Main Power

Main Power In V_IN / GND

P1 — Main PWR Screw Term (1, 2)

HB Power In V_BED / HB_GND

P4 — Bed PWR Screw Term (1, 2)

Auxiliary Power VIN1 / +5V / +3V3

P7 — PWR_AUX (1 3 5 / 2 4 6) GND

MOSFETs

P11 — HB Screw Term (1, 2) — V_BED / HEATED_BED

P12 — H0 Header (1, 2) — V_FET / HEATER0

P15 — H0 Screw Term (1, 2) — V_FET / HEATER0

P16 — H1 Header (1, 2) — V_FET / HEATER1

P17 — H1 Screw Term (1, 2) — V_FET / HEATER1

P19 — F0 Header (1, 2) — V_FET / FAN0

P22 — F0 Screw Term (1, 2) — V_FET / FAN0

P24 — F1 Header (1, 2) — V_FET / FAN1

P26 — F1 Screw Term (1, 2) — V_FET / FAN1

P32 — F2 Header (1, 2) — V_FET / FAN2
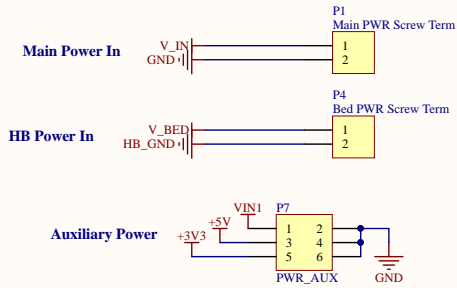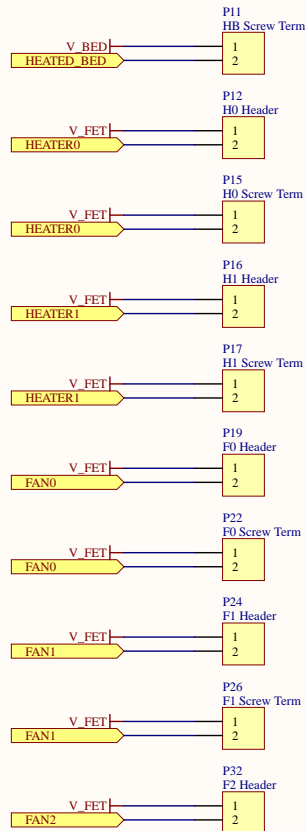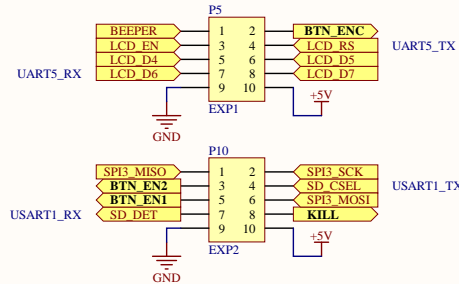
Expansion

EXP1 and EXP2 suit displays / control panels
- buttons on interrupts
- buzzer on timer's PWM output (TIM8 CH4)
- dedicated SPI for SD access
- match existing RAMPS/RUMBA style character+graphic LCDs

EXP1 and EXP2 both have U(S)ARTs (1 & 5) on matching pins
- either could be used individually for a serial-based external display
- note EXP2 USART1 is shared with EXP4 (peripheral, not pins)

P5 — EXP1
UART5_RX / UART5_TX
BEEPER	1	2	BTN_ENC
LCD_EN	3	4	LCD_RS
LCD_D4	5	6	LCD_D5
LCD_D6	7	8	LCD_D7
	9	10	+5V
GND

P10 — EXP2
USART1_RX / USART1_TX
SPI3_MISO	1	2	SPI3_SCK
BTN_EN2	3	4	SD_CSEL
BTN_EN1	5	6	SPI3_MOSI
SD_DET	7	8	KILL
	9	10	+5V
GND

V_USB → J1 — Micro-USB B Socket
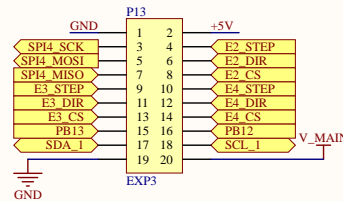USB_D- → D-
USB_D+ → D+
USB_SHLD → SH
VBUS
GND

EXP2 P10 is "KILL" on some boards and control panel schematics
"KILL" is supposed to cause the printer to freeze or reset.
However:
- P10 is often not connected on the display board
  (as per RRD Character / Graphic Schematics)
  (most displays use RESET / P8 instead)
- EXP2 has no power pin, limiting its functionality
Therefore "KILL" has been moved to P8, replacing RESET
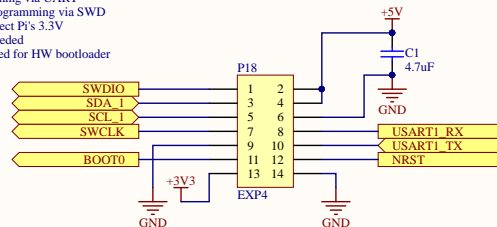And P10 is now a 5V power pin

If an existing control panel does connect P10,
it will likely be a button shorting it to ground
- Which will cause the 5V regulator's short-circuit protection
  to cut off power, resetting the micro
or it will be a button connecting it to 5V (less likely):
- Which will do nothing at all

EXP3 can be used for an expansion board
- Three sets of STEP/DIR/EN pins
- SPI4 for stepper driver control
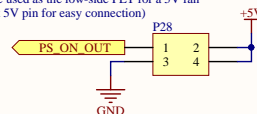- PB12/13 as GPIO or CAN
- SDA/SCL for I2C

This allows three additional TMC2130 stepper drivers
Plus either two MOSFETs directly (PB12/13)
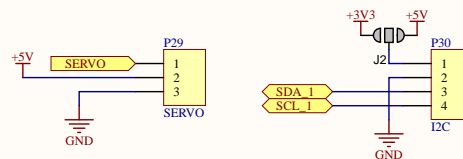Or a more extensive expansion via I2C or CAN

P13 — EXP3
GND	1	2	+5V
SPI4_SCK	3	4	E2_STEP
SPI4_MOSI	5	6	E2_DIR
SPI4_MISO	7	8	E2_CS
E3_STEP	9	10	E4_STEP
E3_DIR	11	12	E4_DIR
E3_CS	13	14	E4_CS
PB13	15	16	PB12
SDA_1	17	18	SCL_1
	19	20	V_MAIN
GND

EXP4 is combination programming and Raspberry Pi / host header
- UART for control by Pi or other host board
- NRST and BOOT0 allow programming via UART
- SWDIO, SWCLK, NRST allow programming via SWD
- SWDIO as pull-down input can detect Pi's 3.3V
- SWCLK can be used as GPIO if needed
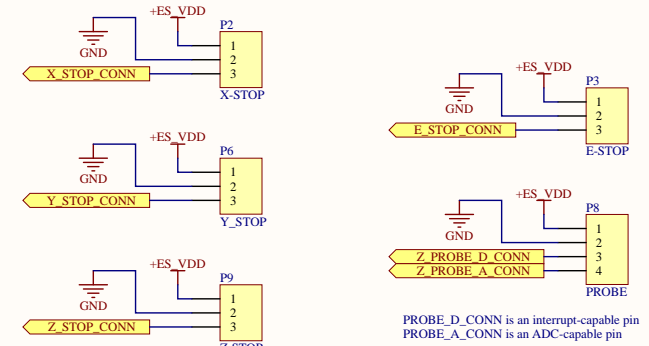- BOOT0 and adj. 3V can be jumpered for HW bootloader

P18 — EXP4
+5V C1 4.7uF GND
SWDIO	1	2	
SDA_1	3	4	
SCL_1	5	6	
SWCLK	7	8	USART1_RX
BOOT0	9	10	USART1_TX
	11	12	NRST
	13	14	
+3V3 GND GND

PS_ON can be used to pull PSU enable low
OR
PS_ON can be used as the low-side FET for a 5V fan
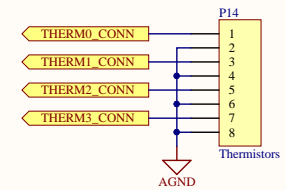(with adjacent 5V pin for easy connection)

P28
+5V
| PS_ON_OUT | 1 | 2 |
| | 3 | 4 |
GND

P29 — SERVO
+5V
SERVO	1
	2
	3
GND

P30 — I2C
+3V3 +5V J2
SDA_1	1
	2
SCL_1	3
	4
GND

5V can be supplied via either of the 5V pins
Bypassing the board's switching regulator

Endstops / Z-Probe

P2 — X-STOP (1 2 3) — GND / +ES_VDD / X_STOP_CONN

P6 — Y_STOP (1 2 3) — GND / +ES_VDD / Y_STOP_CONN

P9 — Z-STOP (1 2 3) — GND / +ES_VDD / Z_STOP_CONN

P3 — E-STOP (1 2 3) — GND / +ES_VDD / E_STOP_CONN

P8 — PROBE (1 2 3 4) — GND / +ES_VDD / Z_PROBE_D_CONN / Z_PROBE_A_CONN

PROBE_D_CONN is an interrupt-capable pin
PROBE_A_CONN is an ADC-capable pin

Thermistors
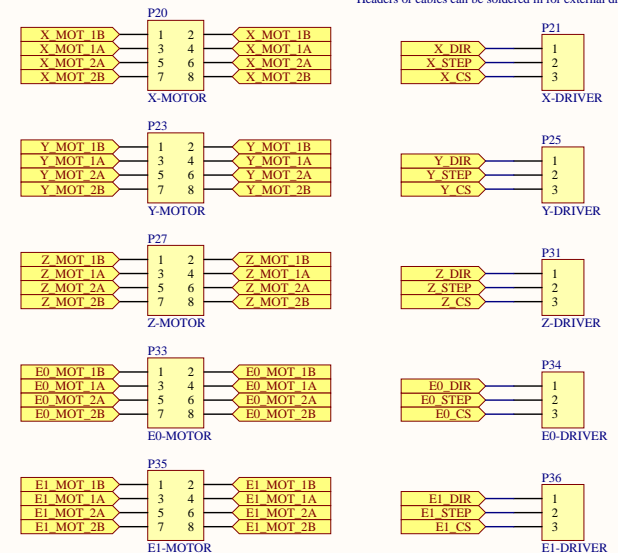
P14 — Thermistors (1–8)
THERM0_CONN
THERM1_CONN
THERM2_CONN
THERM3_CONN
AGND

Stepper Motors

Driver STEP/DIR/EN headers are not populated
Headers or cables can be soldered in for external drivers

P20 — X-MOTOR
X_MOT_1B	1	2	X_MOT_1B
X_MOT_1A	3	4	X_MOT_1A
X_MOT_2A	5	6	X_MOT_2A
X_MOT_2B	7	8	X_MOT_2B

P21 — X-DRIVER
X_DIR	1
X_STEP	2
X_CS	3

P23 — Y-MOTOR
Y_MOT_1B	1	2	Y_MOT_1B
Y_MOT_1A	3	4	Y_MOT_1A
Y_MOT_2A	5	6	Y_MOT_2A
Y_MOT_2B	7	8	Y_MOT_2B

P25 — Y-DRIVER
Y_DIR	1
Y_STEP	2
Y_CS	3

P27 — Z-MOTOR
Z_MOT_1B	1	2	Z_MOT_1B
Z_MOT_1A	3	4	Z_MOT_1A
Z_MOT_2A	5	6	Z_MOT_2A
Z_MOT_2B	7	8	Z_MOT_2B

P31 — Z-DRIVER
Z_DIR	1
Z_STEP	2
Z_CS	3

P33 — E0-MOTOR
E0_MOT_1B	1	2	E0_MOT_1B
E0_MOT_1A	3	4	E0_MOT_1A
E0_MOT_2A	5	6	E0_MOT_2A
E0_MOT_2B	7	8	E0_MOT_2B

P34 — E0-DRIVER
E0_DIR	1
E0_STEP	2
E0_CS	3

P35 — E1-MOTOR
E1_MOT_1B	1	2	E1_MOT_1B
E1_MOT_1A	3	4	E1_MOT_1A
E1_MOT_2A	5	6	E1_MOT_2A
E1_MOT_2B	7	8	E1_MOT_2B

P36 — E1-DRIVER
E1_DIR	1
E1_STEP	2
E1_CS	3

Test Points

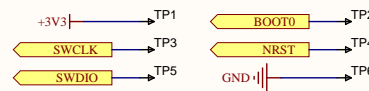| +3V3 | TP1 | BOOT0 | TP2 |
| SWCLK | TP3 | NRST | TP4 |
| SWDIO | TP5 | GND | TP6 |

Aus3D
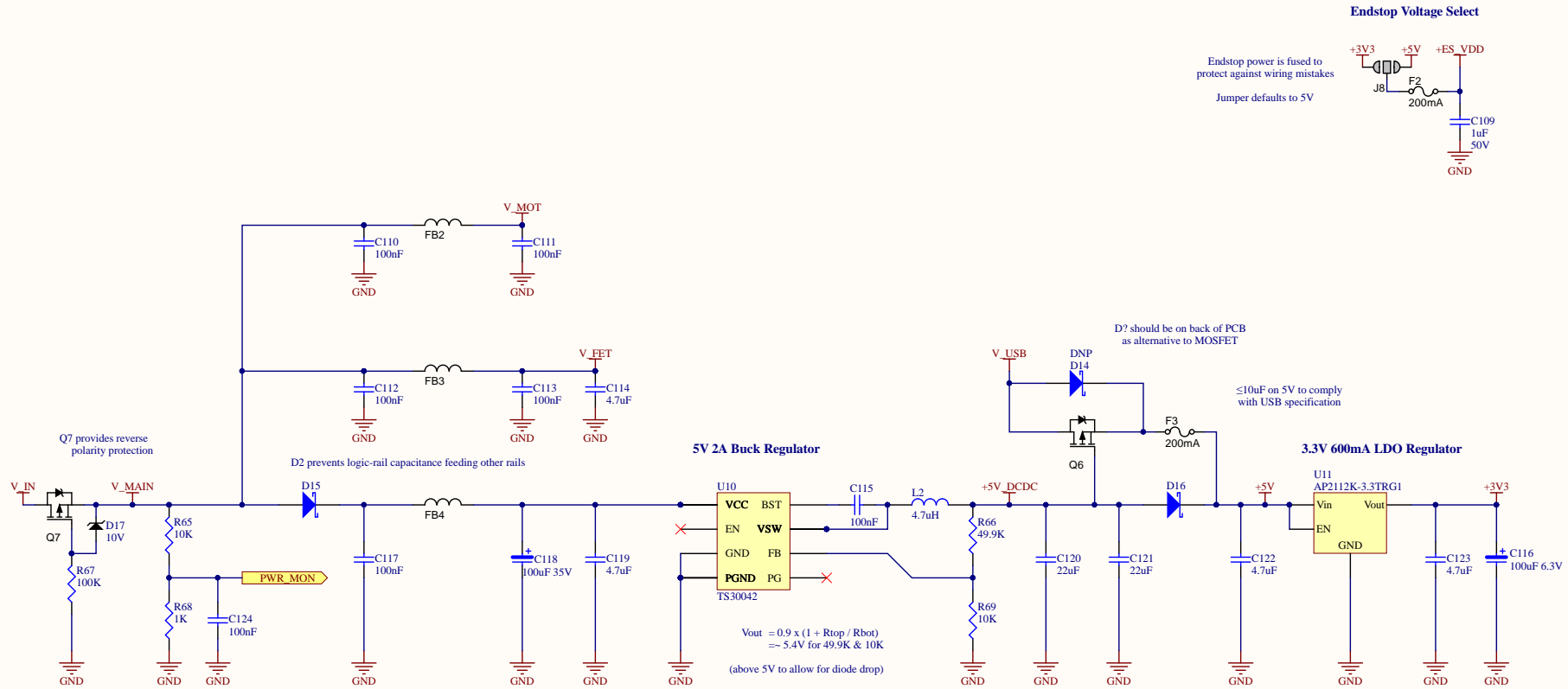
GPLv3
github.com/Aus3D/PicoPrint
www.aus3d.com/picoprint

Revision: 0.3A
Date: 27/11/2017
Drawn: Chris Barr
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Power

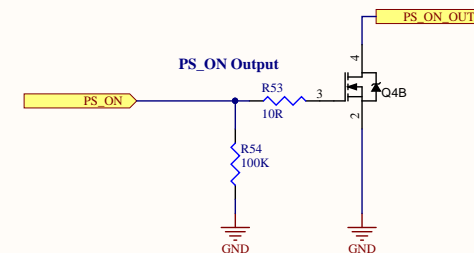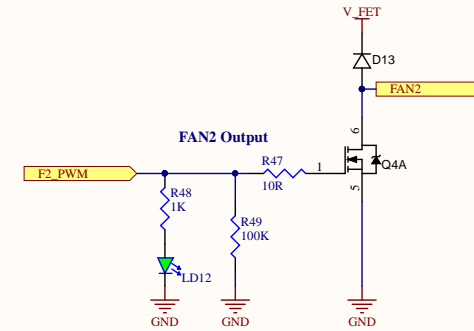**Endstop Voltage Select**

Endstop power is fused to
protect against wiring mistakes

Jumper defaults to 5V

+3V3   +5V   +ES_VDD

J8   F2
200mA

C109
1uF
50V

GND

V_MOT

C110
100nF

FB2

C111
100nF

GND   GND

V_FET

C112
100nF

FB3

C113
100nF

C114
4.7uF

GND   GND   GND

Q7 provides reverse
polarity protection

D2 prevents logic-rail capacitance feeding other rails

D? should be on back of PCB
as alternative to MOSFET

V_USB

DNP
D14

F3
200mA

Q6

≤10uF on 5V to comply
with USB specification

5V 2A Buck Regulator

3.3V 600mA LDO Regulator

V_IN   V_MAIN

Q7

D17
10V

R65
10K

R67
100K

R68
1K

C124
100nF

PWR_MON

D15

FB4

C117
100nF

C118
100uF 35V

C119
4.7uF

U10

VCC	BST
EN	VSW
GND	FB
PGND	PG

TS30042

C115
100nF

L2
4.7uH

+5V_DCDC

R66
49.9K

R69
10K

D16

+5V

U11
AP2112K-3.3TRG1

Vin	Vout
EN	
	GND

+3V3

C120
22uF

C121
22uF

C122
4.7uF

C123
4.7uF

C116
100uF 6.3V

GND   GND   GND   GND   GND   GND   GND   GND   GND   GND   GND   GND   GND   GND

$V_{out} = 0.9 \times (1 + R_{top} / R_{bot})$
$=\sim 5.4V$ for 49.9K & 10K

(above 5V to allow for diode drop)

Aus3D

GPLv3
github.com/Aus3D/PicoPrint
www.aus3d.com/picoprint

Revision: 0.3A
Date: 27/11/2017
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MOSFET Outputs

HE0 Output
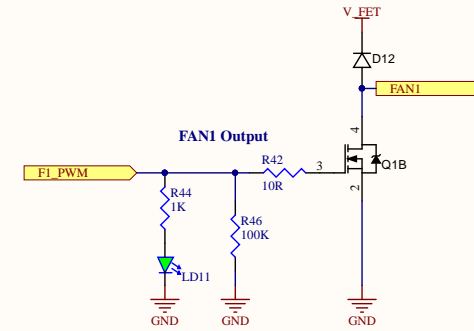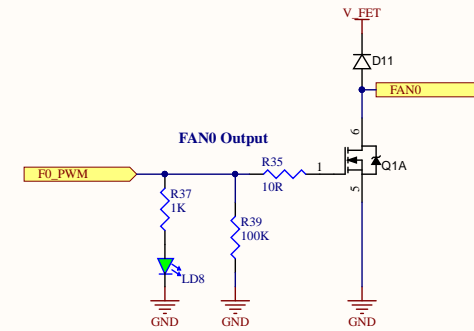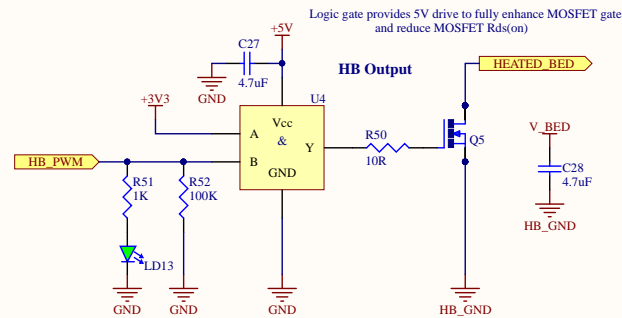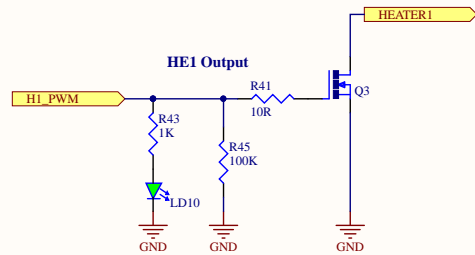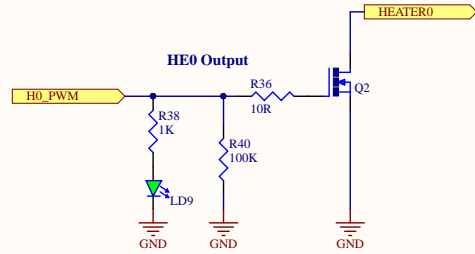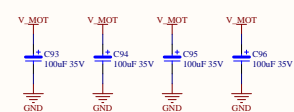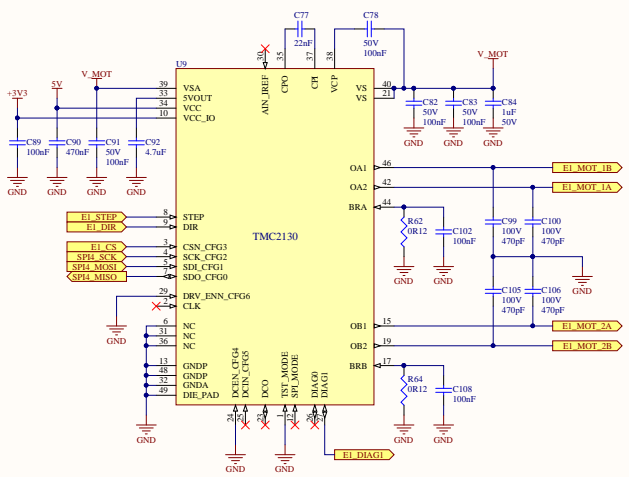
HEATER0

H0_PWM

R36
10R

Q2

R38
1K

R40
100K

LD9

GND GND GND

HE1 Output

HEATER1

H1_PWM

R41
10R

Q3

R43
1K

R45
100K

LD10

GND GND GND

HB Output

Logic gate provides 5V drive to fully enhance MOSFET gate
and reduce MOSFET Rds(on)

+5V

C27
4.7uF

GND

HEATED_BED

+3V3

U4

A   Vcc
&   Y
B   GND

R50
10R

Q5

V_BED

C28
4.7uF

HB_GND

HB_PWM

R51
1K

R52
100K

LD13

GND GND GND GND HB_GND

FAN0 Output

V_FET

D11

FAN0

F0_PWM

R35
10R

Q1A

R37
1K

R39
100K

LD8

GND GND GND

FAN1 Output

V_FET

D12

FAN1

F1_PWM

R42
10R

Q1B

R44
1K

R46
100K

LD11

GND GND GND

FAN2 Output

V_FET

D13

FAN2

F2_PWM

R47
10R

Q4A

R48
1K

R49
100K

LD12

GND GND GND

PS_ON Output

PS_ON_OUT

PS_ON

R53
10R

Q4B

R54
100K

GND GND

Aus3D

GPLv3
github.com/Aus3D/PicoPrint
www.aus3d.com/picoprint

Revision: 0.3A
Date: 27/11/2017
Drawn: Chris Barr
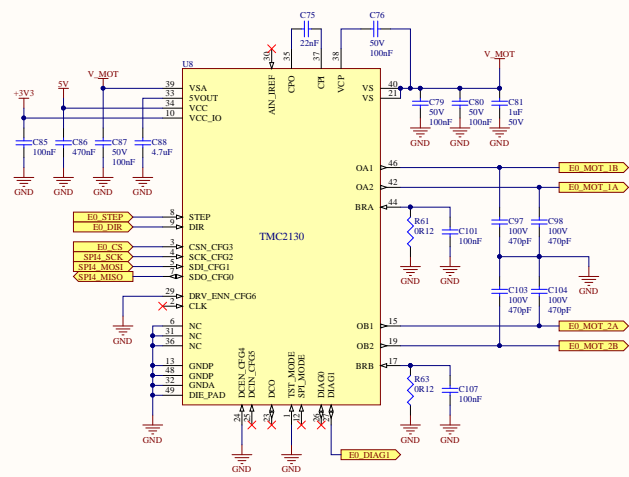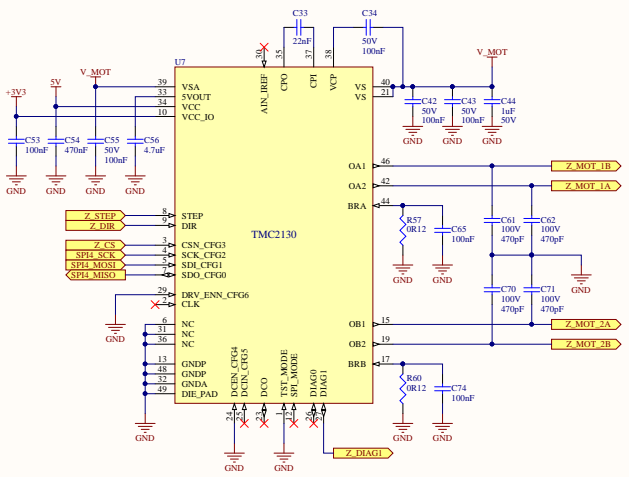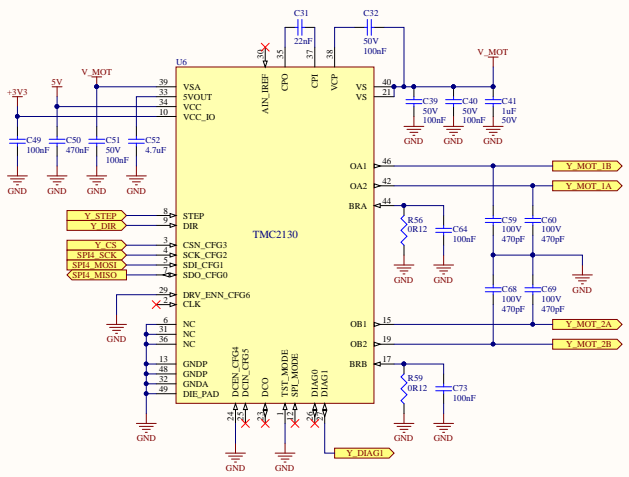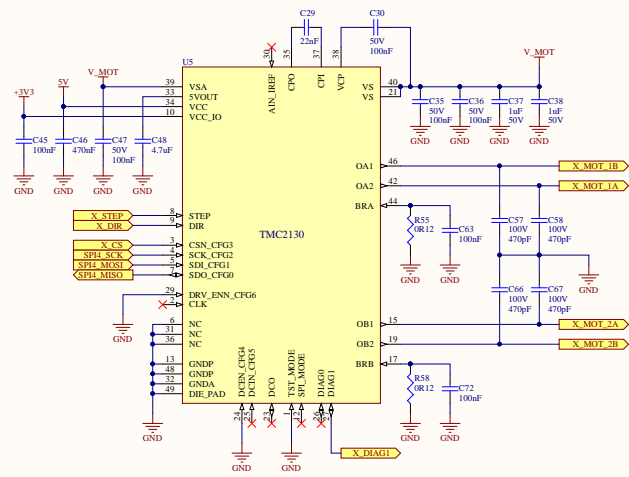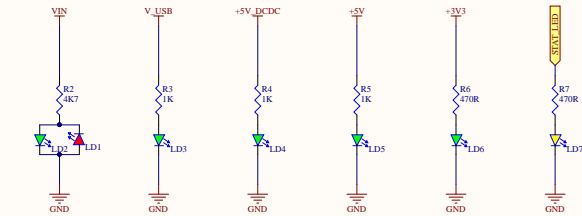Page: 3 of 5

Stepper Drivers

Aus3D

GPLv3
github.com/Aus3D/PicoPrint
www.aus3d.com/picoprint

Revision: 0.3A
Date: 27/11/2017
Drawn: Chris Barr
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Indicator LEDs

VIN R2 4K7 LD2 LD1 GND
V_USB R3 1K LD3 GND
+5V_DCDC R4 1K LD4 GND
+5V R5 1K LD5 GND
+3V3 R6 470R LD6 GND
STAT_LED R7 470R LD7 GND

microSD

+3V3
R16 47K R17 47K R18 10K
USD_CD R19 1K
SPI interface to SD
SPI1_MISO
SPI1_MOSI
SPI1_SCK
USD_CS

U2
CD1 CD1
CD2 CD2
7 DATA_OUT
3 DATA_IN
5 SCLK
2 CS
8 DAT1
1 DAT2
4 VDD
6 VSS
MT1 MT1
MT2 MT2

MICRO-SD
MICROSD

+3V3 C8 4.7uF GND
GND

USB

V_USB
C12 100nF
GND

USB ESD Protection

USB_D- USB_N
USB_D+ USB_P
USB_SHLD
L1
GND

U3
VBUS
IN_1 OUT_1
IN_2 OUT_2
GND
USBLC6 USB ESD Protection

R29 22R USB_D_N USB_DM
R30 22R USB_D_P USB_DP
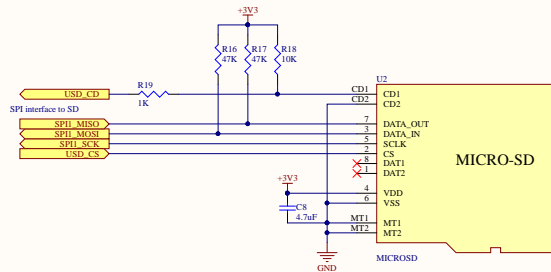
Microcontroller

Pins in **BOLD** are interrupt-capable and will not collide with one another

U1A
23 PA0-WKUP(PA0) F1_PWM
24 PA1 F2_PWM
25 PA2 PWR_MON
26 PA3 Z_PROBE_A
29 PA4 **Z_PROBE_D**
30 PA5 SPI1_SCK
31 PA6 SPI1_MISO
32 PA7 SPI1_MOSI
67 PA8 USD_CD
68 PA9 USART1_TX
69 PA10 USART1_RX
70 PA11 USB_DM
71 PA12 USB_DP
72 PA13(JTMS-SWDIO) SWDIO
76 PA14(JTCK-SWCLK) SWCLK
77 PA15(JTDI)

15 PC0 THERM3_ADC
16 PC1 THERM2_ADC
17 PC2 THERM1_ADC
18 PC3 THERM0_ADC
33 PC4 E1_STEP
34 PC5 E1_DIR
63 PC6 X_STEP
64 PC7 X_DIR
65 PC8 X_CS
66 PC9 BEEPER
78 PC10 BTN_ENC
80 PC11 LCD_RS
7 PC12 E2_STEP
8 PC13 E2_DIR
9 PC14-OSC32_IN(PC14)
10 PC15-OSC32_OUT(PC15) E2_CS

97 PE0 PS_ON
98 PE1 E4_STEP
1 PE2 E4_DIR
2 PE3 E4_CS
3 PE4 E3_DIR
4 PE5 E3_STEP
5 PE6 E3_CS
38 PE7 **E_STOP**
39 PE8 **Z_STOP**
40 PE9 **Y_STOP**
41 PE10 **X_STOP**
42 PE11 E0_CS
43 PE12 SPI4_SCK
44 PE13 SPI4_MISO
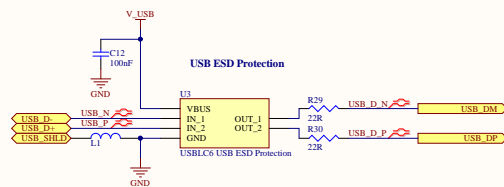45 PE14 SPI4_MOSI
46 PE15 Z_STEP

PB0 35 E1_CS
PB1 36 E0_STEP
PB2-BOOT1(PB2) 37 E0_DIR
PB3(JTDO/TRACESWO) 89 SPI3_SCK
PB4(NJTRST) 90 SPI3_MISO
PB5 91 SPI3_MOSI
PB6 92 SD_CSEL
PB7 93 SD_DET
PB8 95 SCL_1
PB9 96 SDA_1
PB10 47 Z_DIR
PB12 51 PB12
PB13 52 PB13
PB14 53 STAT_LED
PB15 54 USD_CS

PD0 81 BTN_EN2
PD1 82 LCD_D4
PD2 83 LCD_D6
PD3 84 LCD_D5
PD4 85 LCD_D7
PD5 86 KILL
PD6 87 BTN_EN1
PD7 88 LCD_EN
PD8 55 Z_CS
PD9 56 Y_STEP
PD10 57 Y_DIR
PD11 58 Y_CS
PD12 59 HB_PWM
PD13 60 F0_PWM
PD14 61 H1_PWM
PD15 62 H0_PWM

PH0-OSC_IN(PH0) 12
PH1-OSC_OUT(PH1) 13

BOOT0 94 BOOT0
NRST 14 NRST
VCAP_1 48
VCAP_2 73

STM32F446VET6
STM32F446VET6_Big

+3V3
SERVO R14 470R
+3V3 R9 2K2 R10 2K2
R11 100R R12 100R

User Button
Used to stay in bootloader or as user button in application
+3V3 R21 10K S1 User C7 100nF GND

XT1 GND
R23 10K GND
+3V3 R26 10K C11 100nF S2 Reset **Reset Button** GND

U1B
6 VBAT
11 VDD
19 VDD
28 VDD
50 VDD
75 VDD
100 VDD
10 VSS
27 VSS
49 VSS
74 VSS
99 VSS
22 VDDA
21 VREF+
20 VSSA
STM32F446VET6_Big

+3V3
C17 10uF C18 4.7uF C19 100nF C20 100nF C21 100nF C22 100nF C23 100nF
GND

FB1 +3V3
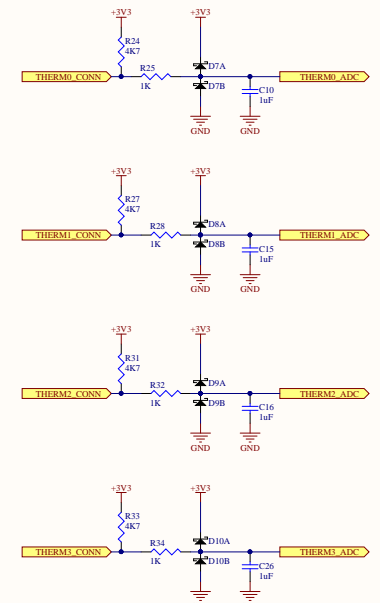C24 100nF C25 4.7uF GND
F1 200mA AGND
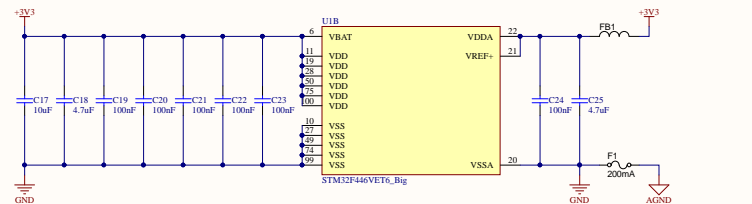
Fuse protects ground-rail if thermistor ground is shorted to any other voltage accidentally

Endstops

Stepper driver DIAG1 pins are connected by default
Unless otherwise configured, they default to open-drain floating outputs
(so should not interfere with regular endstop action)

X_STOP_CONN R1 1K +3V3 D1A D1B C2 100nF X_STOP
X_DIAG1 J3 GND GND

Y_STOP_CONN R8 1K +3V3 D2A D2B C3 100nF Y_STOP
Y_DIAG1 J4 GND GND

Z_STOP_CONN R13 1K +3V3 D3A D3B C4 100nF Z_STOP
Z_DIAG1 J5 GND GND

E_STOP_CONN R15 1K +3V3 D4A D4B C5 100nF E_STOP
E0_DIAG1 J6
E1_DIAG1 J7 GND GND

Z_PROBE_D_CONN R20 1K +3V3 D5A D5B C6 100nF Z_PROBE_D
GND GND

Z_PROBE_A_CONN R22 1K +3V3 D6A D6B C9 100nF Z_PROBE_A
GND GND

Thermistors

THERM0_CONN +3V3 R24 4K7 +3V3 R25 1K D7A D7B C10 1uF THERM0_ADC
GND GND

THERM1_CONN +3V3 R27 4K7 +3V3 R28 1K D8A D8B C15 1uF THERM1_ADC
GND GND

THERM2_CONN +3V3 R31 4K7 +3V3 R32 1K D9A D9B C16 1uF THERM2_ADC
GND GND

THERM3_CONN +3V3 R33 4K7 +3V3 R34 1K D10A D10B C26 1uF THERM3_ADC
GND GND

Aus3D
GPLv3
github.com/Aus3D/PicoPrint
www.aus3d.com/picoprint

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4 x M3 mounting holes
MH1 MH2 MH3 MH4
OSH_LOGO1
OSH_LOGO