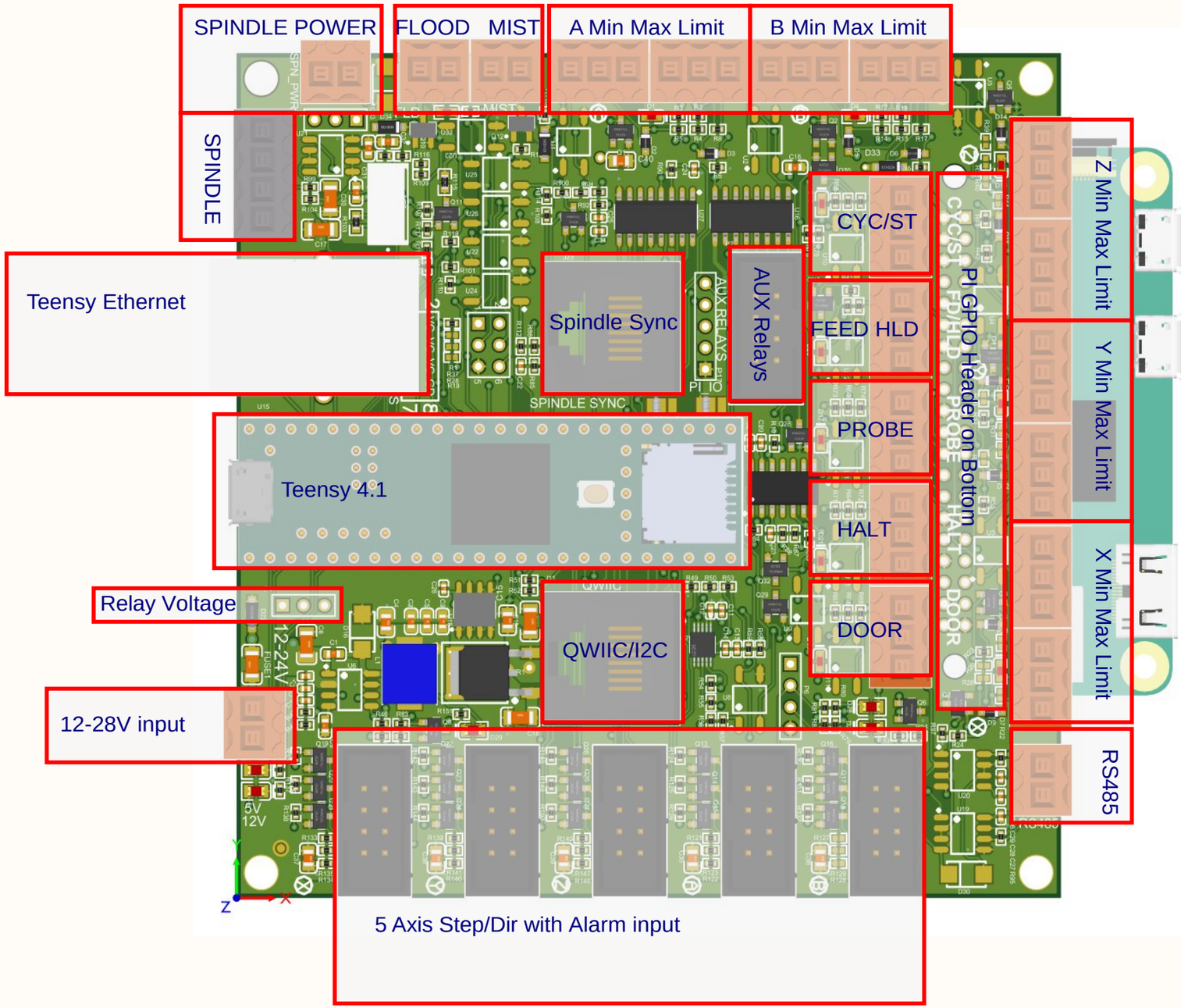
GRBLHAL2000 Breakout



Mechanical

PCB
LOGO
Expatria Technologies

FID1 FID2 FID3

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Port Coquitlam, BC V3B 1R5
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SHEET: Title Sheet		
PROJECT: PrintNC_GRBLHAL_Breakout.PrjPCB		REV: A.7
ENGR: AM	DOCUMENT: Title Sheet.SchDoc	
SIZE: B	MODIFIED: 2021-07-25 1:52:35 PM	SHEET: 1 / 14

Top Level Design

No nets on these pages

U_Title Sheet
Title Sheet.SchDoc

U_Change Log
Change Log.SchDoc

U_PrintNC_BREAKOUT
PrintNC_CNC_Breakout.SchDoc

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SHEET	Top Level Design	
PROJECT	PrintNC_GRBLHAL_Breakout.PrjPCB	REV A
ENGR AM	DOCUMENT Top Level.SchDoc	
SIZE B	MODIFIED 2021-07-25 1:52:35 PM	SHEET 2 / 14

HAL2000 Breakout

12-28V input
P3
WJ15EDGVC-3.5-2P
FUSE1
24V 1A
+24V
C18
10uF
VR1
L78M12ABDT-TR
+12V
C19
10uF
C15
22uF
C40
22uF
D24
0805 Green
R78
10KΩ ±1%
5V_Supply
5V_Power_Supply.SchDoc
PWR_IN_24V
POWER_OUT_5V
+5V
D23
0805 Green
R77
1.2KΩ ±1%
RELAY_VCC
+5V
P4
Header 3
Relay Voltage Selector
D22
SMAZ27-13-F
Change R to dim power LEDs.

+5V
L2
0Ω ±1%
STEPPER_VCC
+12V
L3
0Ω ±1% DNI

STP_X
Stepper_driver.SchDoc
STEP
DIR
ENABLE
ALARM_5V_n
STEP_X
DIR_X
STP_EN
STP_ALARM_5V_n
STP_Y
Stepper_driver.SchDoc
STEP_Y
DIR_Y
STP_EN
STP_ALARM_5V_n
STP_Z
Stepper_driver.SchDoc
STEP_Z
DIR_Z
STP_EN_Z
STP_ALARM_5V_n
STP_A
Stepper_driver.SchDoc
STEP_A
DIR_A
STP_EN
STP_ALARM_5V_n
STP_B
Stepper_driver.SchDoc
STEP_B
DIR_B
STP_EN
STP_ALARM_5V_n

LIM_SW
Limit_Switches.SchDoc
X_LIM
Y_LIM
Z_LIM
A_LIM
B_LIM
USR_SW
Misc_switches.SchDoc
HALT
FD/HLD
PROBE
CYC/ST
DOOR
SPINDLE
Spindle_Control.SchDoc
SPINDLE_PWM
SPINDLE_DIR
SPINDLE_EN
COOLANT
MIST

FRAM storage
U18
A0
A1
A2
WP
SCL
SDA
VCC
VSS
FM24W256-GTR
+3.3V
C26
1.0uF

U16
AUX3
AUX2
AUX1
AUX0
IN1
IN2
IN3
IN4
IN5
IN6
IN7
GND
OUT1
OUT2
OUT3
OUT4
OUT5
OUT6
OUT7
COM
AUX3_RLY
AUX2_RLY
AUX1_RLY
AUX0_RLY
ULN2003AFWG
P2
C9135
VCC_RLY
C16
100nF
R75
0Ω ±1%
RELAY_VCC
+5V
500mA total maximum relay current.

EXT_KEYPAD
I2C_Keypad.SchDoc
SCL
SDA
HALT
KPSTR
SPINDLE_SYNC
Spindle_Sync.SchDoc
Use existing buffer for voltage conversion
A_INDEX_5V
Z_PULSE_5V
B_5V
EXT_IN2
EXT_IN3
EXT_IN1
QEI_B_PIN
EXT_IN0
QEI_A_PIN
J17

Note that Reset is unused in GRBLHAL software, in that code Reset==Halt
GRBL assumes NC switches.

U15
TEENSY_4.1
+5V
+3.3V
VIN
DIR_Y
PROGRAM
RESET
ON/OFF
RXD_EXT
TXD_EXT
DIR_Z
STEP_A
B_LIM
DOOR
RXD_INT
TXD_INT
QEI_B_PIN
EXT_IN1_BUF
SPINDLE_INDEX
QEI_SEL_PIN
EXT_IN2_BUF
DIR_X
STEP_Y
AUX2
SPINDLE_PWM
SPINDLE_PULSE
EXT_IN3_BUF
PROBE
FD/HLD
CYC/ST
MIST
COOLANT
X_LIM
Y_LIM
Z_LIM
LED
ELED
T-
T+
R-
R+
D+
D-
OUT2
OUT1D
OUT1C
OUT1B
CS3
CS2
CS1
MISO
MOSI
A17
A16
A15
A14
A13
A12
A11
A10
A9
GND
USB_GND
STEP_X
STEP_Z
DIR_A
AUX1
AUX0
EXT_IN0_BUF
QEI_A_PIN
STP_EN
SPINDLE_EN
SPINDLE_DIR
KPSTR
HALT
STP_EN_Z
AUX3
DIR_B
STEP_B
SDA
SCL
A_LIM
GND1
GND2
GND3
GND4
GND5
USB_GND1
USB_GND2
Pinout modified from GRBLHAL source

P1
Magjack
ET_p
ET_n
ER_p
ER_n
ELED
C17
100nF

D27
0805 Red
D28
0805 Green
R79
4.7KΩ ±1%
R80
5.6KΩ ±1%
MMBT5401 2L
Q6
MMBT5401 2L
Q7
R81
51KΩ ±1%
R82
51KΩ ±1%
TXD_EXT
RXD_EXT

Option to flip polarity
U17E
74HC14D
J24
STP_ALARM
STP_ALARM_5V_n
Closed loop driver switch type is NO.
R84
10KΩ ±1%
C20
100nF
U17F
74HC14D
R7
0Ω ±1%
R9
10KΩ ±1%
Q8
MMBT5551 G1
D29
0805 Blue
R151
2KΩ ±1%
Choices for postion error action (already have pullup)
DOOR
B_LIM
HALT
FD/HLD
J18
J19
J20
J21
User switch type is NO (Active Low) if combined with closed loop stepper.

MODBUS
RS485.SchDoc
RXD
TXD
A
B
P5
WJ15EDGVC-3.5-2P
P6
Header 4
P17
Header 5
PI_GPIO2
PI_GPIO1
PI_GPIO0
PI+3.3V

Inverter as Scmitt trigger isn't ideal, but is JLC basic part and polarity should be configurable in SW
P7
Header 3X2
EXT_IN0
EXT_IN1
EXT_IN2
EXT_IN3
C21
1.0uF
U17A
74HC14D
U17B
74HC14D
U17C
74HC14D
U17D
74HC14D
R85
100KΩ ±1%
R86
510Ω ±1%
C22
10nF
R87
100KΩ ±1%
R88
510Ω ±1%
C23
10nF
R89
100KΩ ±1%
R90
510Ω ±1%
C24
10nF
R91
100KΩ ±1%
R92
510Ω ±1%
C25
10nF
EXT_IN0_BUF
EXT_IN1_BUF
EXT_IN2_BUF
EXT_IN3_BUF

D33
B5819W SL
A1
ADA3708
PI+3.3V
SDA
SCL
CYC/ST
SPINDLE_EN
KPSTR
EXT_IN3_BUF
AUX0
AUX1
AUX2
AUX3
HALT
RXD_INT
TXD_INT
PI_GPIO2
FD/HLD
PI_GPIO1
PI_GPIO0
EXT_IN2_BUF
EXT_IN1_BUF
EXT_IN0_BUF
DOOR

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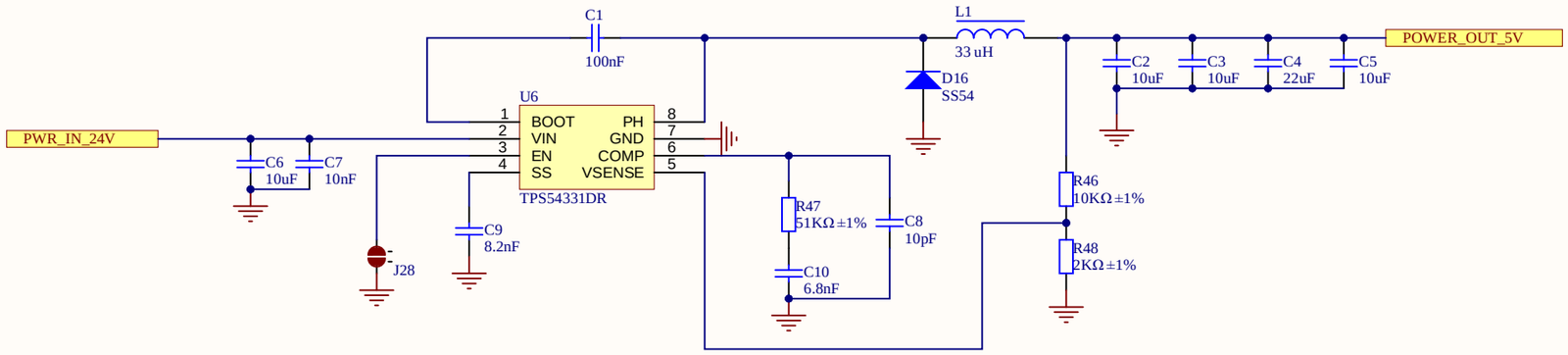
SHEET	PNC Teensy Breakout
PROJECT	PrintNC_GRBLHAL_Breakout.PrjPCB
REV	A.1
ENGR	AM
DOCUMENT	PrintNC_CNC_Breakout.SchDoc
SIZE	C
MODIFIED	2021-07-25 1:52:35 PM
SHEET	3 / 14

5V Power Supply



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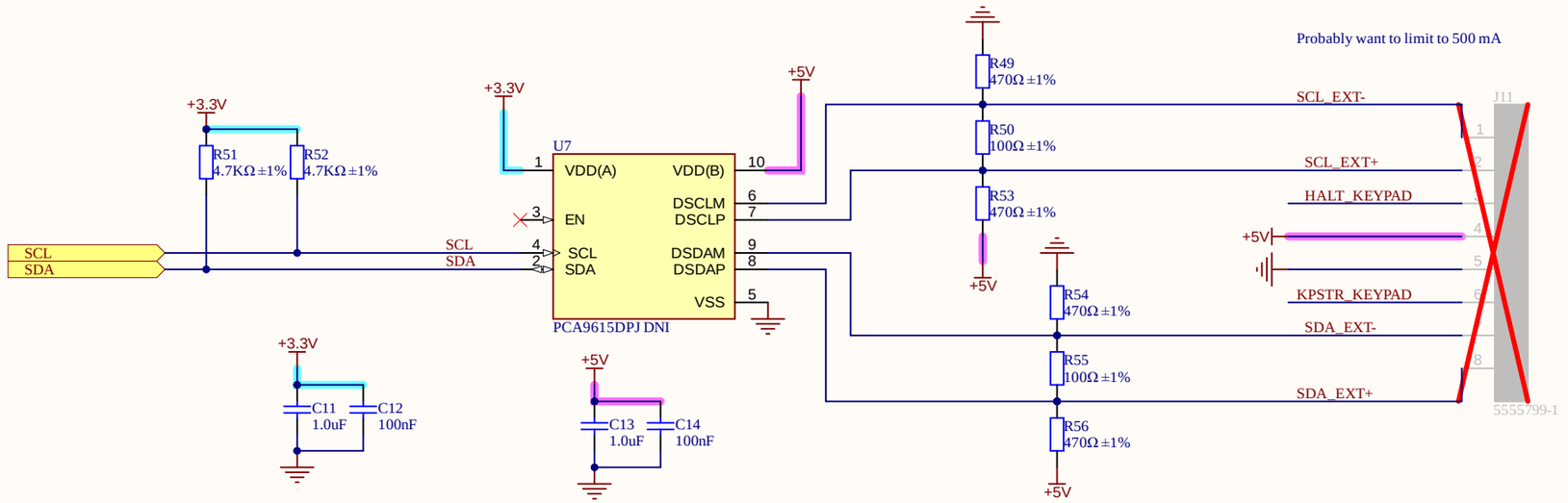
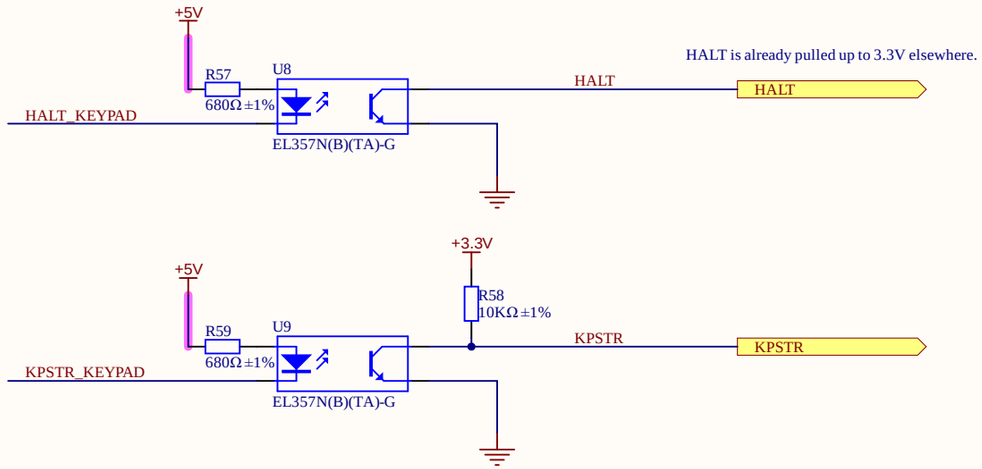
SHEET	5V power regulator
PROJECT	PrintNC_GRBLHAL_Breakout.PrjPCB
REV	A
ENGR	AM
DOCUMENT	5V_Power_Supply.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:35 PM
SHEET	4 / 14

QWIIC I2C Keypad

This should be a QWIIC compatible endpoint but adds KPSTR and HALT to the RJ45. All appropriate credit to Sparkfun for QWIIC.





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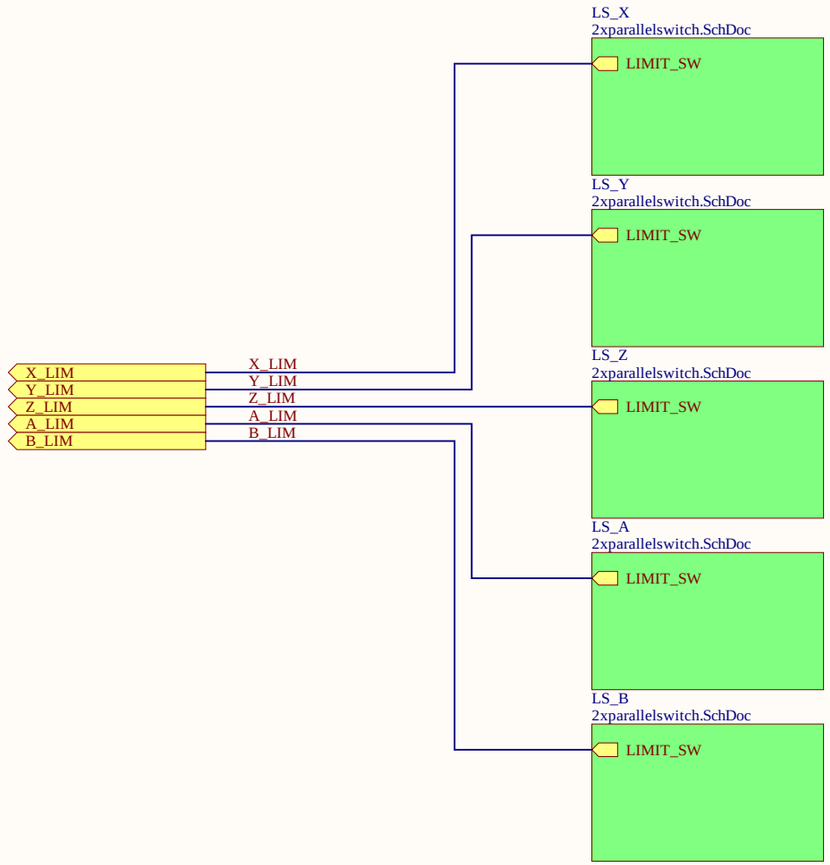
SHEET	QWIIC I2C Keypad		
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB	REV	A
ENGR	AM	DOCUMENT	I2C_Keypad.SchDoc
SIZE	B	MODIFIED	2021-07-25 1:52:35 PM
SHEET	13 of 14		

Limit Switches



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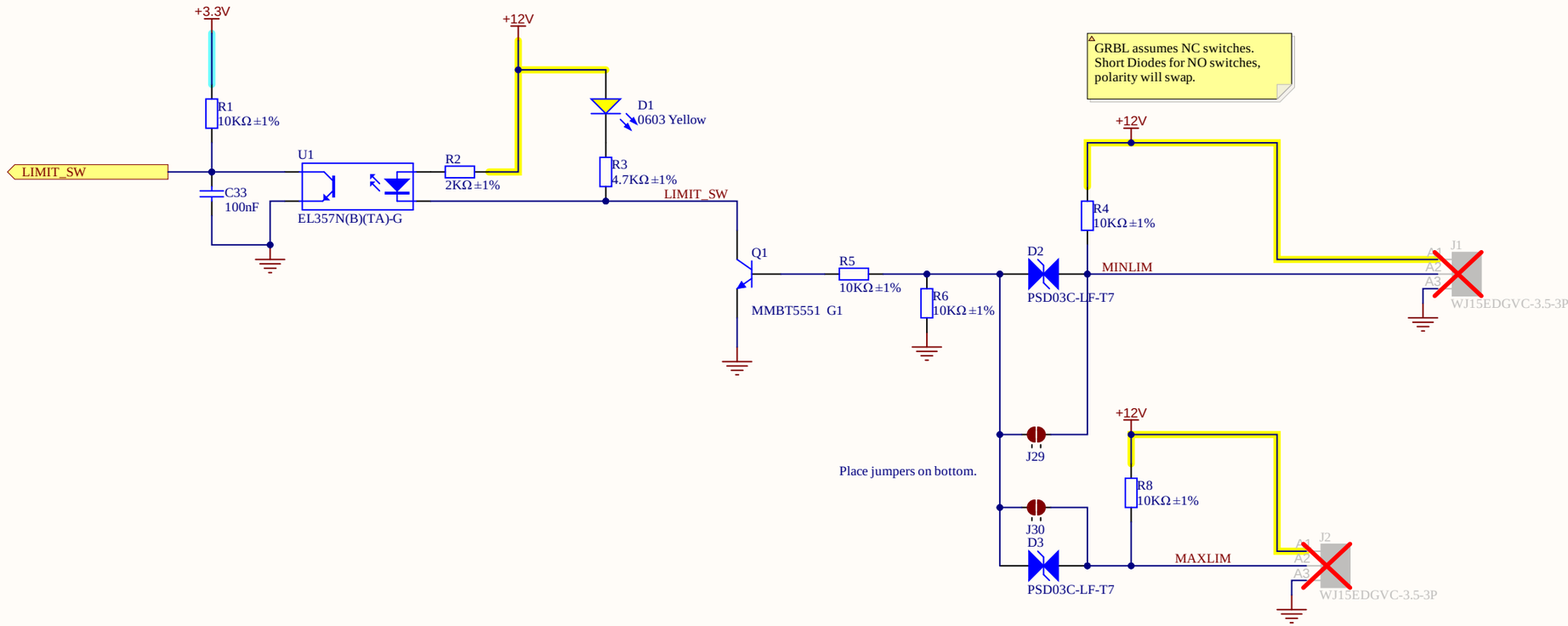
SHEET	Limit Switches
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A2
ENGR	AM
DOCUMENT	Limit_Switches.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:35 PM
SHEET	5 / 14

Limit Switch OR



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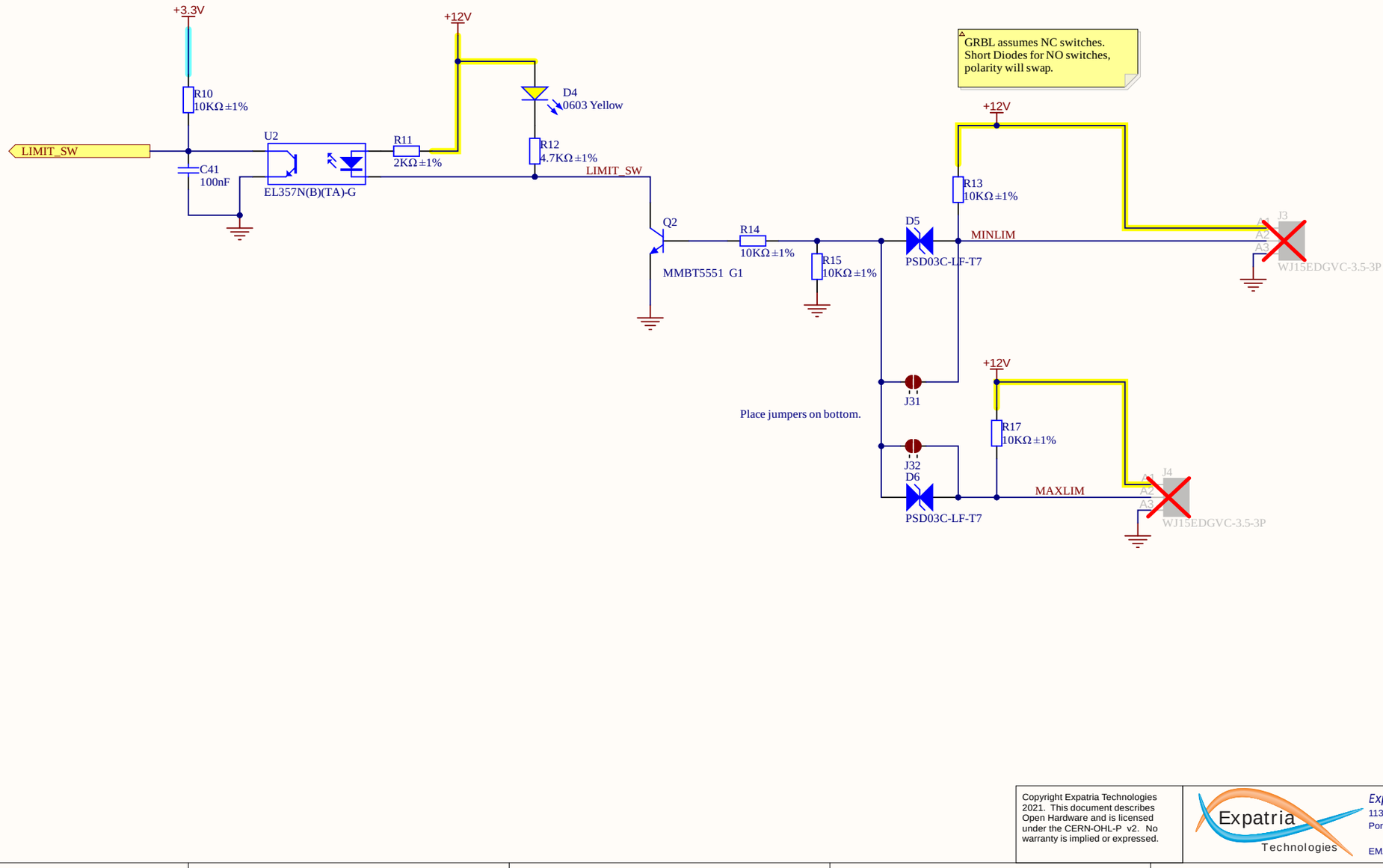
SHEET	Limit Switch OR
PROJECT	PrintNC_GRBLHAL_Breakout.PrjPCB
REV	A
ENGR	AM
DOCUMENT	2xparallelswitch.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:35 PM
SHEET	6 / 14

Limit Switch OR



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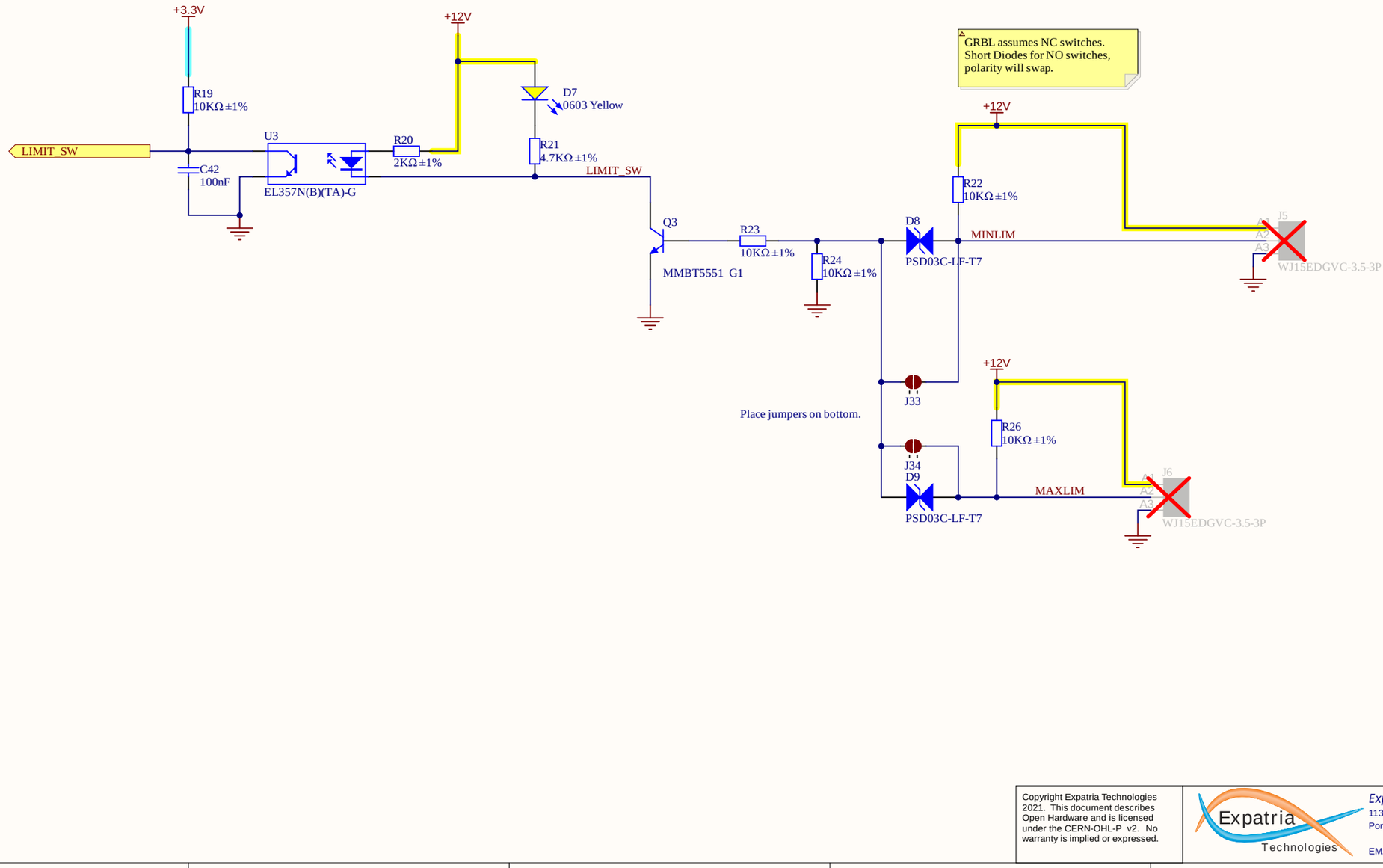
SHEET	Limit Switch OR
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A
ENGR	AM
DOCUMENT	2xparallelswitch.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:35 PM
SHEET	6 / 14

Limit Switch OR



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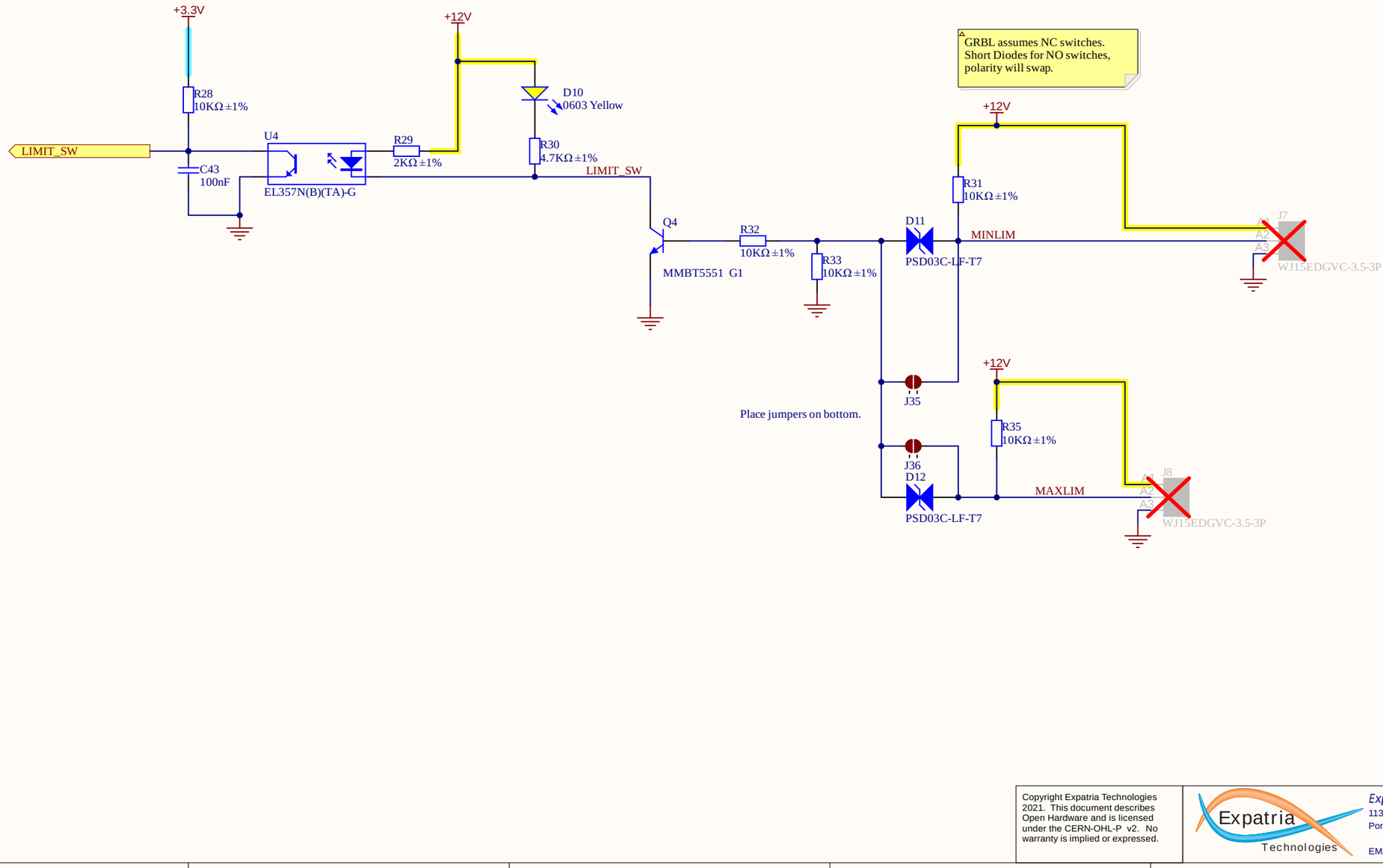
SHEET	Limit Switch OR
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A
ENGR	AM
DOCUMENT	2xparallelswitch.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:35 PM
SHEET	6 / 14

Limit Switch OR



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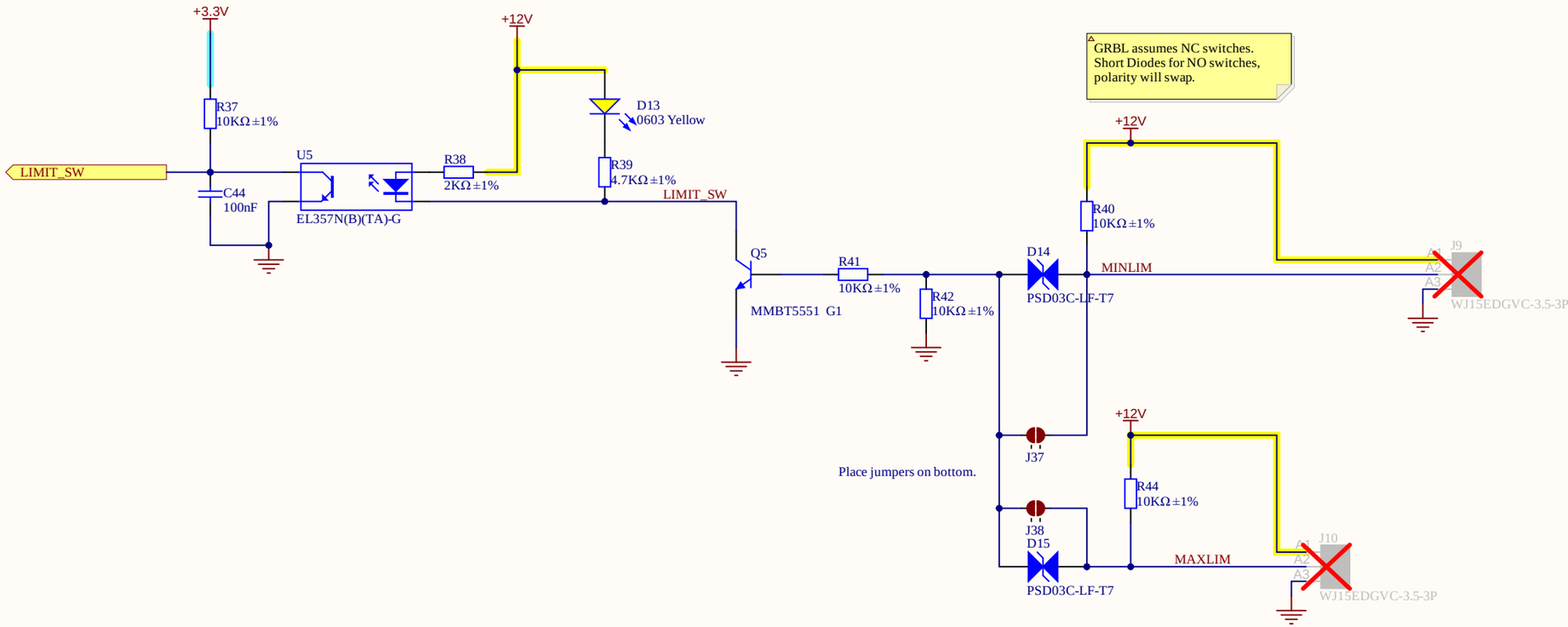
SHEET	Limit Switch OR
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A
ENGR	AM
DOCUMENT	2xparallelswitch.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:35 PM
SHEET	6 / 14

Limit Switch OR



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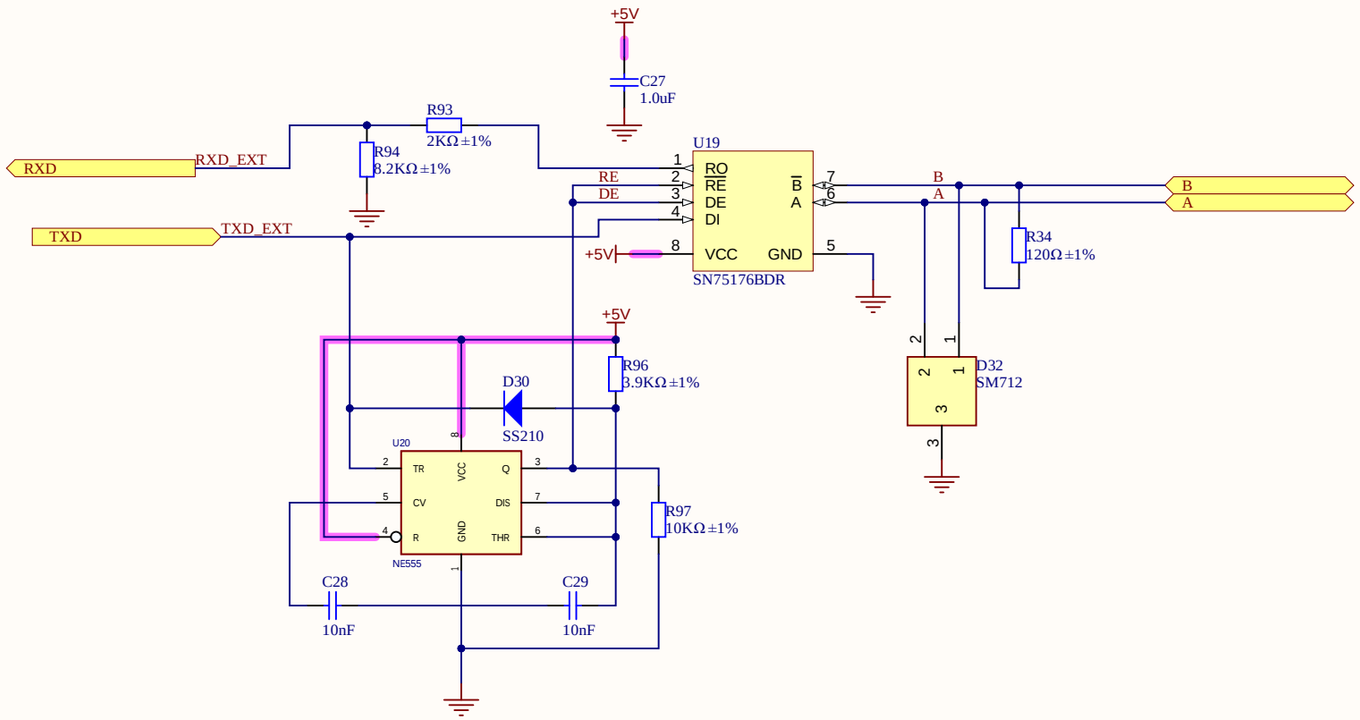
SHEET	Limit Switch OR
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A
ENGR	AM
DOCUMENT	2xparallelswitch.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:35 PM
SHEET	6 / 14



Auto direction circuit from Bryan Varner pi485 project used under MIT license. Thank you!

https://github.com/bvarner/pi485

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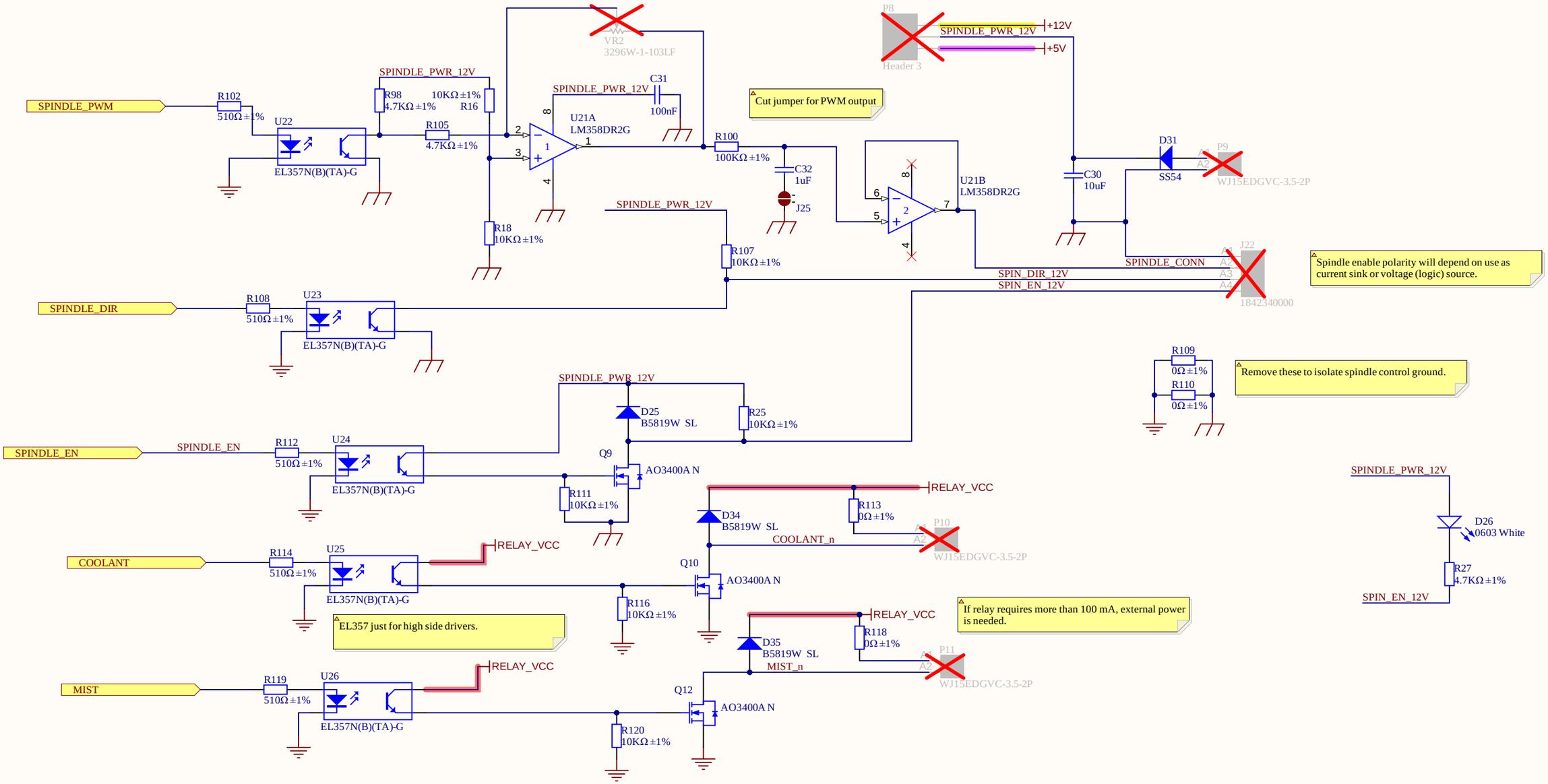
SHEET	Spindle_Sync
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A2
ENGR	AM
DOCUMENT	RS485.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:35 PM
SHEET	11/ 14

Spindle Controls



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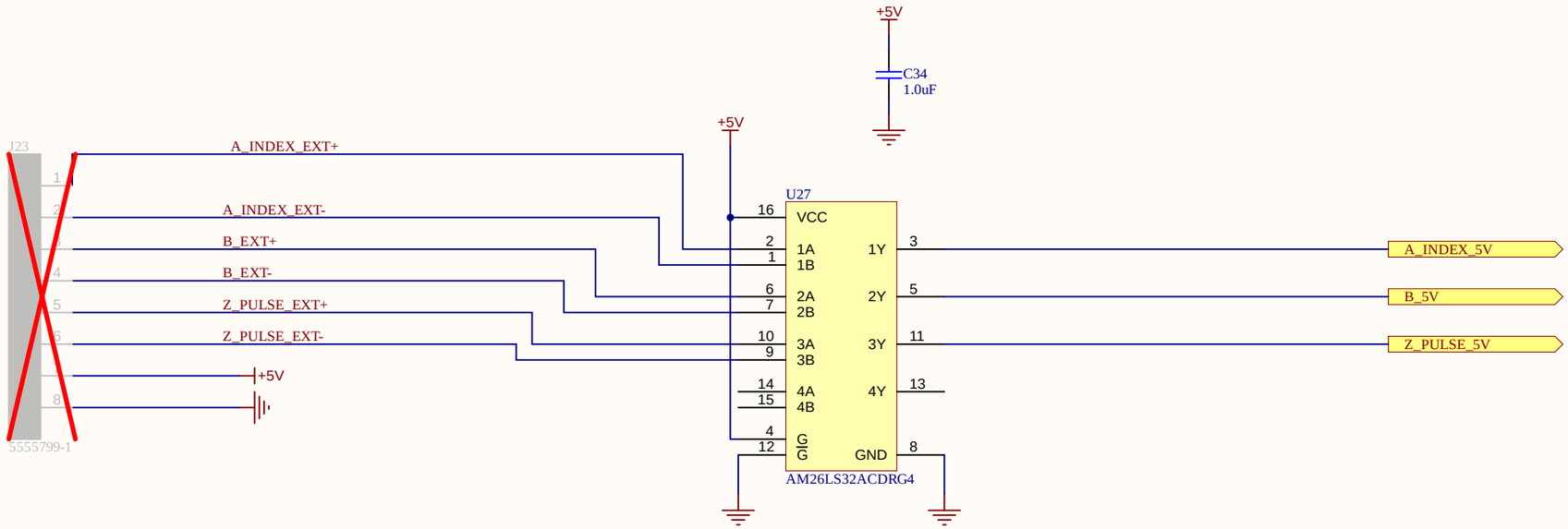
SHEET	Spindle Control
PROJECT	PrintNC_GRBLHAL_Breakout.PrjPCB
REV	A2
ENGR	AM
DOCUMENT	Spindle_Control.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:35 PM
SHEET	10 of 14



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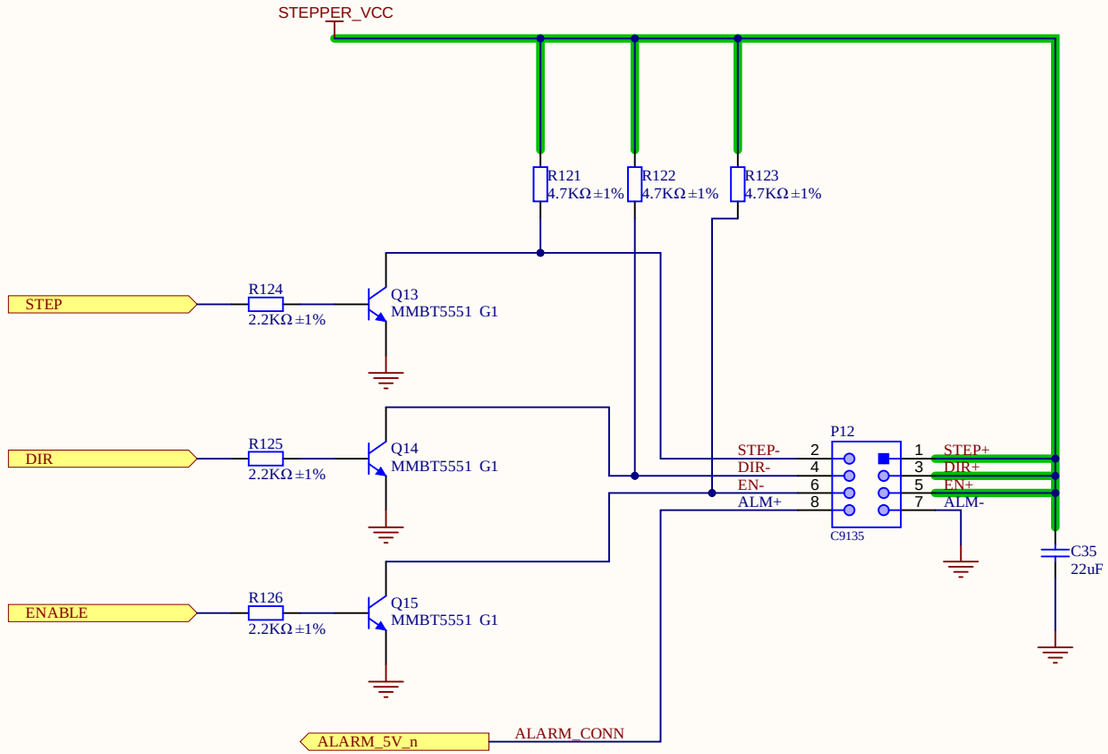
SHEET	Spindle_Sync
PROJECT	PrintNC_GRBLHAL_Breakout.PrjPCB
REV	A
ENGR	AM
DOCUMENT	Spindle_Sync.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:35 PM
SHEET	12 / 14

Stepper Driver



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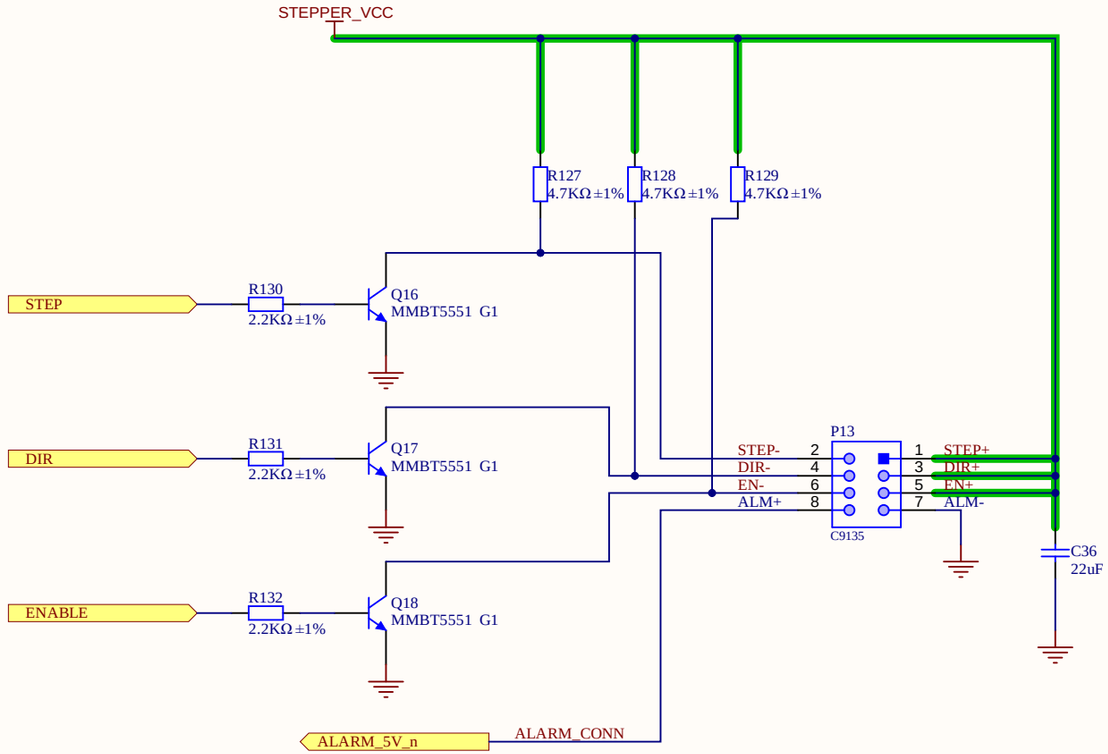
SHEET	Stepper Driver
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A
ENGR	AM
DOCUMENT	Stepper_driver.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:36 PM
SHEET	9 / 14

Stepper Driver



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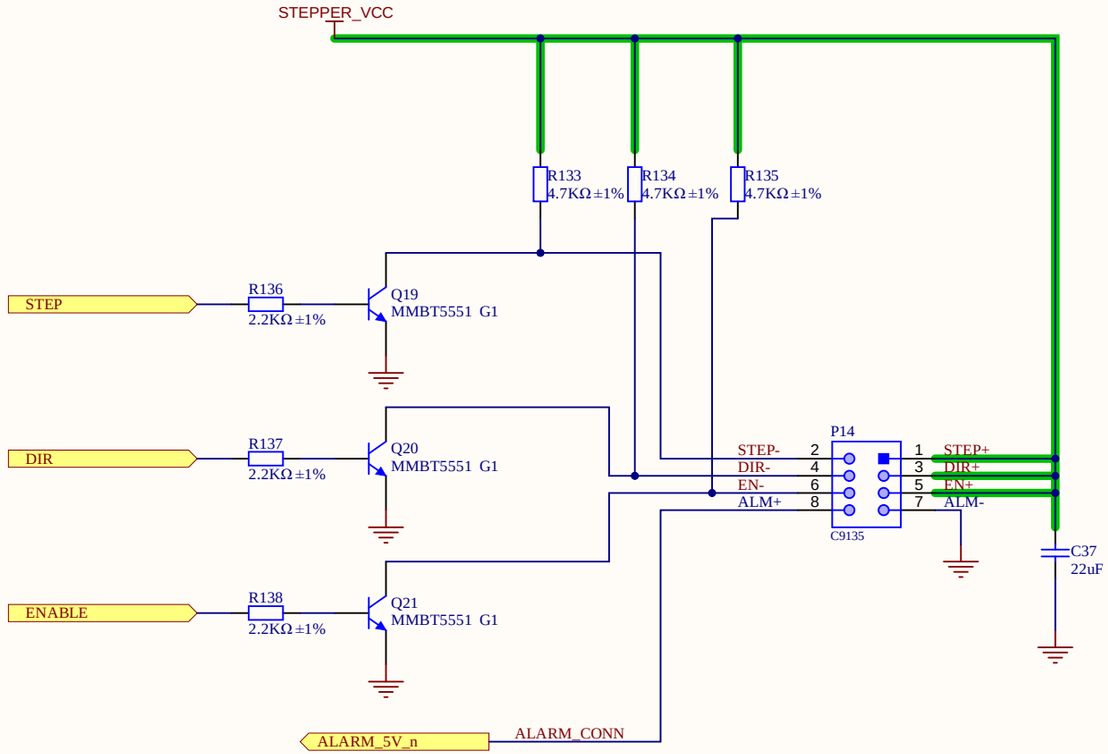
SHEET	Stepper Driver
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A
ENGR	AM
DOCUMENT	Stepper_driver.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:36 PM
SHEET	9 / 14

Stepper Driver



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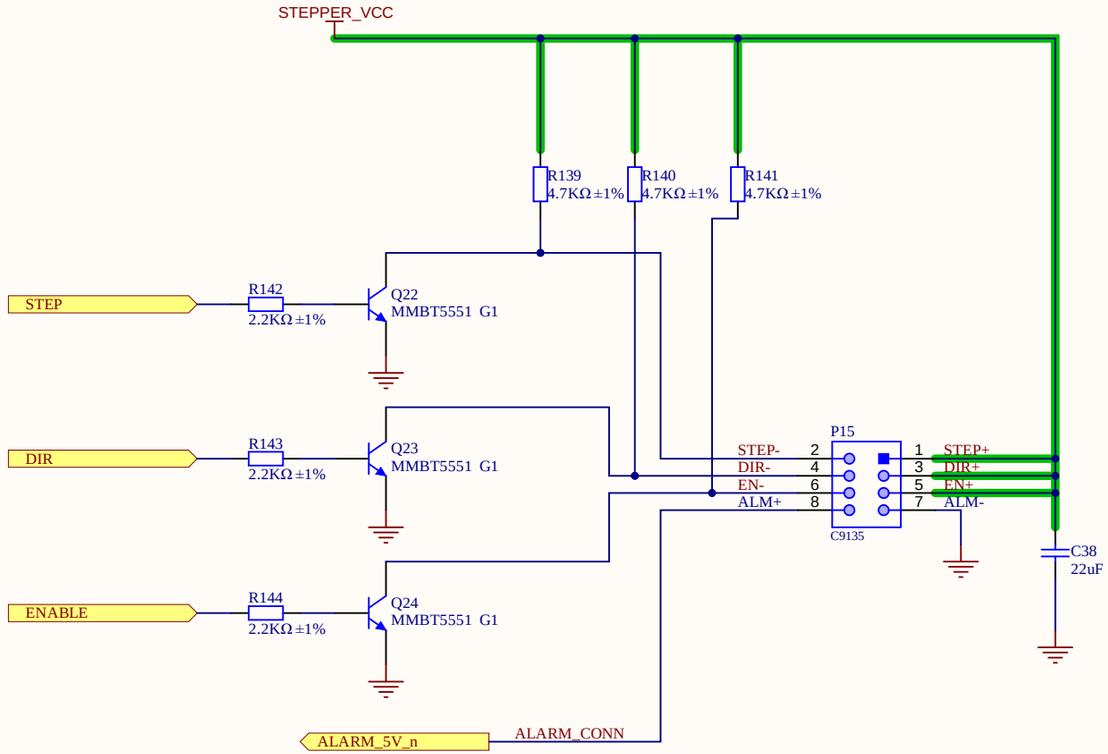
SHEET	Stepper Driver
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A
ENGR	AM
DOCUMENT	Stepper_driver.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:36 PM
SHEET	9 / 14

Stepper Driver



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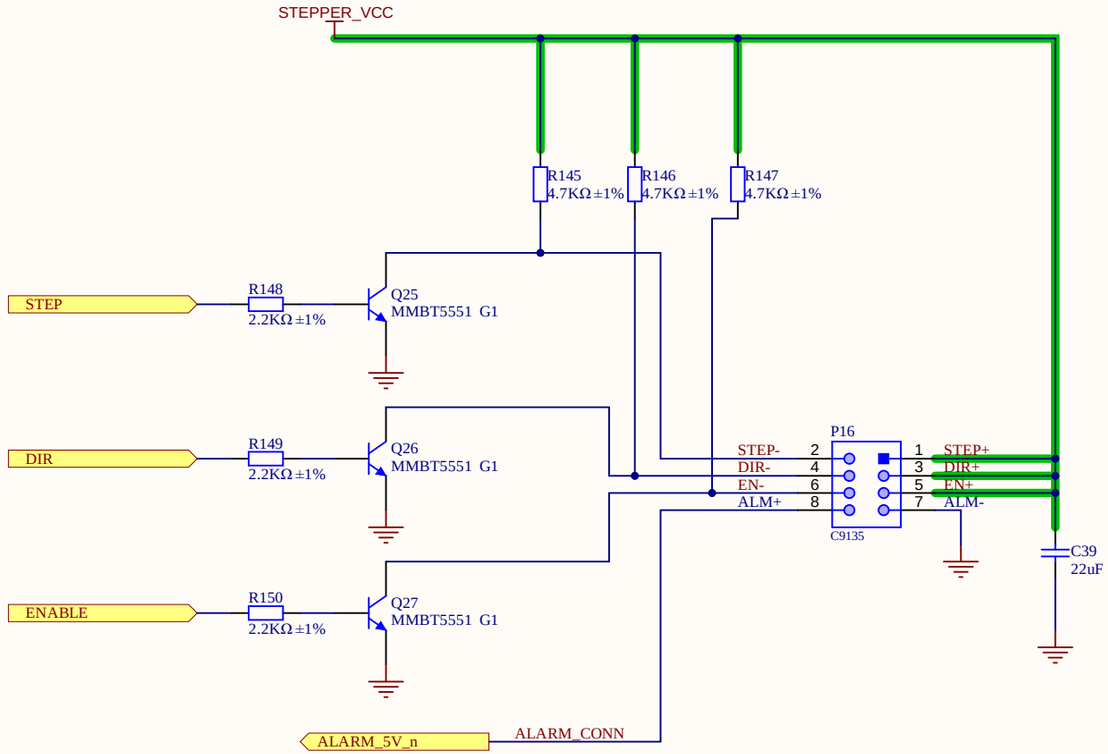
SHEET	Stepper Driver
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A
ENGR	AM
DOCUMENT	Stepper_driver.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:36 PM
SHEET	9 / 14

Stepper Driver



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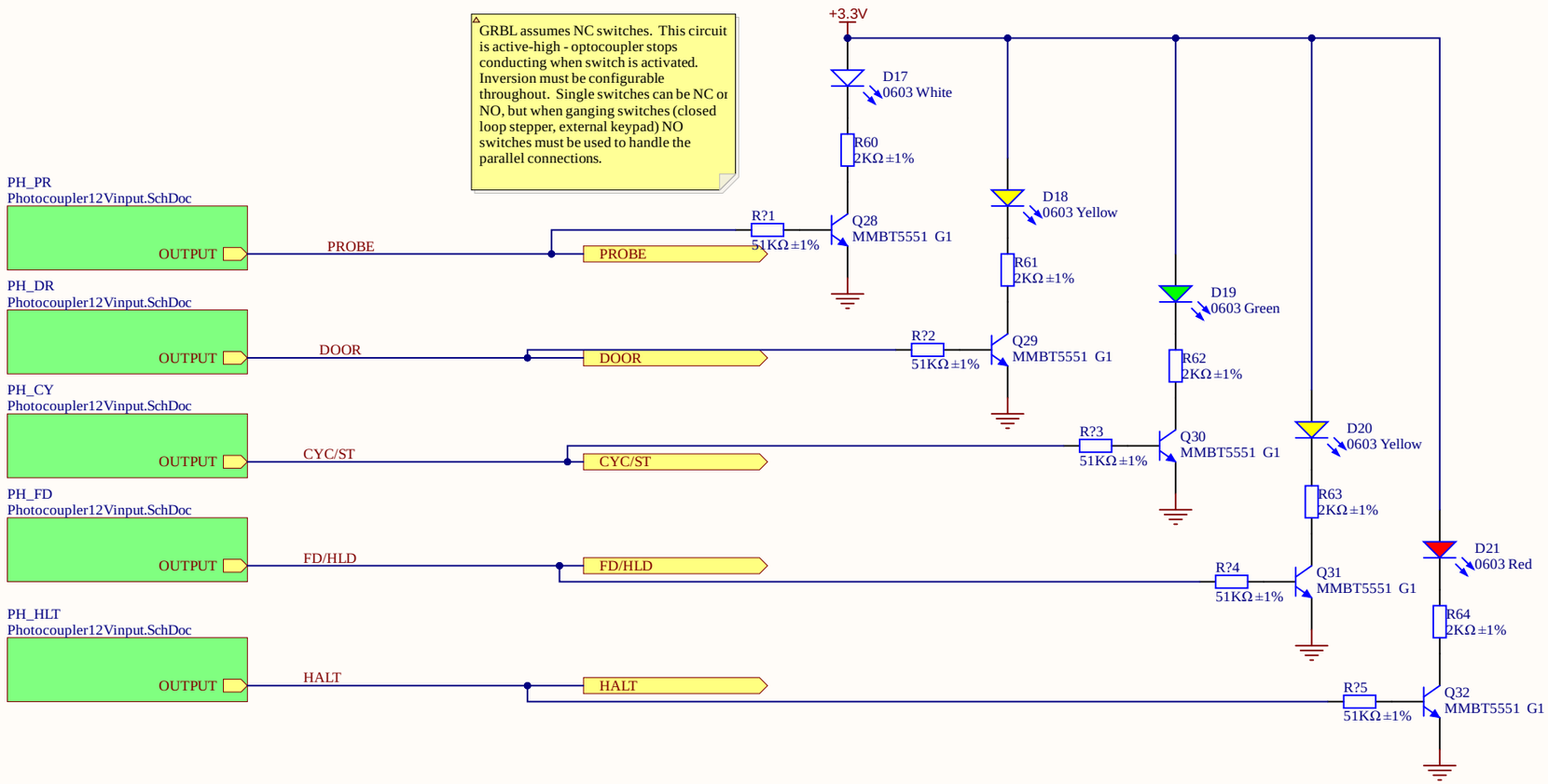
SHEET	Stepper Driver
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A
ENGR	AM
DOCUMENT	Stepper_driver.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:36 PM
SHEET	9 / 14

User Switches

GRBL assumes NC switches. This circuit is active-high - optocoupler stops conducting when switch is activated. Inversion must be configurable throughout. Single switches can be NC or NO, but when ganging switches (closed loop stepper, external keypad) NO switches must be used to handle the parallel connections.



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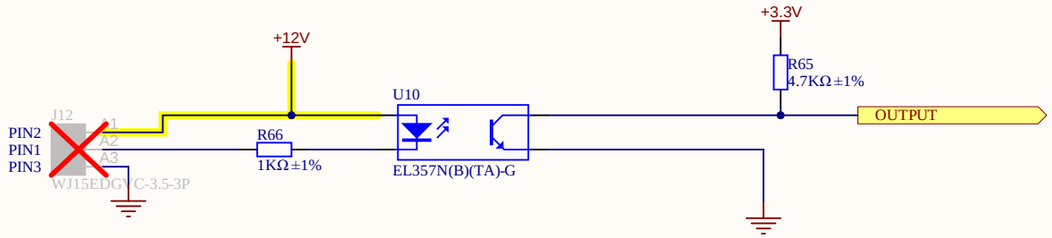
SHEET	Misc Switches
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB
REV	A2
ENGR	AM
DOCUMENT	Misc_switches.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:36 PM
SHEET	7 / 14

Photo Coupler 12V input

GRBL assumes NC switches. For that reason this circuit is active-high - U2 stops conducting when switch is activated. Inversion must be configurable throughout.



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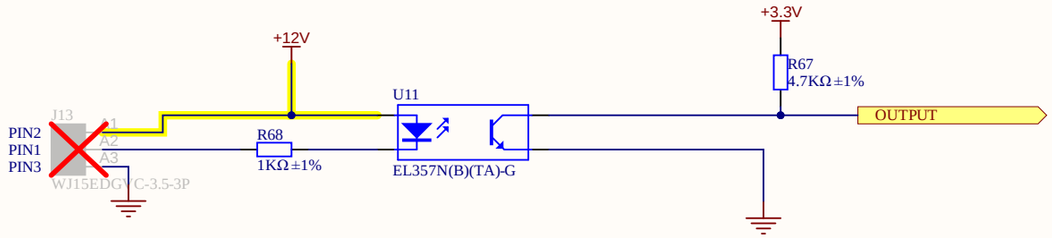
EMAIL: INFO@EXPATRIA.CA

SHEET	Coupler 12V input
PROJECT	PrintNC_GRBLHAL_Breakout.PrjPCB
REV	A
ENGR	AM
DOCUMENT	Photocoupler12Vinput.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:36 PM
SHEET	8 / 14

Photo Coupler 12V input

GRBL assumes NC switches. For that reason this circuit is active-high - U2 stops conducting when switch is activated. Inversion must be configurable throughout.



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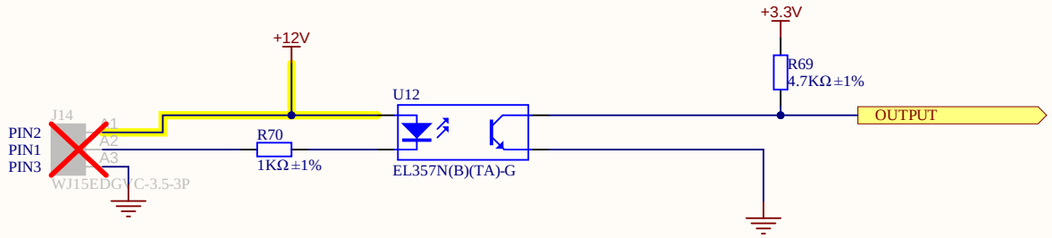
SHEET	Coupler 12V input
PROJECT	PrintNC_GRBLHAL_Breakout.PrjPCB
REV	A
ENGR	AM
DOCUMENT	Photocoupler12Vinput.SchDoc
SIZE	B
MODIFIED	2021-07-25 1:52:36 PM
SHEET	8 / 14

Photo Coupler 12V input

GRBL assumes NC switches. For that reason this circuit is active-high - U2 stops conducting when switch is activated. Inversion must be configurable throughout.



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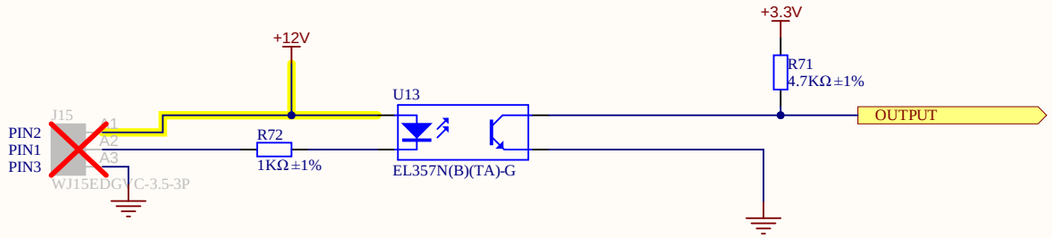

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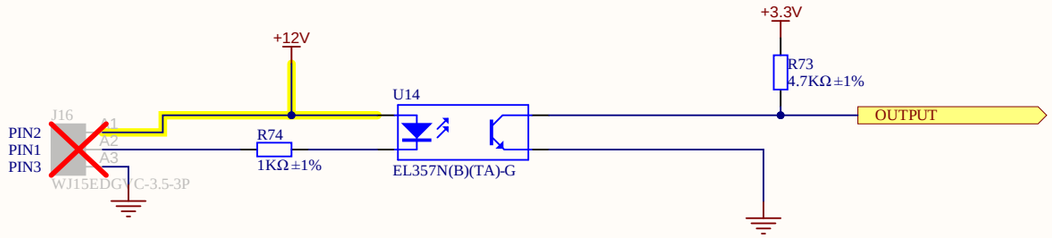

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SHEET	8 / 14

Change Log

Date	Revision	Description
6/08/2021	A1	Initial release of schematic.
6/16/2021	A2	Isolated 12V from relays. Added option to power relays from main input. Removed redundant 12V input Removed redundant LED Added additional 12V capacitance Replaced reverse didode with fuse and OV diode. Replaced switch diode resistors with jumpers. Updated component values Simplified closed loop controls Updated spindle control 0-10V. Removed spindle PWM for dual-amp DAC.
6/27/2021	A3	Layout updates.

Date	Revision	Description

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SHEET	Change Log		
PROJECT	PrintNC_GRBLHAL_BreakoutPrjPCB	REV	A2
ENGR	AM	DOCUMENT	Change Log.SchDoc
SIZE	B	MODIFIED	2021-07-25 1:52:36 PM
		SHEET	14 / 14