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Phase measurements

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Power supply and break functionality

Design Overview

MCU and interfaces

CAN interface	Socket(s) for LPCXpresso
USB-device interface	PLCC44 socket
UART-to-USB bridge	SWD/JTAG interface (for PLCC44 socket)
RS485 interface	Reset generation
Ethernet interface	OLED
	Joystick

Interface to motor elect.

Interface signals has "C-" prefix

← Jumpers

→ Interface signals has "E-" prefix

Connector to external controller

Motor electronics

Input voltage protection
Power supply: +11V, +5V, +3.3V
Temperature sensor

4-phase drivers
Current measurement
Voltage measurement
Sensor inputs

Schematic page 2-5

Schematic page 6

Schematic page 7-11

UL = UnLoaded = normally not mounted component.

Default jumper settings are indicated in the schematic.
However, always check jumper positions on actual boards
since there is no guarantee that all jumpers are in default place.

Rev B update

Changed PRL5819 diodes to PMEG4030ER.

Rev B

Added jumper to select VBUS on BEMFA signal.
Changed R143 to UL and R101/104/106 to 100R.
Added R146 10K, JP11 (GND connector) and C52.
Added "Digital phase voltage measurements" (U27-29).
Changed R108-110 to 39K and R111 to 1K2.
Swaped signal C-VZERO and C-BEMFC for LPC176x control.
Split J14 into J14 and J16.



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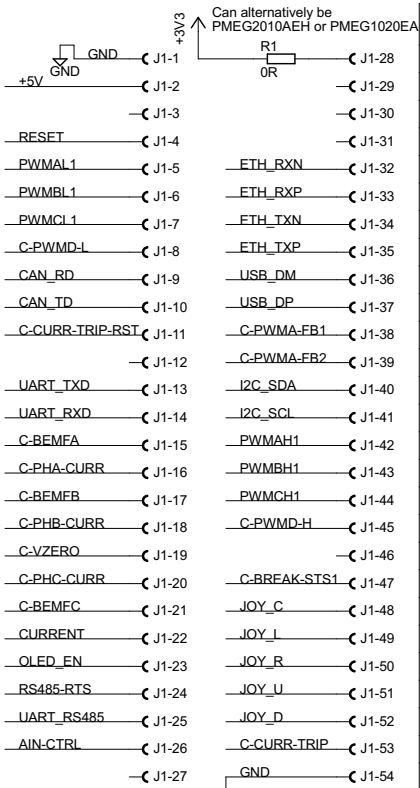
Sheet: 1/11

Sockets for LPCXpresso (LPC11x14 / LPC1343 / LPC1768 / LPC1549)

LPCXpresso LPC1549 / LPC1768

Dual row holes (2x27), 100 mil spacing

LPC1768	LPC1549
GND	GND
VIN (4.5-5.5V)	VIN (4.5-5.5V)
not used	VBAT
RESET_N	RESET / PIO0_21
P0.9 / MAT2.3	PIO0_6 / SCT0_OUT0
P0.8 / MAT2.2	PIO0_26 / SCT0_OUT2
P0.7 / MAT2.1	PIO0_1 / SCT0_OUT4
P0.6 / MAT2.0	PIO0_0 / SCT1_OUT3
P0.0 / RD1	PIO0_11 / CAN_RD
P0.1 / TD1	PIO0_31 / CAN_TD
P0.18	PIO0_28
P0.17	not connected
P0.15 / TXD1	PIO0_18 / ISP_TX
P0.16 / RXD1	PIO0_13 / ISP_RX
P0.23 / AD0.0	PIO0_9 / ADC1_1
P0.24 / AD0.1	PIO0_4 / ADC0_4
P0.25 / AD0.2	PIO0_10 / ADC1_2
P0.26 / AD0.3	PIO0_5 / ADC0_3
P1.30 / AD0.4	PIO0_16 / ADC1_9
P1.31 / AD0.5	PIO0_7 / ADC0_1
P0.2 / AD0.7	PIO1_3 / ADC1_5
P0.3 / AD0.6	PIO0_8 / ADC0_0
P0.21	PIO1_2
P0.22 / RTS1	PIO1_10
P0.27	PIO1_9
P0.28	PIO0_12
P2.13	not connected

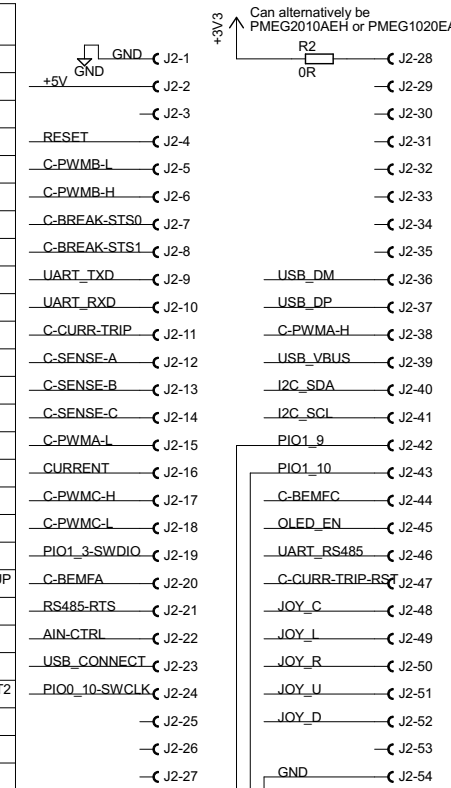


LPC1549	LPC1768
+3.3V	VOUT (+3.3V out) if self-powered, else +3.3V input
not connected	not used
not connected	not used
not connected	not used
not connected	RD-
not connected	RD+
not connected	TD-
not connected	TD+
not connected	P0.30 / USB_D-
not connected	P0.29 / USB_D+
not connected	P0.4 / CAP2.0
not connected	P0.5 / CAP2.1
PIO0_23 / I2C_SDA	P0.10 / SDA2
PIO0_22 / I2C_SCL	P0.11 / SCL2
PIO0_29 / SCT0_OUT1	P2.0 / PWM1.1
PIO0_0 / SCT0_OUT3	P2.1 / PWM1.2
PIO0_24 / SCT0_OUT6	P2.2 / PWM1.3
PIO0_3 / SCT1_OUT4	P2.3 / PWM1.4
not connected	P2.4
PIO1_1	P2.5
PIO1_5	P2.6
PIO1_4	P2.7
PIO1_6	P2.8
PIO1_7	P2.10
PIO1_8	P2.11
PIO0_27	P2.12 / EINT2
GND	GND

LPCXpresso LPC1114 / LPC11C24 / LPC11U14 / LPC1343

Dual row holes (2x27), 100 mil spacing

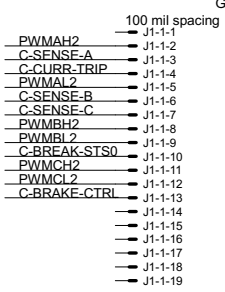
LPCXpresso pinning
GND
VIN (4.5-5.5V)
not used
Reset / PIO0_0
PIO0_9 / MOSI / CT16B0_MAT1 / SWO
PIO0_8 / MISO / CT16B_MAT0
PIO0_11 / SCK
PIO0_2 / SSEL / CT16B0_CAP0
PIO1_7 / TXD / CT32B0_MAT1
PIO1_6 / RXD / CT32B0_MAT0
PIO0_7 / CTS
PIO2_0 / DTR
PIO2_1 / DSR
PIO2_2 / DCD
R / PIO0_11 / AD0 / CT32B0_MAT3
R / PIO1_0 / AD1 / CT32B1_CAP0
R / PIO1_1 / AD2 / CT32B1_MAT0
R / PIO1_2 / AD3 / CT32B1_MAT1
SWDIO / PIO1_3 / AD4 / CT32B1_MAT2
PIO1_4 / AD5 / CT32B1_MAT3 / WAKEUP
RS485-RTS
AIN-CTRL
PIO0_6 / USB_CONNECT / SCK
SWCLK / PIO0_10 / SCK / CT16B0_MAT2
PIO3_0
PIO3_1
PIO3_2



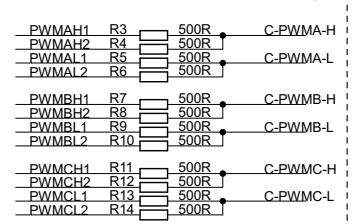
LPCXpresso pinning
VOUT (+3.3V out) if self powered, else +3.3V input
not used
not used
not used
not used
not used
not used
not used
not used
not used
USB_DM
USB_DP
C-PWMA-H
USB_VBUS
PIO0_1 / CLKOUT / CT32B0_MAT2 / USB_FTOGGLE
PIO0_3 / USB_VBUS
PIO0_5 / SDA
PIO0_4 / SCL
PIO1_9 / CT16B1_MAT0
PIO1_10 / AD6 / CT16B1_MAT1
PIO1_11 / AD7
PIO2_3 / RI
PIO2_4
PIO2_5
PIO2_6
PIO2_7
PIO2_8
PIO2_9
PIO2_10
PIO3_3
GND

Signals available in area between board edges

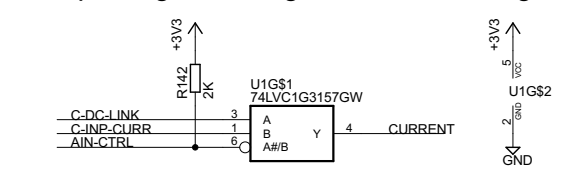
P1.18	
P1.19 / MCOA0	PIO0_2
P1.20 / MCI0	
P1.21 / MCOA0B1	
P1.22 / MCOB0	
P1.23 / MCI1	PIO0_30
P1.24 / MCI2	PIO0_17
P1.25 / MCOA1	
P1.26 / MCOB1	
P1.27 / CAP0.1	PIO0_15
P1.28 / MCOA2	
P1.29 / MCOB2	
P2.9	PIO0_25
P2.26	
P4.28	
P4.29	
P0.19	
P0.20	
P2.9	




LPCXpresso LPC1768:
Dual drive of PWM signals
(one pin shall drive and the other shall be input)



Multiplexing of analog measurement signals





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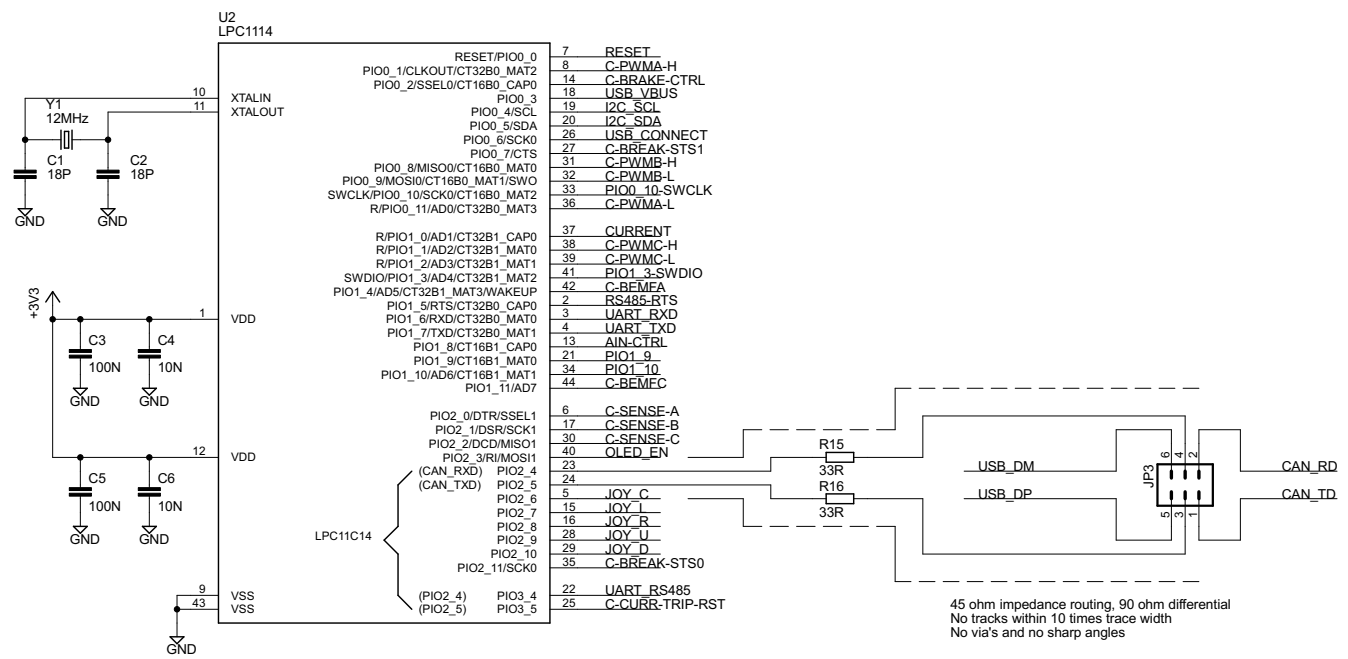
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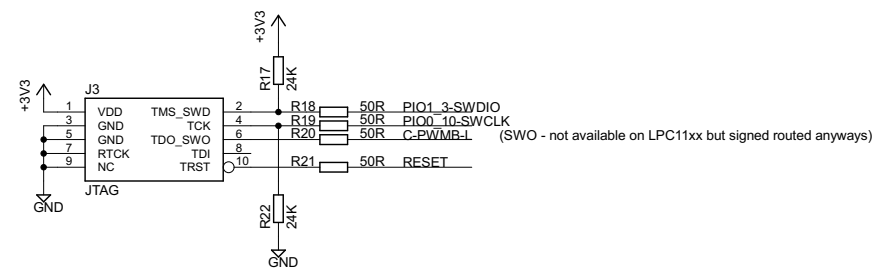
Sheet: 2/11

PLCC44 socket

PLCC44 socket for LPC1114 (and future PLCC44 versions)
 (Note: Do not insert MCU in PLCC44 socket simultaneous with LPCXpresso Boards)



SWD interface (for PLCC44)



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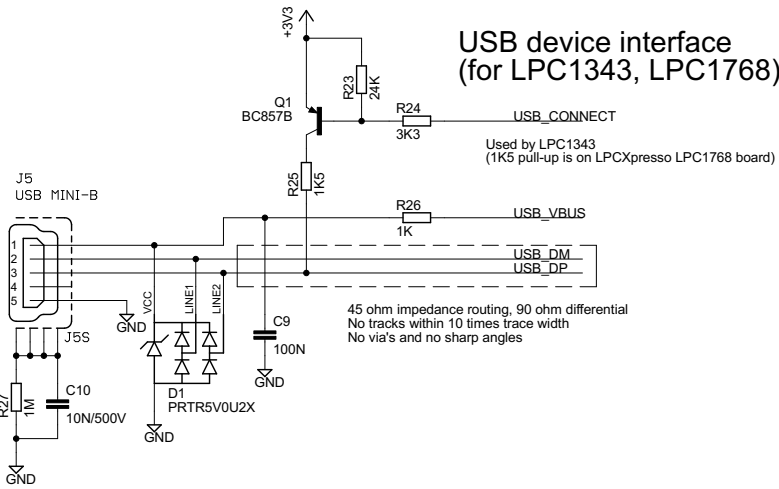
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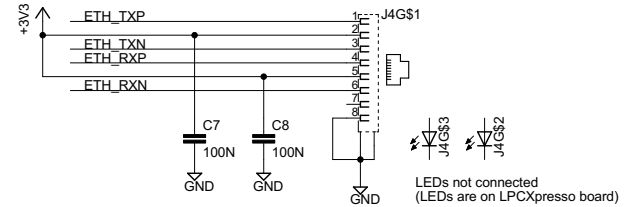
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Communication interfaces (Ethernet, CAN, USB, UART-over-USB, RS422/485)

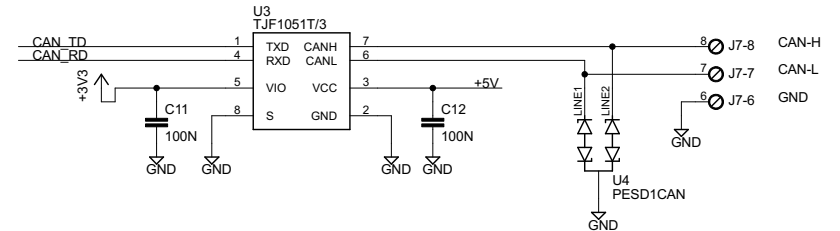
USB device interface (for LPC1343, LPC1768)



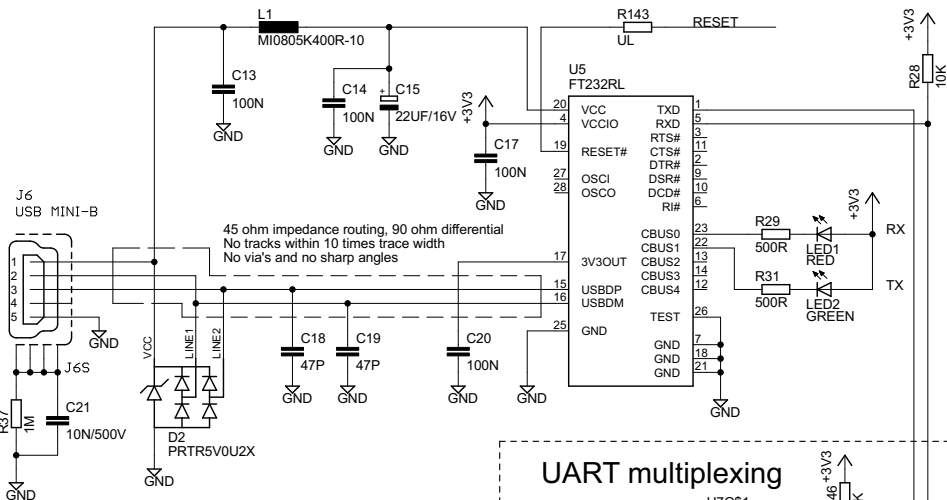
RJ45 Ethernet Connector (for LPC1768)



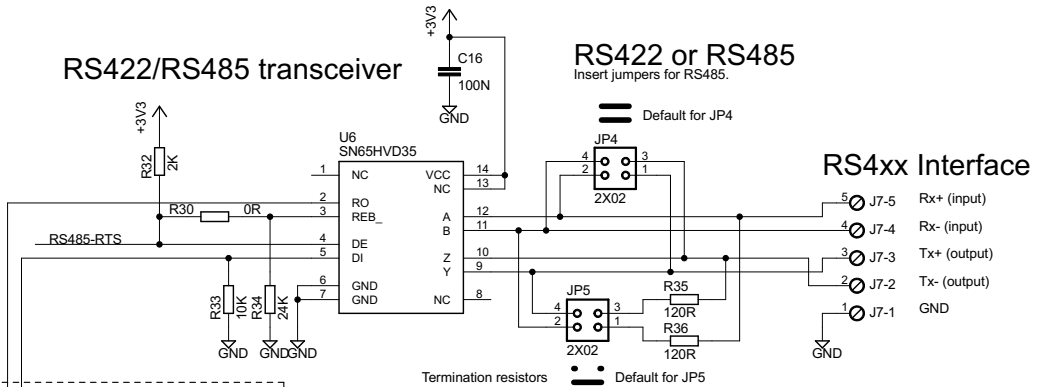
CAN interface (for LPC1768) (LPC11C24 has on-board transceiver and connector)



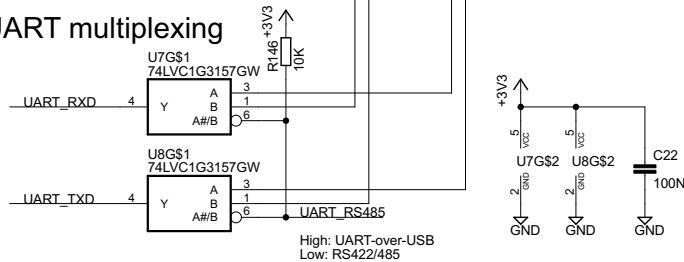
UART-to-USB bridge interface



RS422/RS485 transceiver



UART multiplexing



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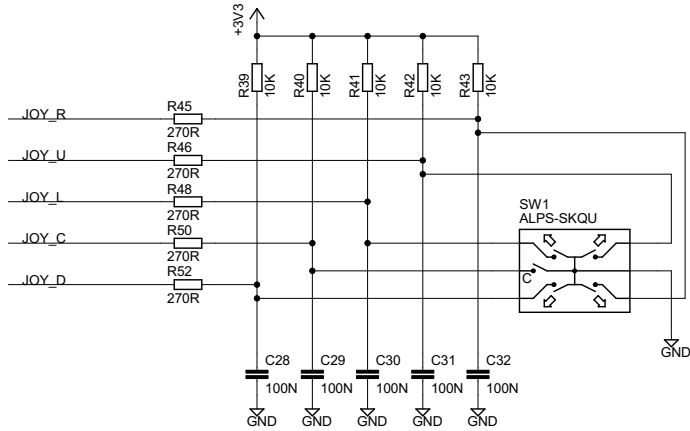
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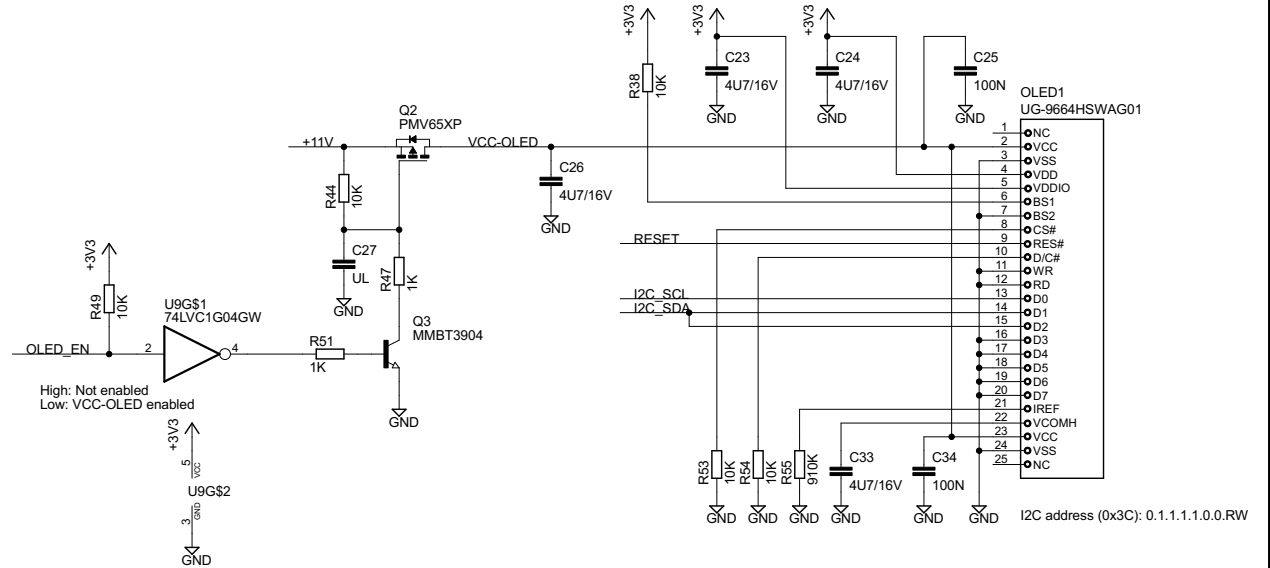
Sheet: 4/11

User interface with OLED and 5-key joystick

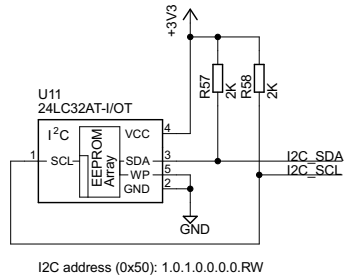
5-key joystick switch



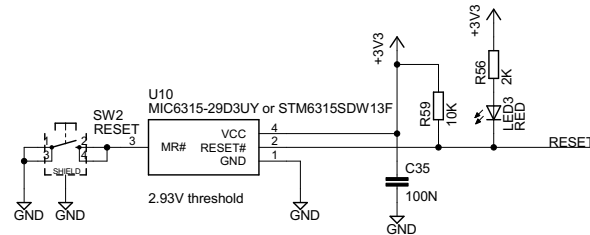
96x64 White OLED with I2C interface



32Kbit I2C-E2PROM



Reset generation



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Interface between controller and motor electronics

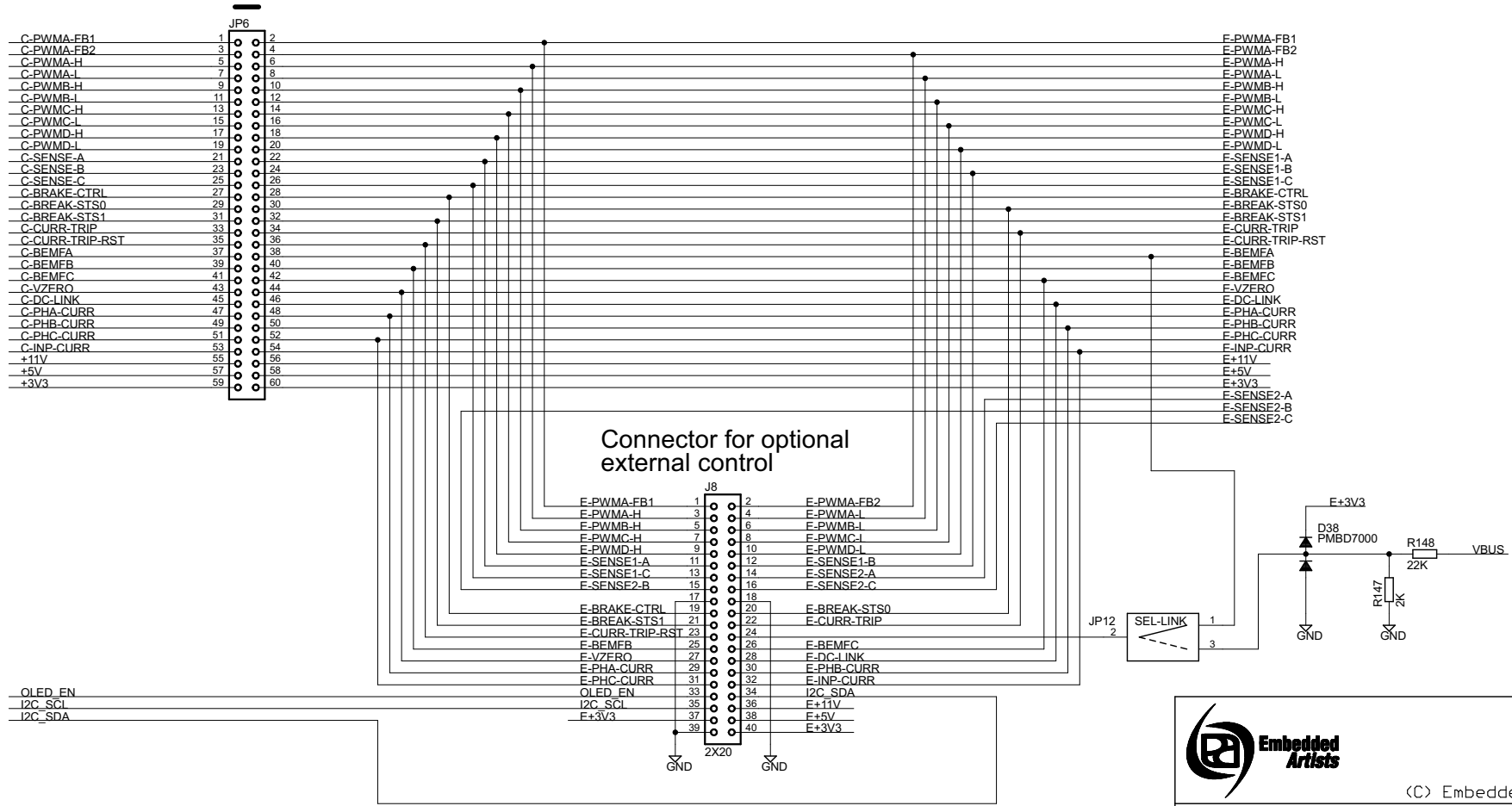
"C-" prefix on control side



"E-" prefix on motor electronic side



All signals normally connected



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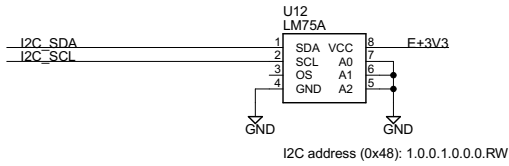
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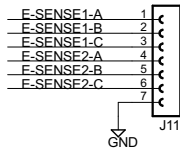
Date: 2014-05-27 23:13:02 Sheet: 6/11

Sensor interfaces

Temperature sensor
Mounted close to output drivers

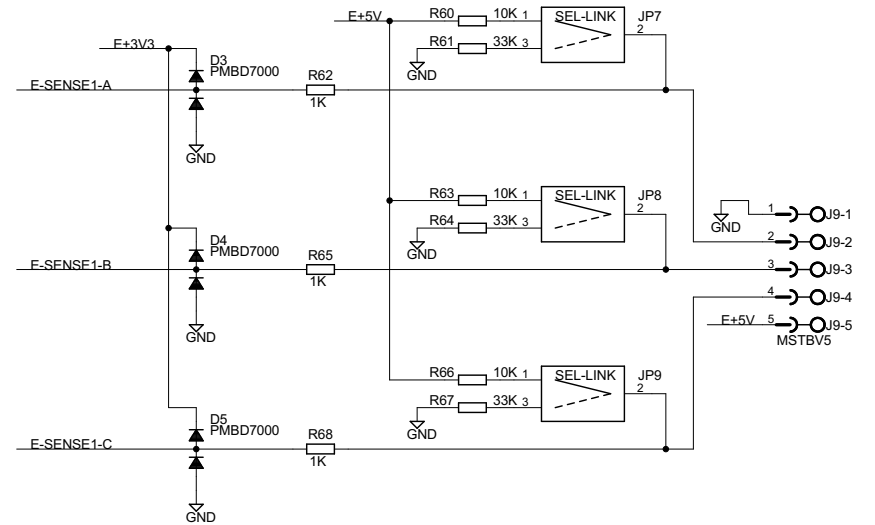


Pin list connector for easy access for sensor signals

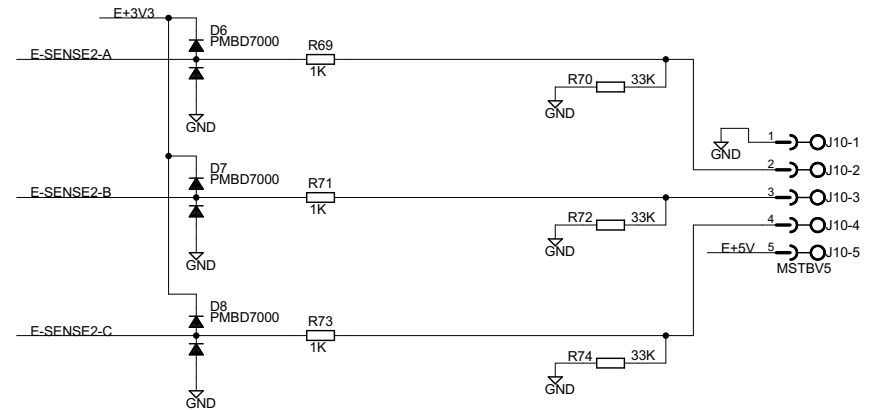


Sensor inputs (Hall or QEI)

Upper position: Optional pull-up for Hall sensors
Lower position: Pull-down for Quadrature Encoder sensor



Separate QEI sensor inputs (optional inputs, not supported by LPC1xxx family)



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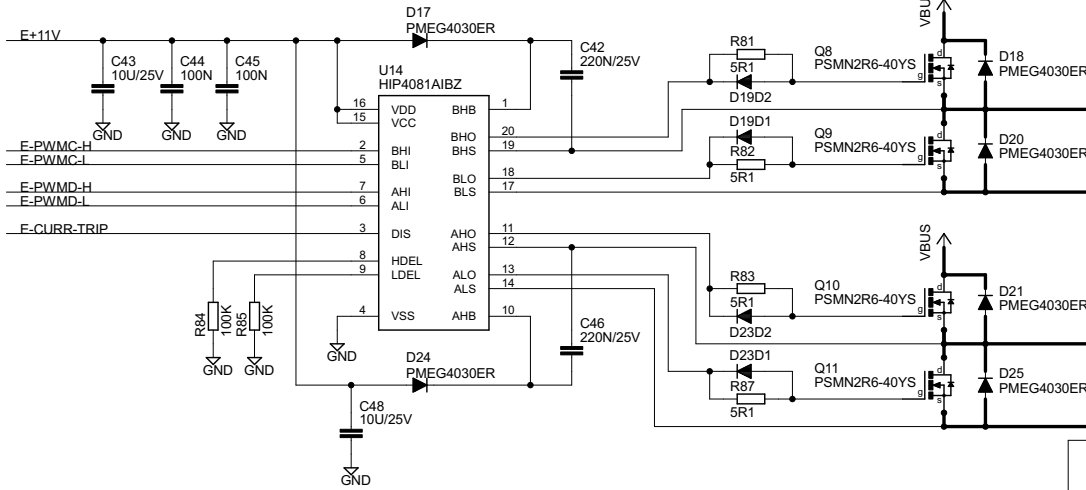
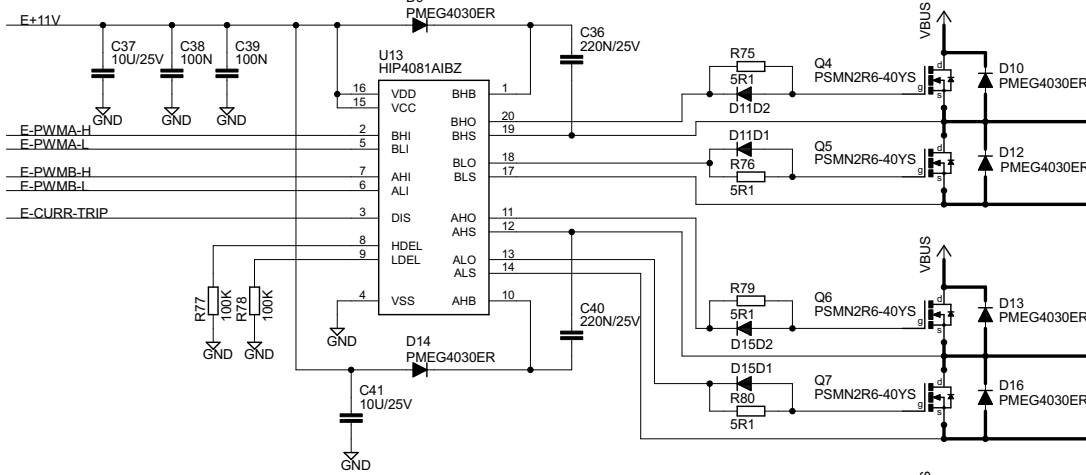
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4-phase output drivers

Gate drivers

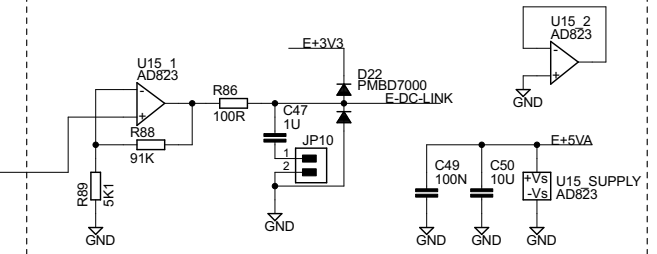
Phase drivers



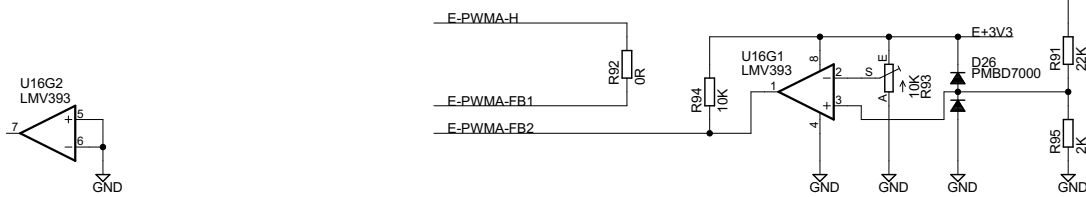
Current rating: 17A max

PHASEA
PHASEB
PHASEC
PHASED

Low-side current measurements



Phase A mid-point measurements



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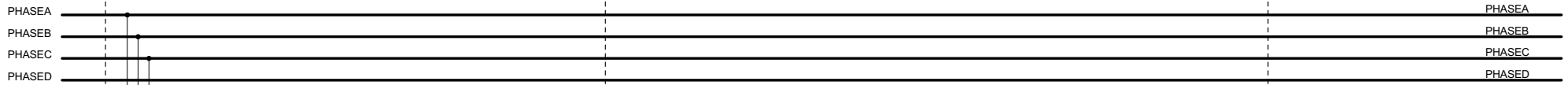
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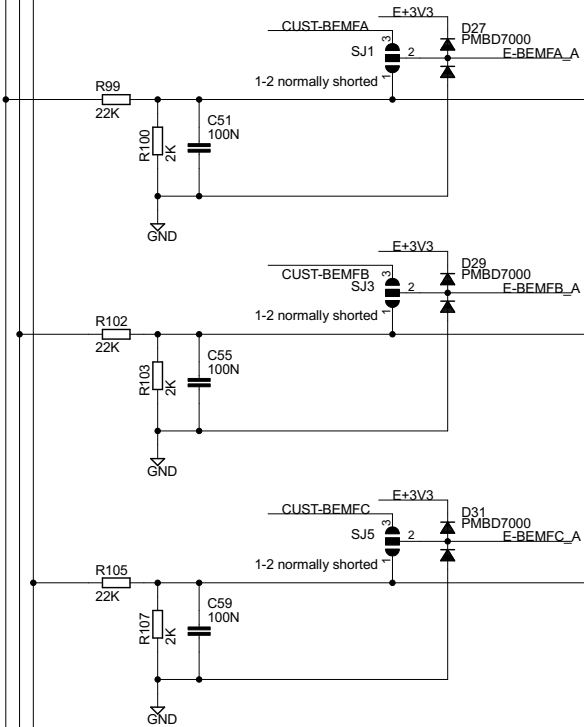
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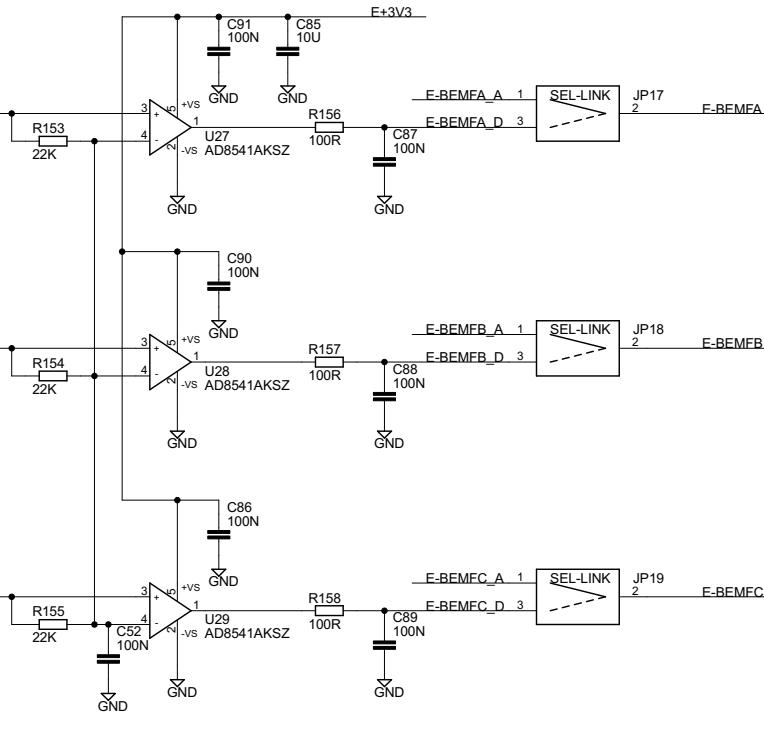
Phase measurements - Voltage



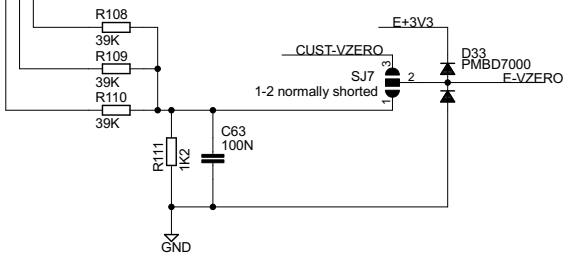
Analog phase voltage measurements



Digital phase voltage measurements



Virtual ground voltage measurements



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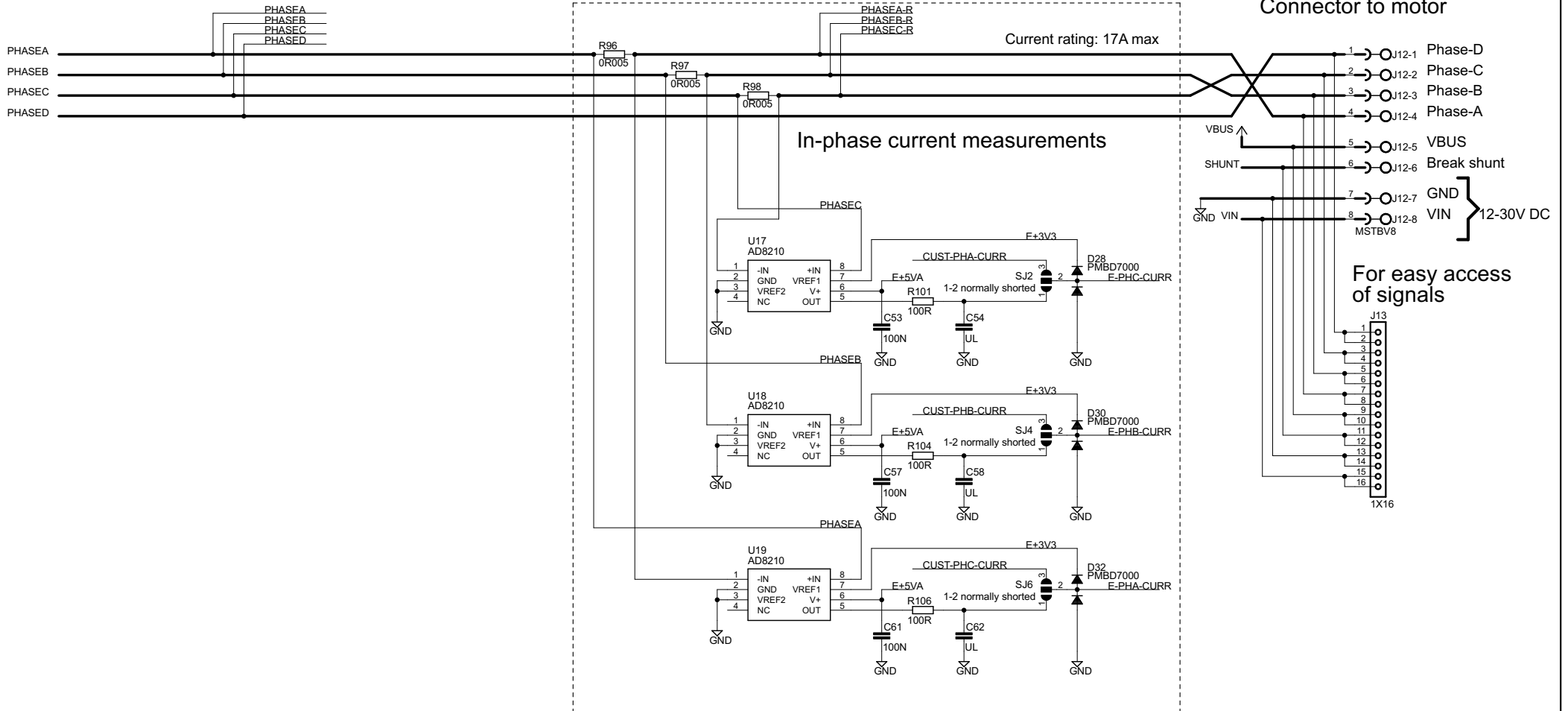
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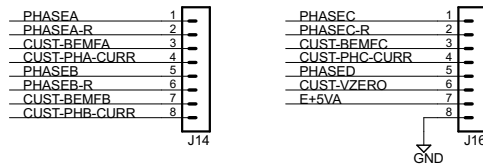
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Phase measurements - Current



Connector for custom signal conditioning



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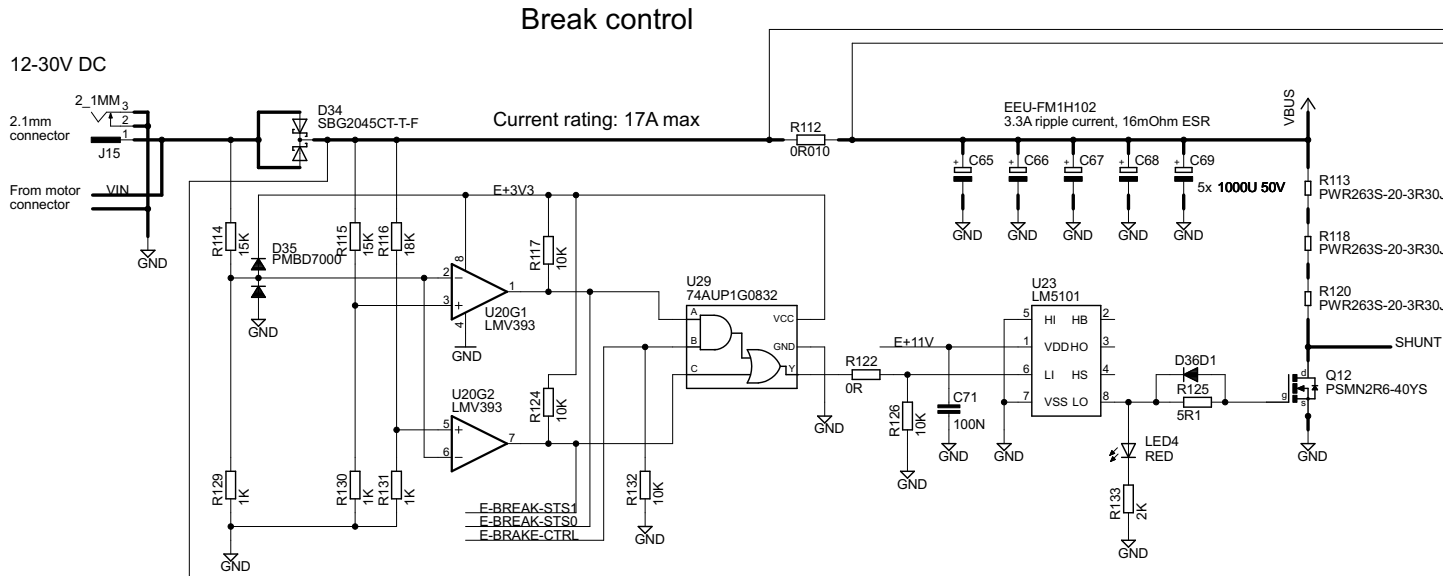
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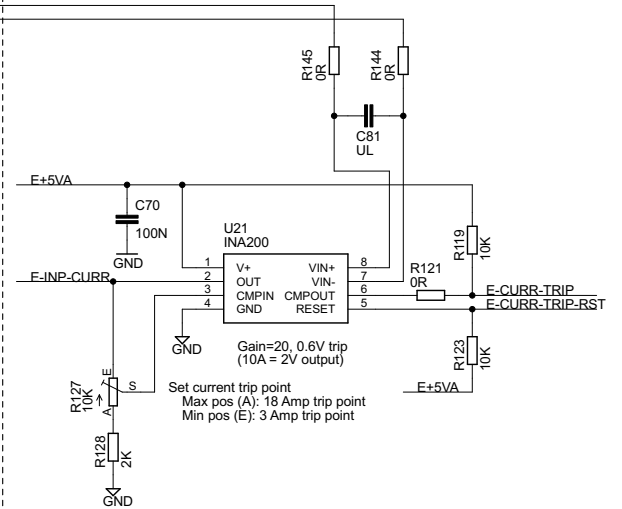
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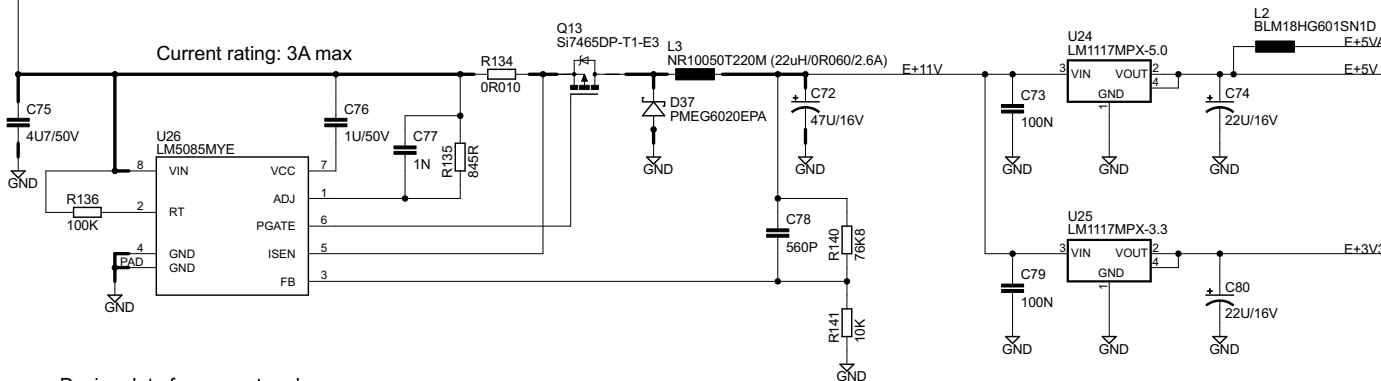
Power supply and Break functionality



Over-current protection

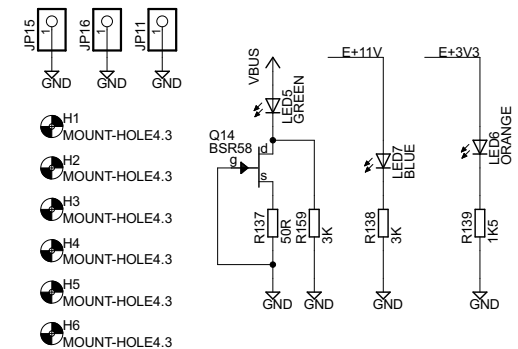


+11V, +5V and +3V3 power supplies



Design data for converter above:
12-30V input, 11V / 1.5A output
f=600kHz

Power supply LEDs and mounting holes



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