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Power supply and break functionality

Design Overview

MCU and interfaces

CAN interface
USB-device interface
UART-to-USB bridge
RS485 interface
Ethernet interface

Socket(s) for LPCXpresso
PLCC44 socket
SWD/JTAG interface (for PLCC44 socket)
Reset generation
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 7-10

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 A

Added R142 and R143. Changed R32 to 2K pullup. Changed R32 to 24K. Added SWD connections to J2. Changed value on R96/R97/R98. Changed input polarity and VREF1 connection of U17/U18/U19. Added R144/145/C81.

Rev PA6

Frozen design - for layout



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TITLE: Motor Control Evaluation Board rev A

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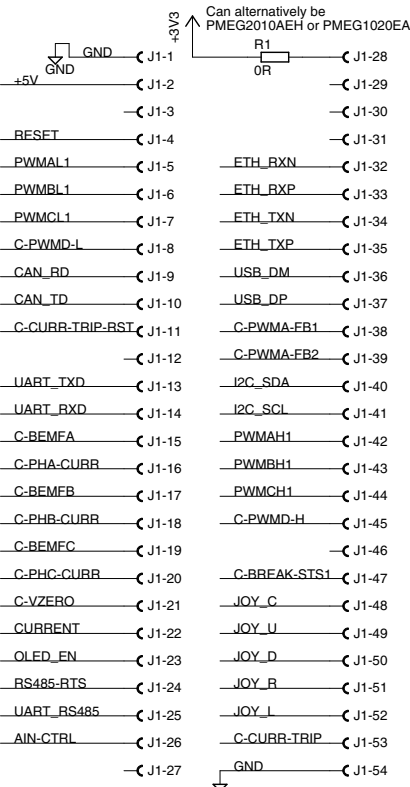
Sheet: 1/10

Sockets for LPCXpresso (LPC11x14 / LPC1343 / LPC1768)

LPCXpresso LPC1768

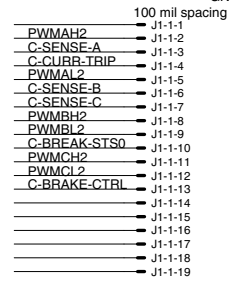
Dual row holes (2x27), 100 mil spacing

| LPCXpresso pinning | |
|------------------------------------|--|
| GND | |
| VIN (4.5-5.5V) | |
| not used | |
| RESET_N | |
| P0.9 / I2STX_SDA / MOSI1 / MAT2.3 | |
| P0.8 / I2STX_WS / MISO1 / MAT2.2 | |
| P0.7 / I2STX_CLK / SCK1 / MAT2.1 | |
| P0.6 / I2SRX_SDA / SSEL1 / MAT2.0 | |
| P0.0 / RD1 / TXD3 / SDA1 | |
| P0.1 / TD1 / RXD3 / SCL1 | |
| P0.18 / DCD1 / MOSIO / MOSI | |
| P0.17 / CTS1 / MISO0 / MISO | |
| P0.15 / TXD1 / SCK0 / SCK | |
| P0.16 / RXD1 / SSEL0 / SSEL | |
| P0.23 / AD0.0 / I2SRX_CLK / CAP3.0 | |
| P0.24 / AD0.1 / I2SRX_WS / CAP3.1 | |
| P0.25 / AD0.2 / I2SRX_SDA / TXD3 | |
| P0.26 / AD0.3 / AOUT / RXD3 | |
| P1.30 / VBUS / AD0.4 | |
| P1.31 / SCK1 / AD0.5 | |
| P0.2 / TXD0 / AD0.7 | |
| P0.3 / RXD0 / AD0.6 | |
| P0.21 / RI1 / RD1 | |
| P0.22 / RTS1 / TD1 | |
| P0.27 / SDA0 / USB_SDA | |
| P0.28 / SCL0 / USB_SCL | |
| P2.13 / EINT3 / I2STX_SDA | |

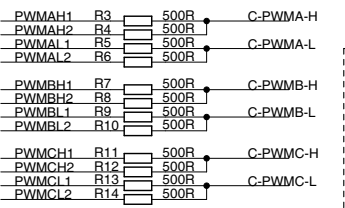


| LPCXpresso pinning | |
|--|--|
| VOUT (+3.3V out) if self powered, else +3.3V input | |
| not used | |
| not used | |
| not used | |
| RD- | |
| RD+ | |
| TD- | |
| TD+ | |
| P0.30 / USB_D- | |
| P0.29 / USB_D+ | |
| P0.4 / I2SRX_CLK / RD2 / CAP2.0 | |
| P0.5 / I2SRX_WS / TD2 / CAP2.1 | |
| P0.10 / TXD2 / SDA2 / MAT3.0 | |
| P0.11 / RXD2 / SCL2 / MAT3.1 | |
| P2.0 / PWM1.1 / TXD1 | |
| P2.1 / PWM1.2 / RXD1 | |
| P2.2 / PWM1.3 / TD1 | |
| P2.3 / PWM1.4 / DCD1 | |
| P2.4 / PWM1.5 / DSR1 | |
| P2.5 / PWM1.6 / DTR1 | |
| P2.6 / PCAP1.0 / RI1 | |
| P2.7 / RD2 / RTS1 | |
| P2.8 / TD2 / TXD2 | |
| P2.10 / EINT0 / NMI | |
| P2.11 / EINT1 / I2STX_CLK | |
| P2.12 / EINT2 / I2STX_WS | |
| GND | |

P1.18 / USB_UP_LED / PWM1.1 / CAP1.0
 P1.19 / MCOA0 / USB_PPWR / CAP1.1
 P1.20 / MCI0 / PWM1.2 / SCK0
 P1.21 / MCABORT / PWM1.3 / SSEL0
 P1.22 / MCOB0 / USB_PWRD / MAT1.0
 P1.23 / MCI1 / PWM1.4 / MISO0
 P1.24 / MCI2 / PWM1.5 / MOSIO
 P1.25 / MCOA1 / MAT1.1
 P1.26 / MCOB1 / PWM1.6 / CAP0.0
 P1.27 / CLKOUT / USB_OVRCR / CAP0.1
 P1.28 / MCOA2 / PCAP1.0 / MAT0.0
 P1.29 / MCOB2 / PCAP1.1 / MAT0.1
 P3.23 / MAT0 / PWM1.2
 P3.28 / STCLK / MAT0.1 / PWM1.3
 P4.28 / RX_MCLK / MAT2.0 / TXD3
 P4.29 / TX_MCLK / MAT2.1 / RXD3
 P0.19 / DSR1 / SDA1
 P0.20 / DTR1 / SCL1
 P2.9 / USB_CONNECT / RXD2



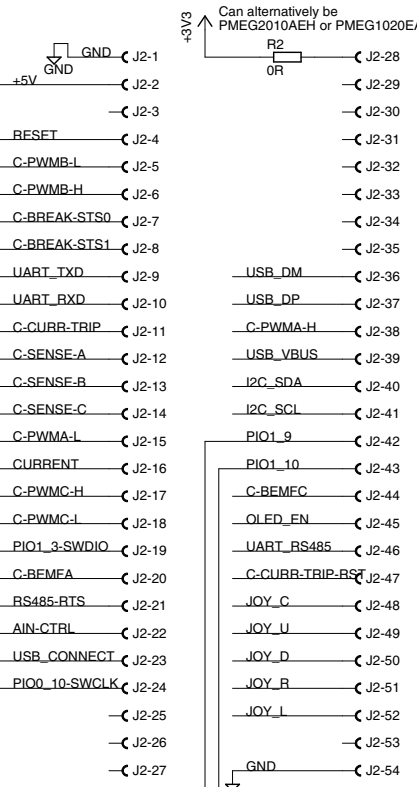
Dual drive of PWM signals
 (one pin shall drive and the other shall be input)



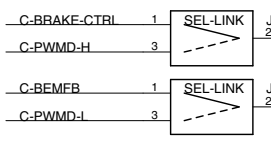
LPCXpresso LPC1114 / LPC11C14 / LPC11U14 / LPC1343

Dual row holes (2x27), 100 mil spacing

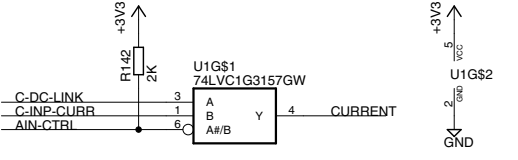
| LPCXpresso pinning | |
|-------------------------------------|--|
| GND | |
| VIN (4.5-5.5V) | |
| not used | |
| Reset / PIO0_0 | |
| PIO0_9 / MOSI / CT16B0_MAT1 / SWO | |
| PIO0_8 / MISO / CT16B_MAT0 | |
| PIO2_11 / SCK | |
| PIO0_2 / SSEL / CT16B0_CAP0 | |
| PIO1_7 / TXD / CT32B0_MAT1 | |
| PIO1_6 / RXD / CT32B0_MAT0 | |
| PIO0_7 / CTS | |
| PIO2_0 / DTR | |
| PIO2_1 / DSR | |
| PIO2_2 / DCD | |
| R / PIO1_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 | |
| PIO1_5 / RTS / CT32B0_CAP0 | |
| PIO1_8 / CT16B1_CAP0 | |
| 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 | |
| USB_DM | PIO2_4 for LPC1114 |
| USB_DP | PIO2_5 for LPC1114 |
| PIO0_3 / USB_VBUS | PIO0_3 / USB_VBUS |
| I2C_SDA | PIO0_5 / SDA |
| I2C_SCL | PIO0_4 / SCL |
| PIO1_9 | PIO1_9 / CT16B1_MAT0 |
| PIO1_10 | PIO1_10 / AD6 / CT16B1_MAT1 |
| PIO1_11 / AD7 | PIO1_11 / RI |
| PIO2_3 / RI | PIO2_4 |
| PIO2_4 | PIO3_4 for LPC1114 |
| PIO2_5 | PIO3_5 for LPC1114 |
| PIO2_6 | |
| PIO2_7 | |
| PIO2_8 | |
| PIO2_9 | |
| PIO2_10 | |
| PIO3_3 | |
| GND | |



Multiplexing of analog measurement signals



Signals available in area between board edges



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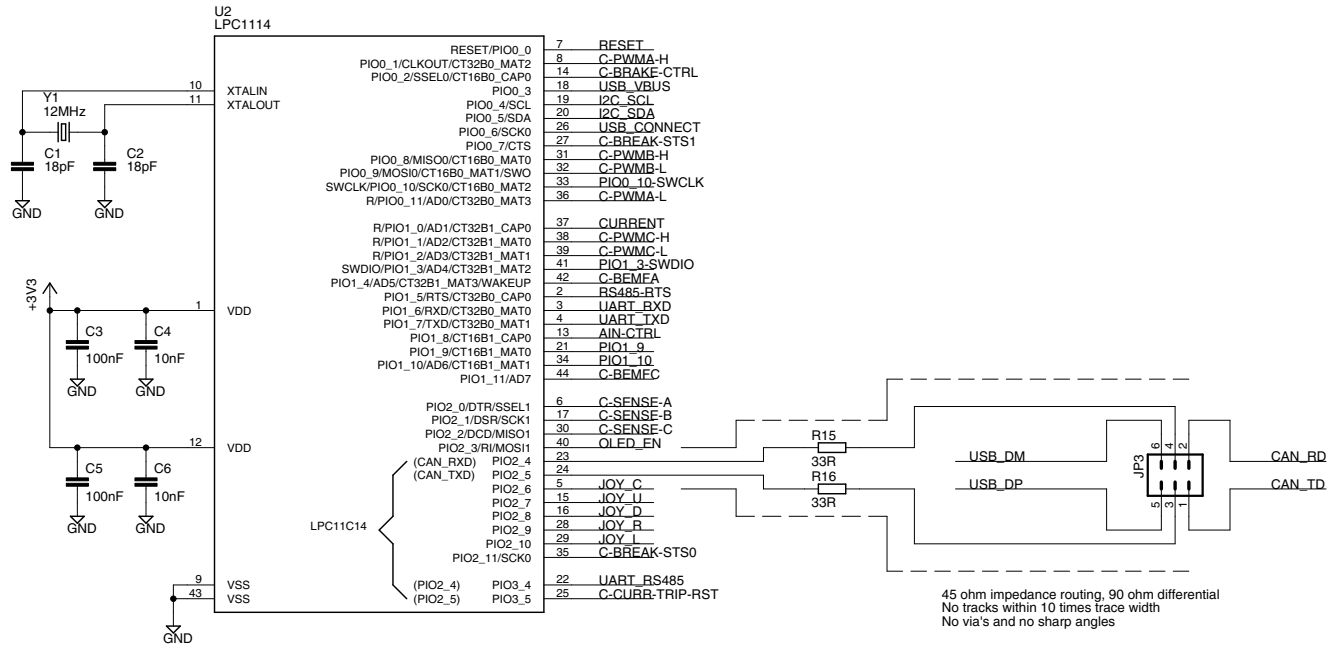
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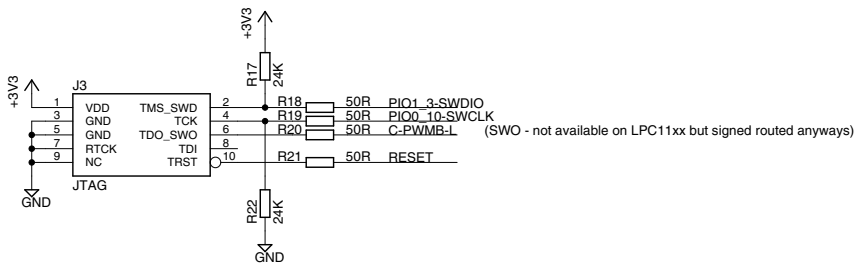
PLCC44 socket

PLCC44 socket for LPC1114 (and future PLCC44 versions)

(Note: Do not insert MCU in PLCC44 socket simultaneous with LPCXpresso Boards)

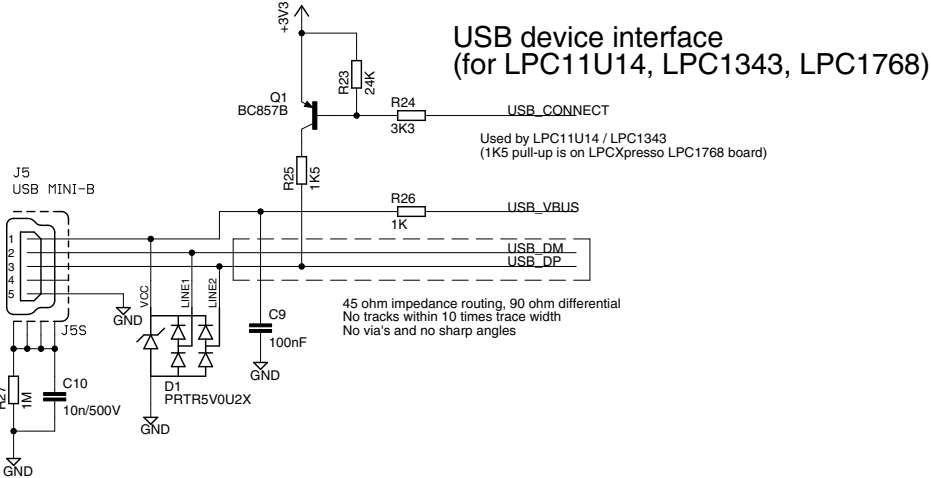


SWD interface (for PLCC44)

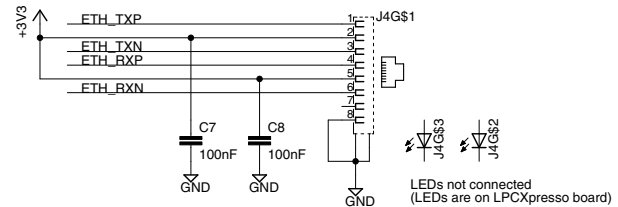


Communication interfaces (Ethernet, CAN, USB, UART-over-USB, RS422/485)

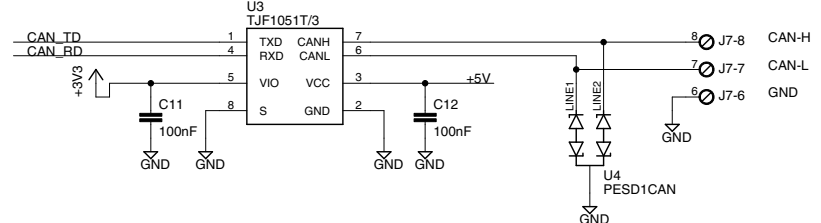
USB device interface
(for LPC11U14, LPC1343, LPC1768)



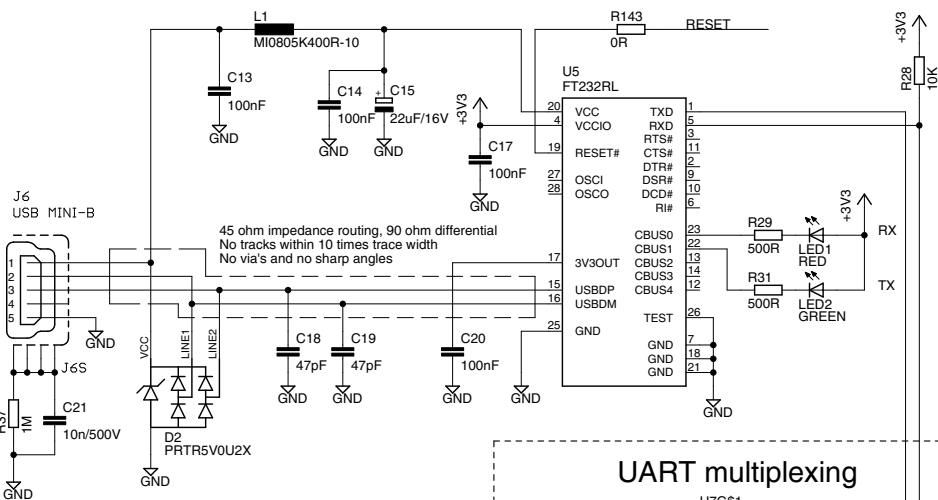
RJ45 Ethernet Connector
(for LPC1768)



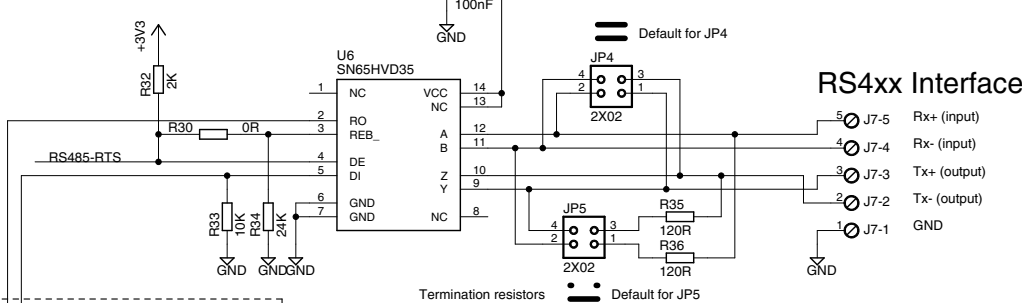
CAN interface (for LPC1768)
(LPC11C14 has on-board transceiver and connector)



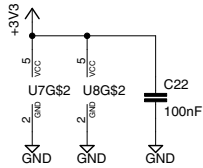
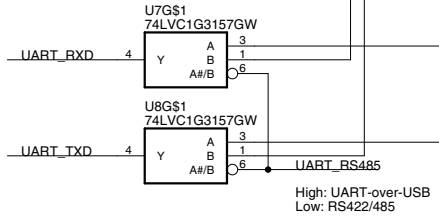
UART-to-USB bridge interface



RS422/RS485 transceiver



UART multiplexing



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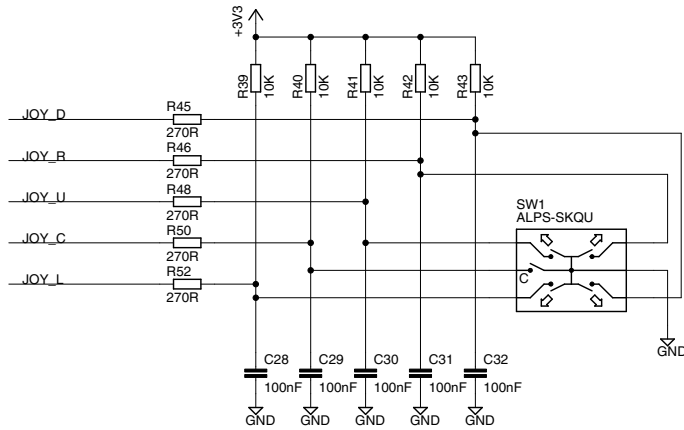
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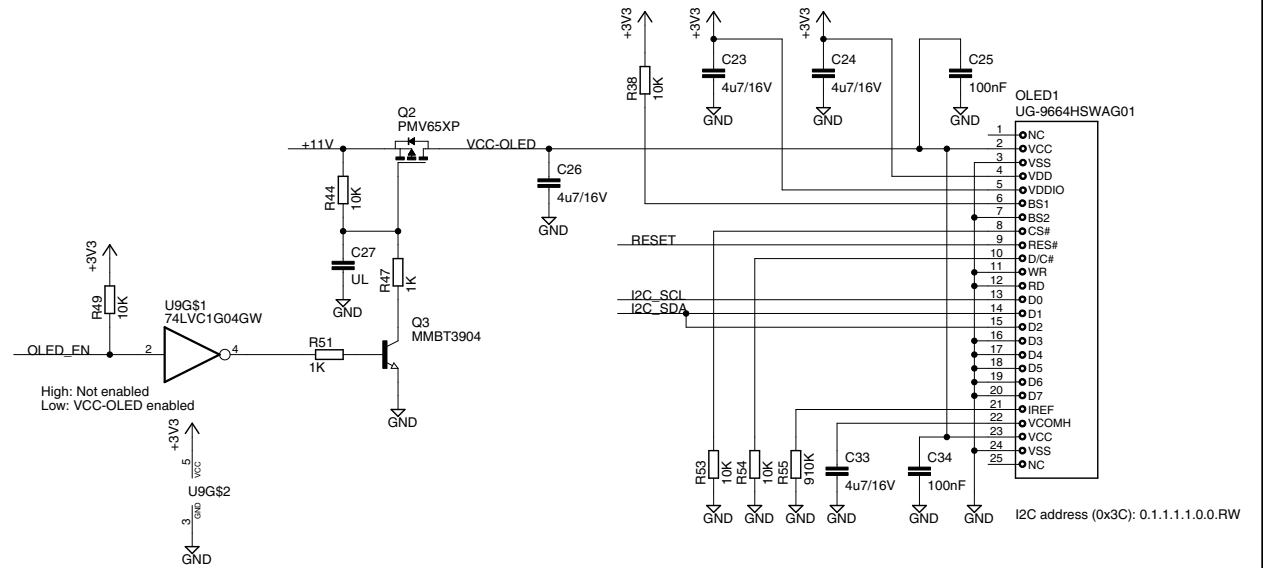
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User interface with OLED and 5-key joystick

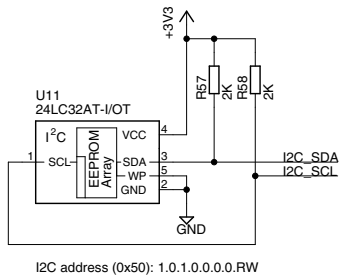
5-key joystick switch



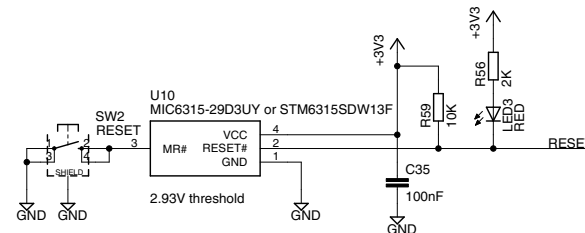
96x64 White OLED with I2C interface



32Kbit I2C-E2PROM



Reset generation



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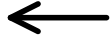
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Interface between controller and motor electronics

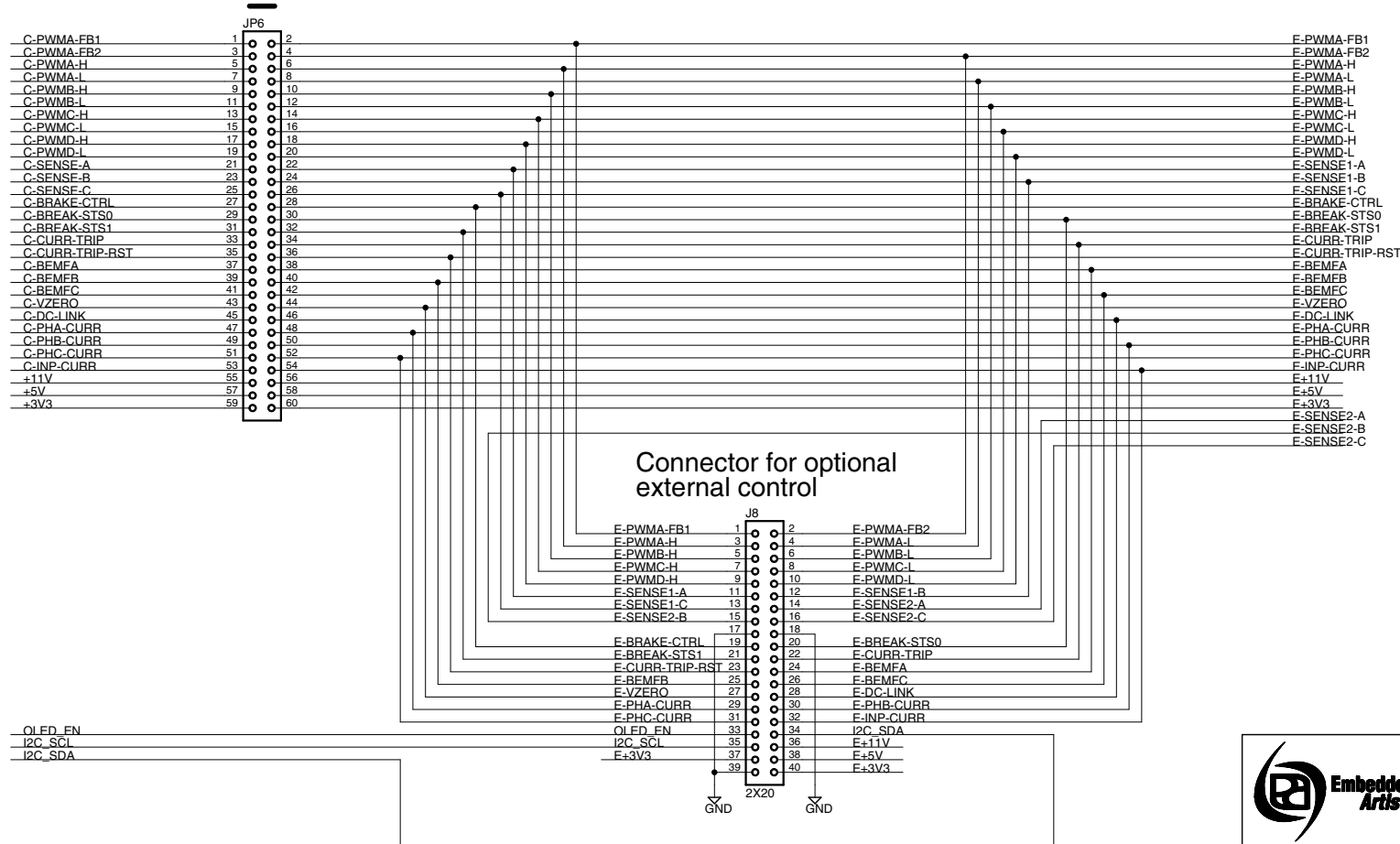
"C-" prefix on control side



"E-" prefix on motor electronic side



All signals normally connected



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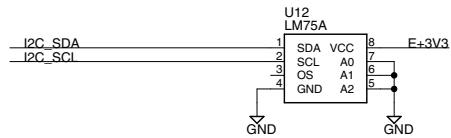
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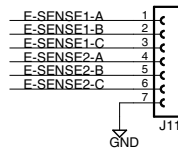
Date: 2010-10-18 23:45:27 Sheet: 6/10

Sensor interfaces

Temperature sensor
Mounted close to output drivers

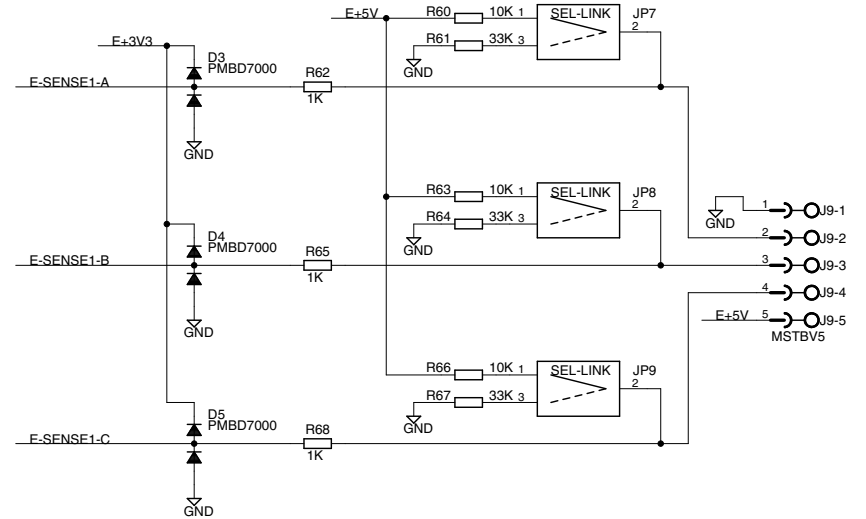


Pin list connector for easy access for sensor signals

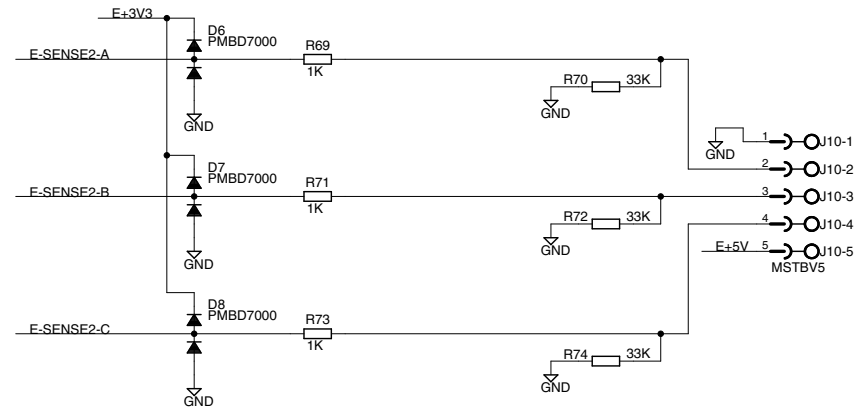


Sensor inputs (Hall or QEI)

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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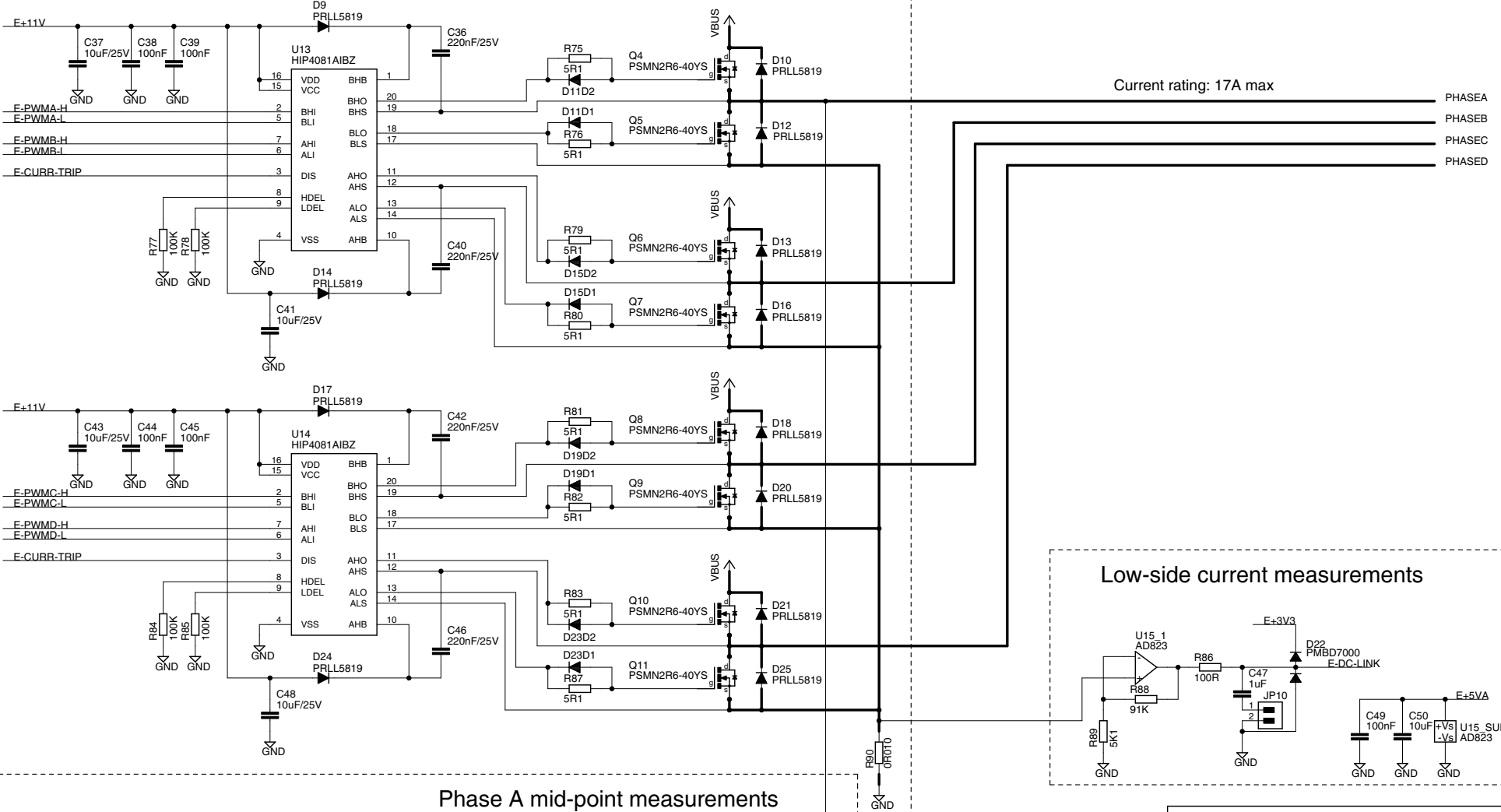
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4-phase output drivers

Gate drivers

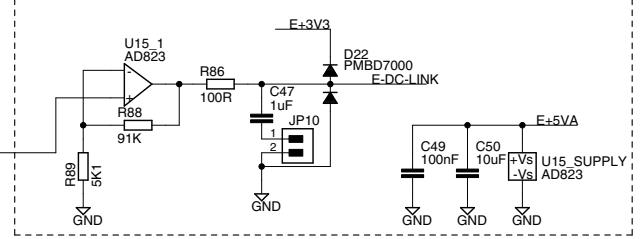
Phase drivers



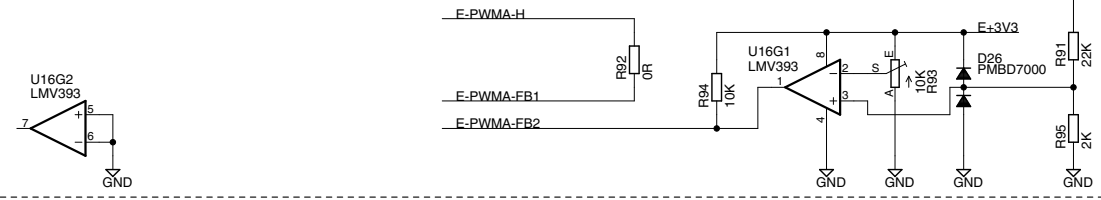
Current rating: 17A max

PHASEA
PHASEB
PHASEC
PHASED

Low-side current measurements



Phase A mid-point measurements



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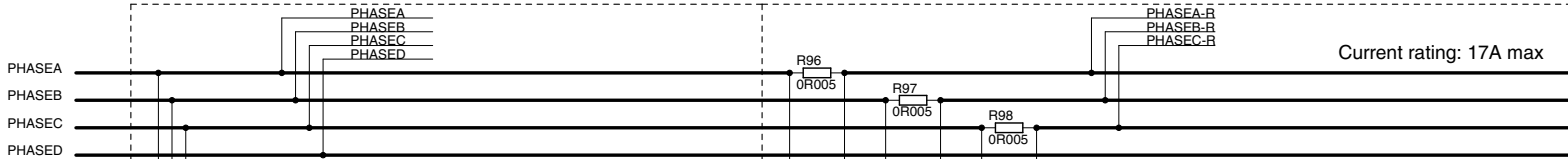
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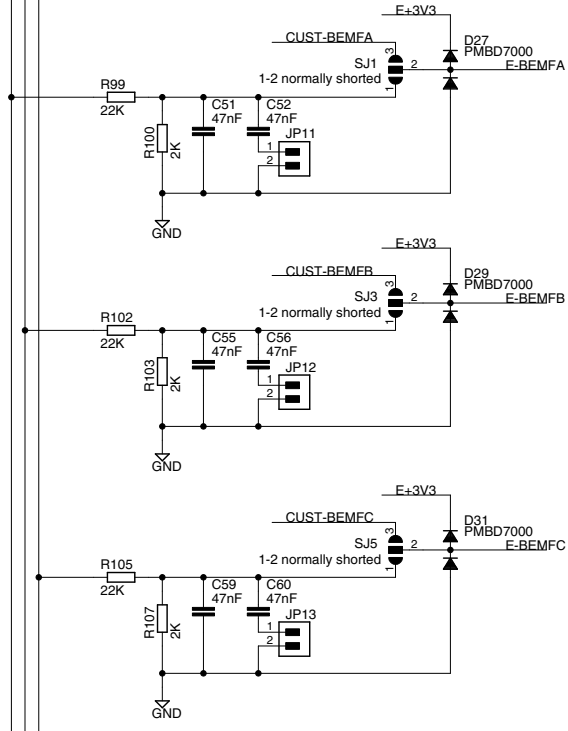
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Sheet: 8/10

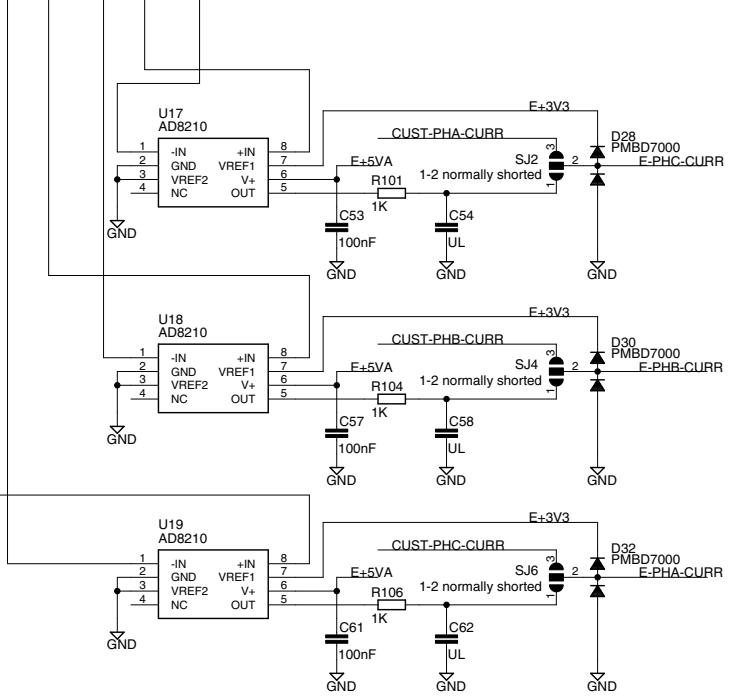
Phase measurements



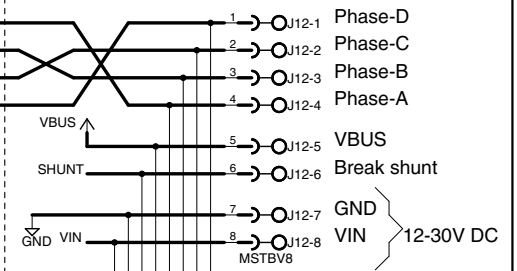
Phase voltage measurements



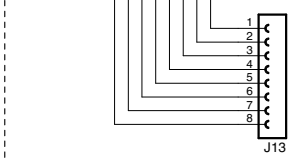
In-phase current measurements



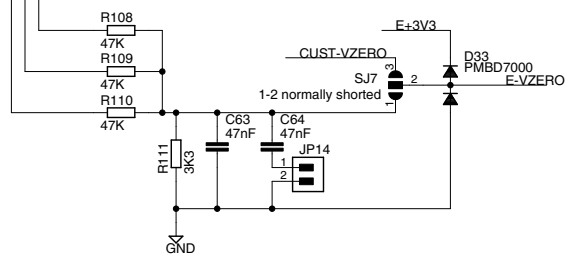
Connector to motor



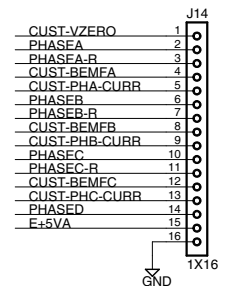
For easy access of signals



Virtual ground voltage measurements



Connector for custom signal condition



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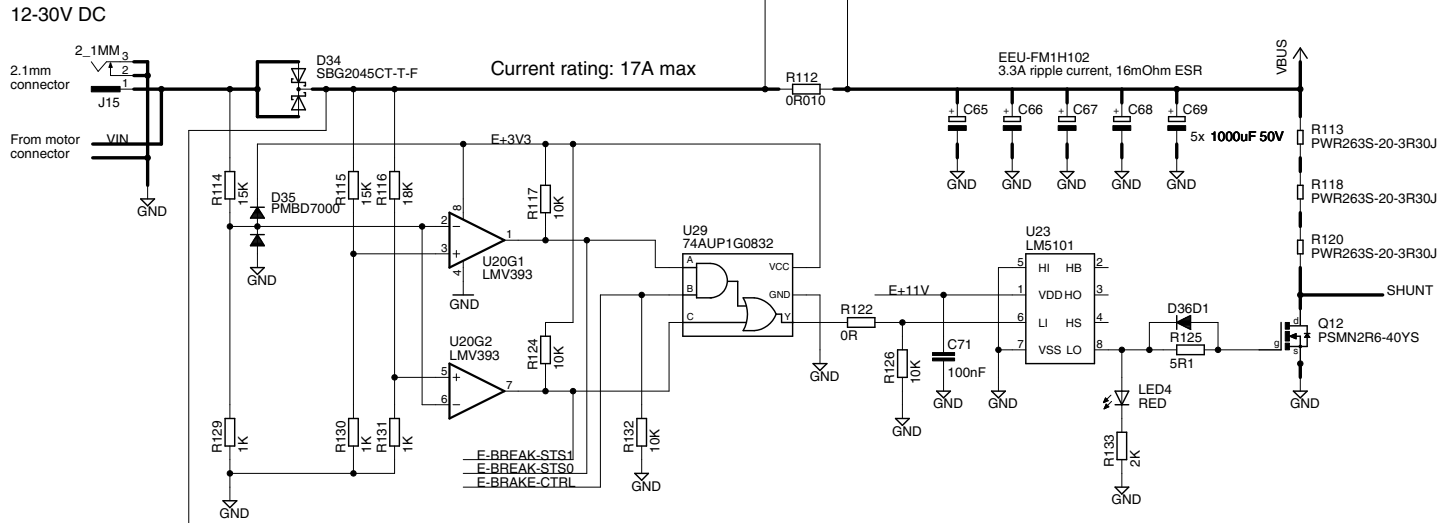
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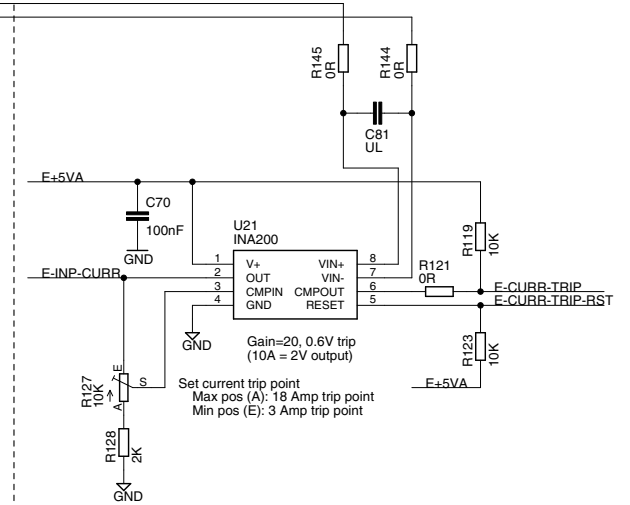
Date: 2010-10-18 23:45:27 Sheet: 9/10

Power supply and Break functionality

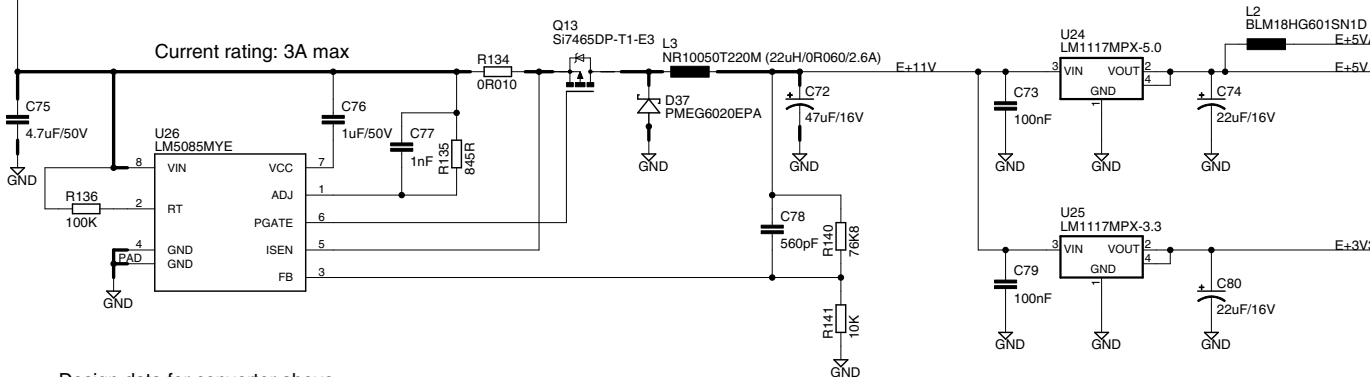
Break control



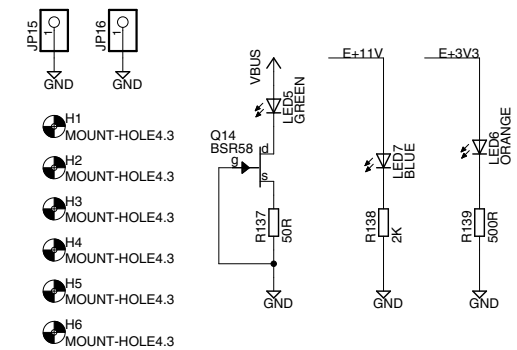
Over-current protection



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



Power supply LEDs and mounting holes



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