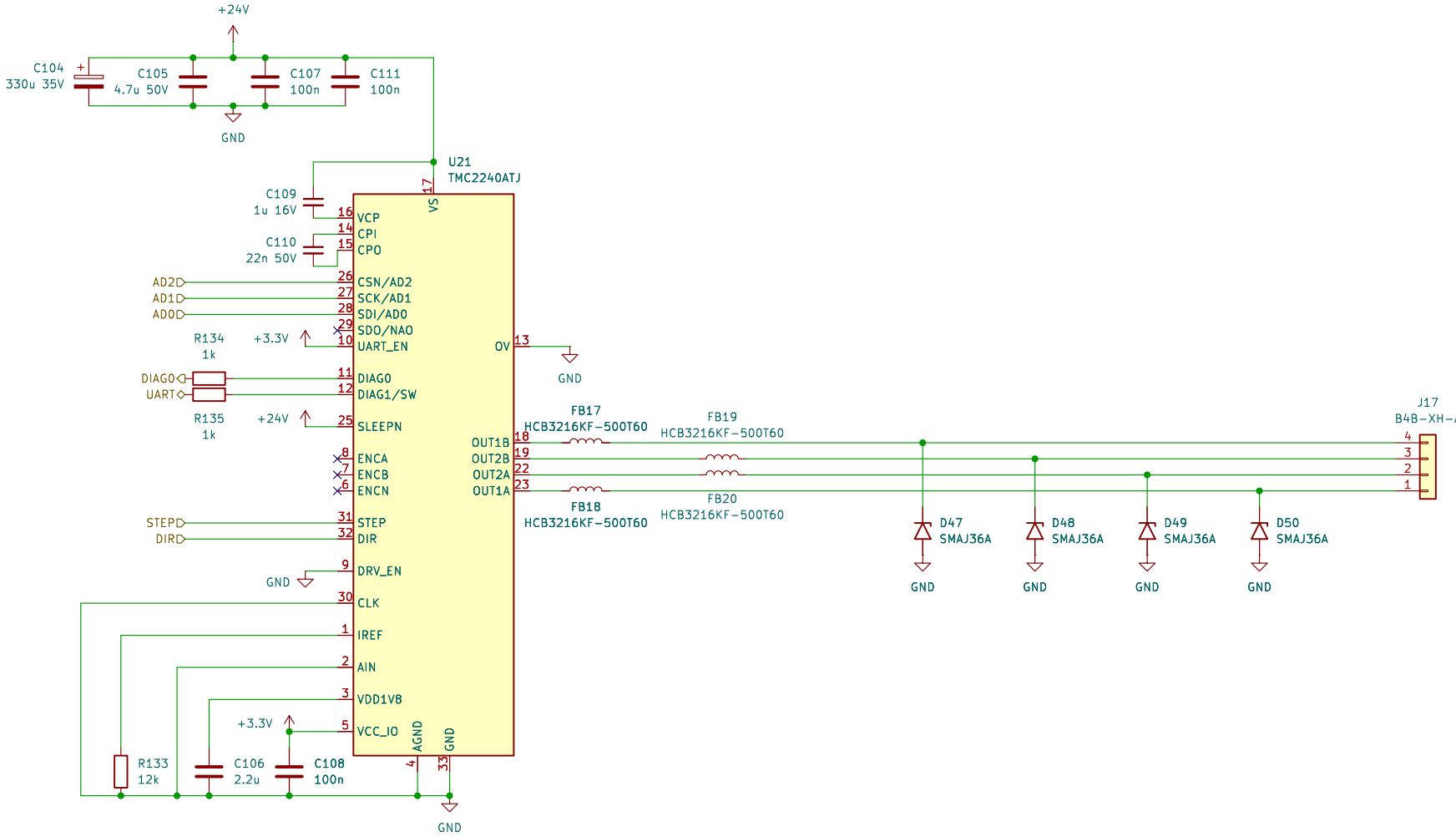
Prunt 3D Pty Ltd		
Sheet: /Stepper_2/		
File: stepper.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 10/17



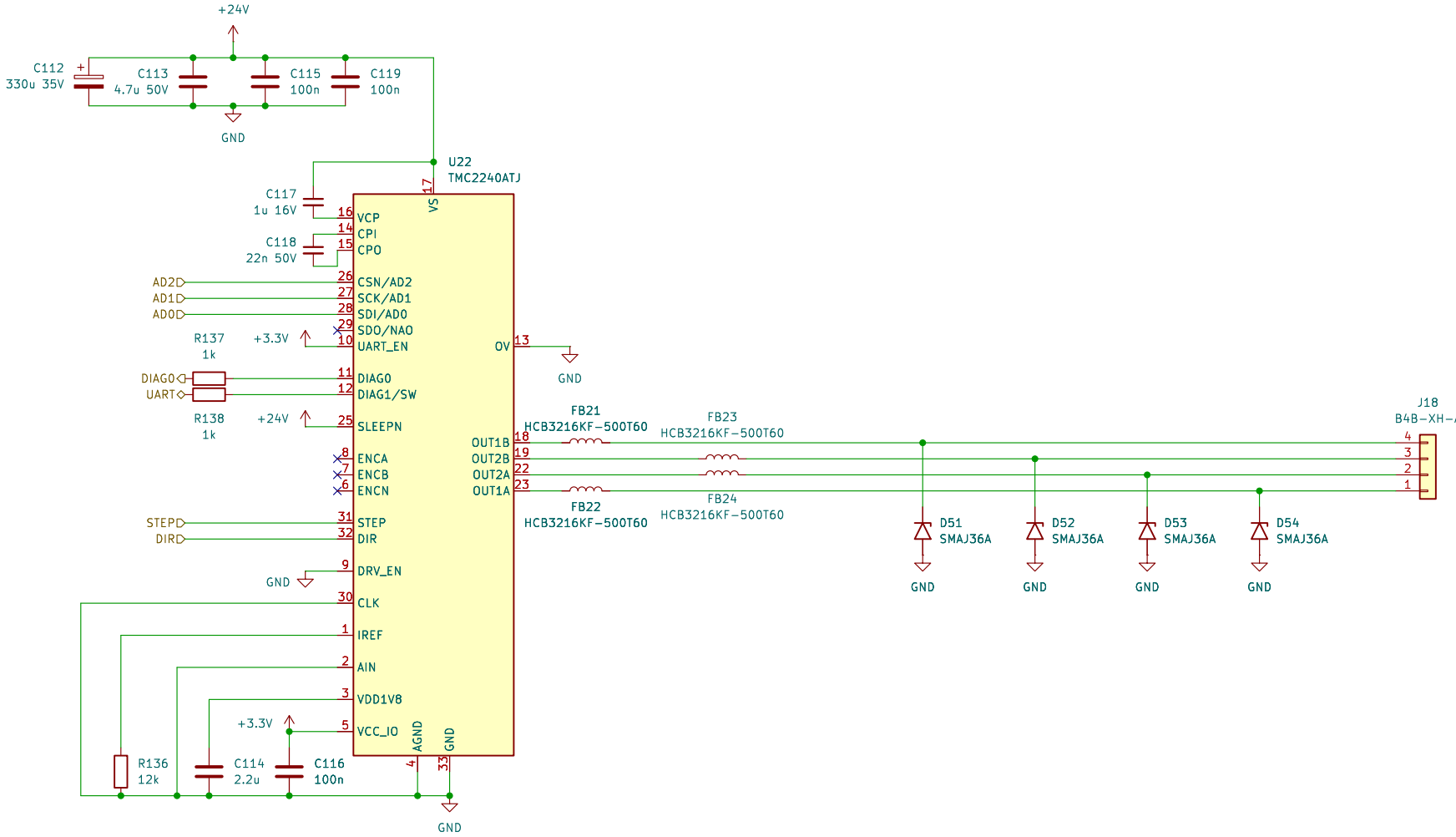
Prunt 3D Pty Ltd		
Sheet: /Stepper_3/		
File: stepper.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 11/17



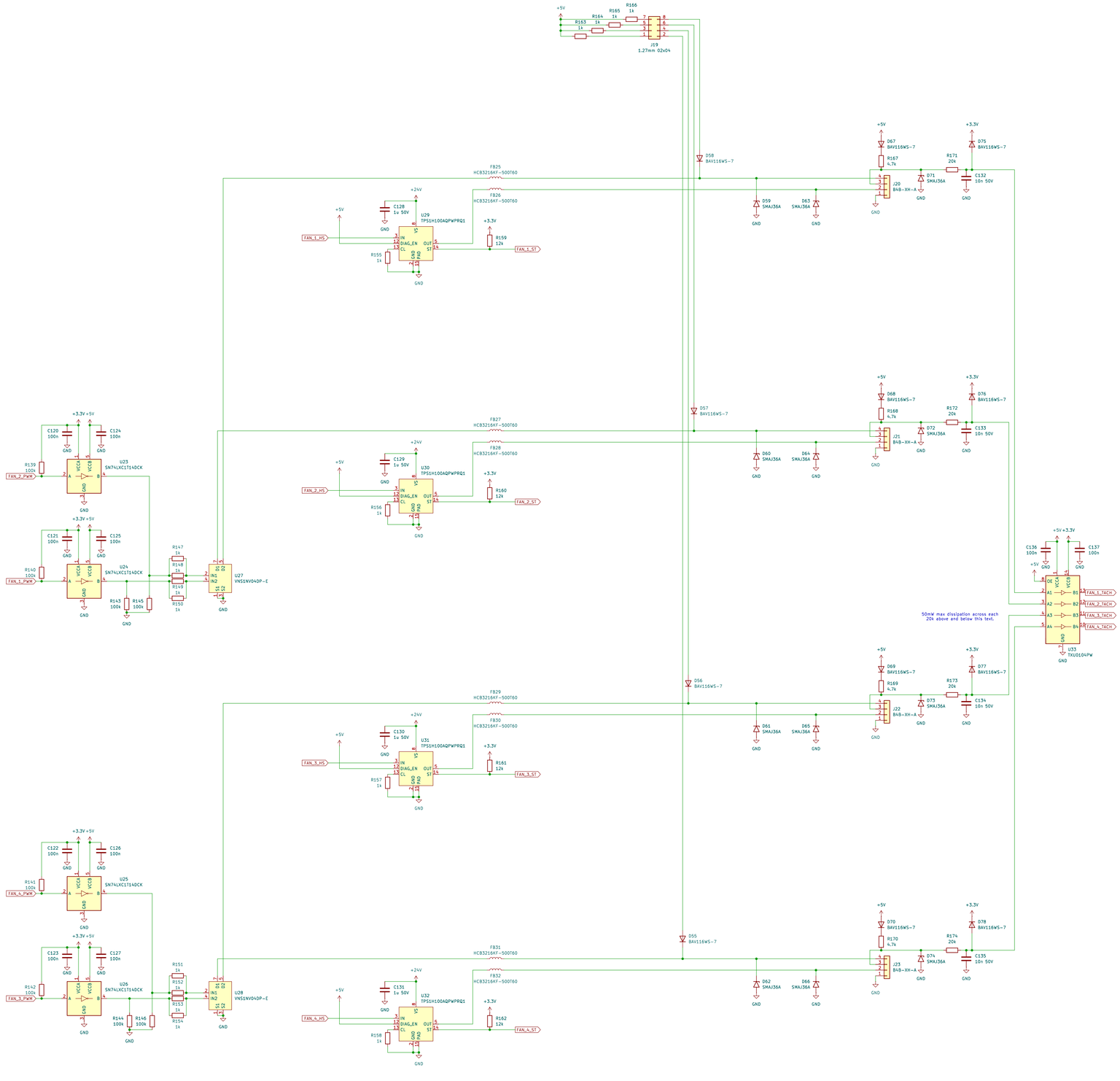
Prunt 3D Pty Ltd		
Sheet: /Stepper_4/		
File: stepper.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 12/17



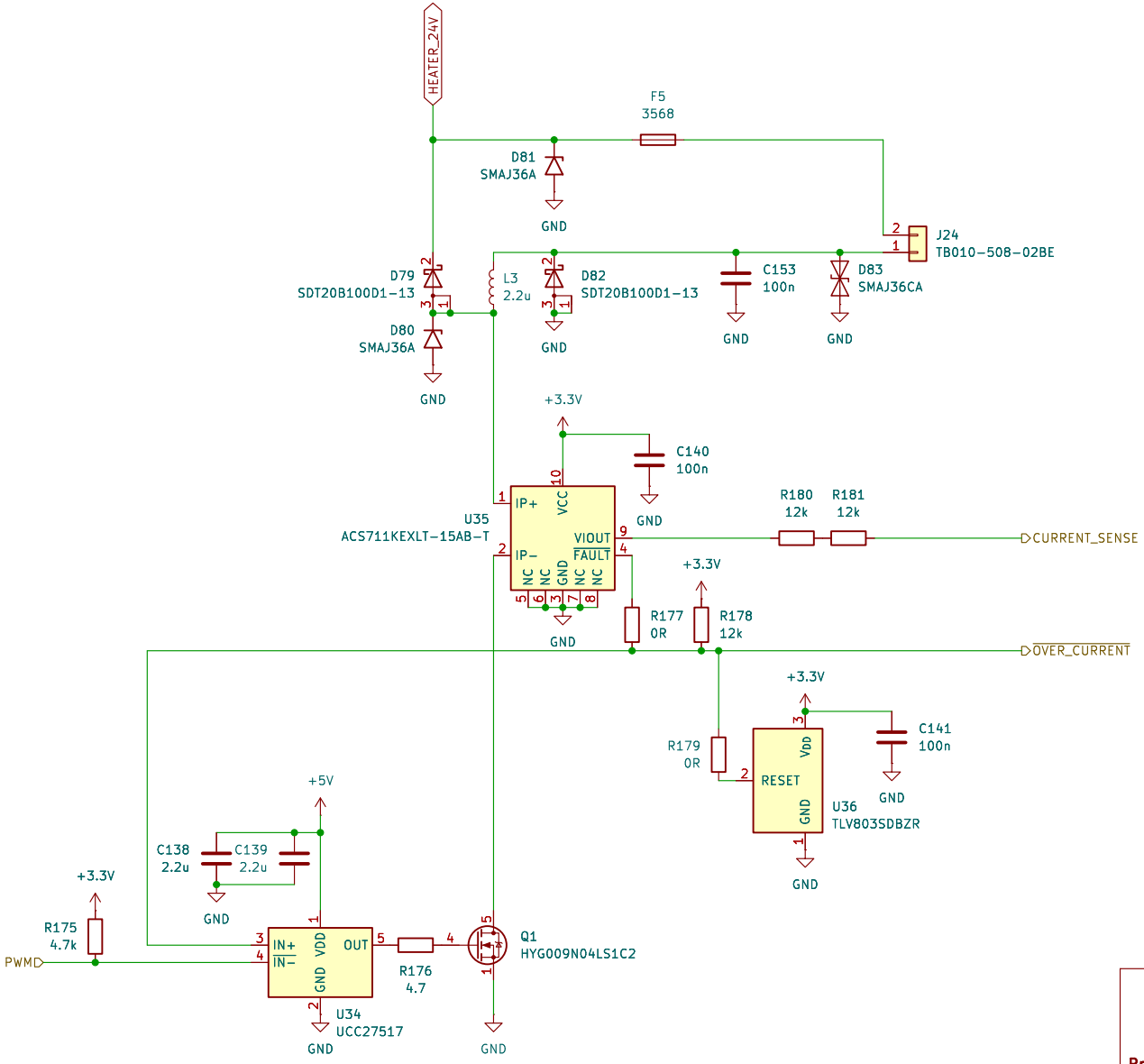
Prunt 3D Pty Ltd		
Sheet: /Stepper_5/		
File: stepper.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 13/17

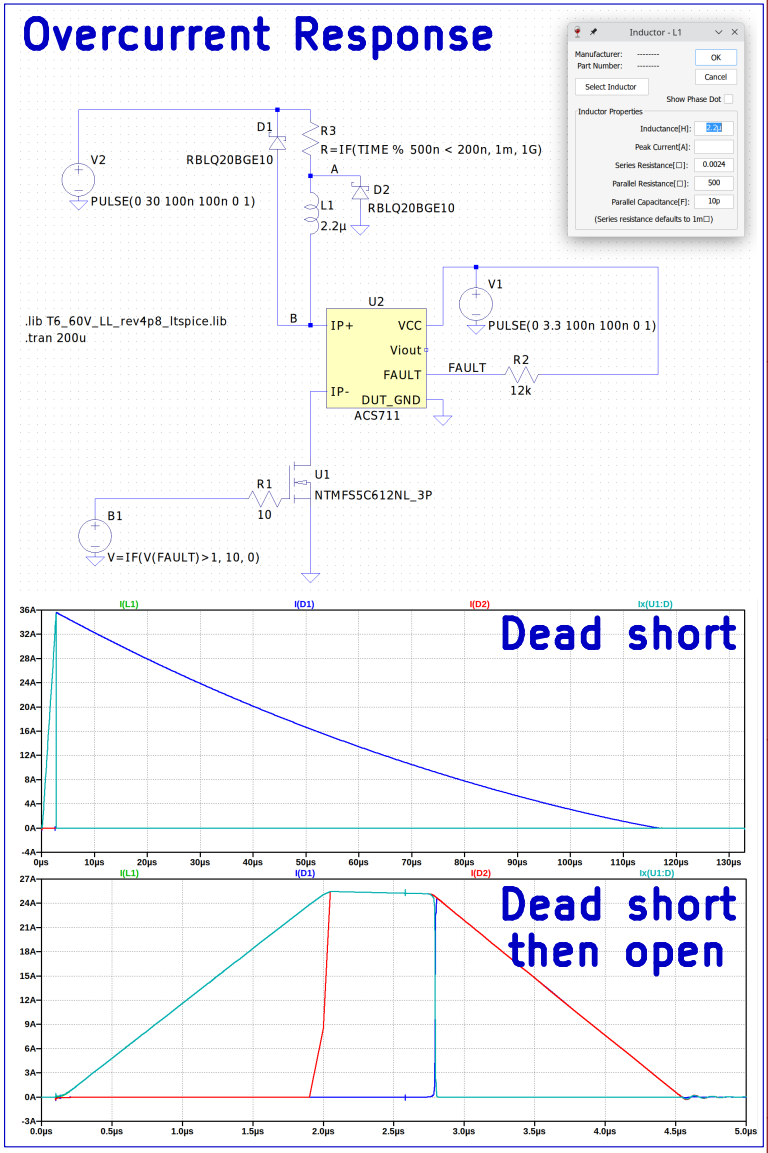


Prunt 3D Pty Ltd		
Sheet: /Stepper_6/		
File: stepper.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 14/17

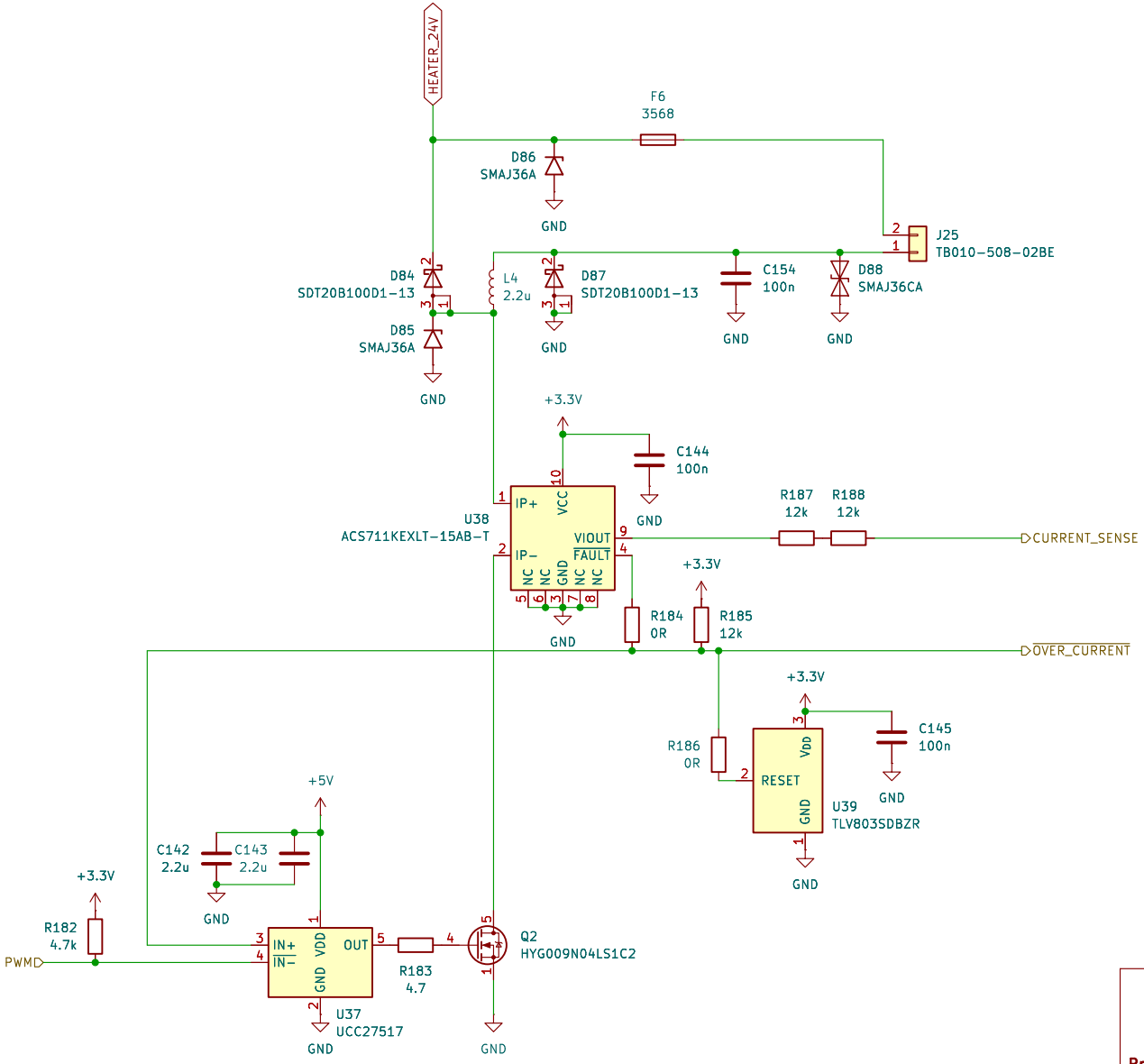


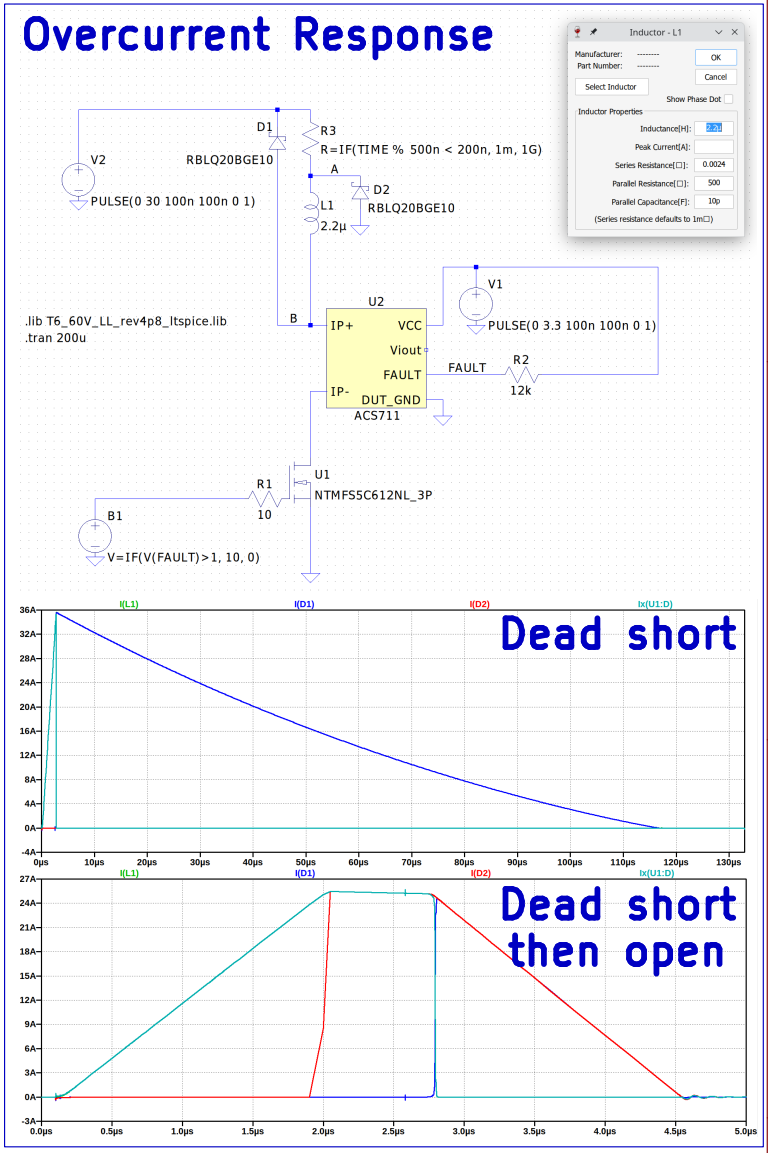
Prunt 3D Pty Ltd	
Sheet: /Fans/	
File: fans.kicad_sch	
Title: Prunt Board 3	
Size: A1 Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2	Id: 15/17





Prunt 3D Pty Ltd		
Sheet: /Heater_1/		
File: heater.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 16/17





Prunt 3D Pty Ltd		
Sheet: /Heater_2/		
File: heater.kicad_sch		
Title: Prunt Board 3		
Size: A4	Date: 2025-06-02	**Rev: 2**
KiCad E.D.A. 9.0.2		Id: 17/17