

BLDC motor controller

V_SUPPLY

39k R3

2k2 R4

100n C2

MINI-USB-SHIELD-32005-201

X1A

Mount OR if used as USB host R6

22R 103

22R 104

USB_DM

USB_DP

FSD protection?

P101

CANBUS

CAN bus transceiver

CAN_RX

CAN_TX

CAN.sch

P1

HALL/Encoder

HALL3_IN

HALL2_IN

HALL1_IN

TEMP_IN

HALL3_OUT

HALL2_OUT

HALL1_OUT

TEMP_OUT

5V

Filters

hall_filters.sch

Temp

NTC temp sensor

temp.sch

STM32F4 64LQFP.sch

EN_GATE

H1

L1

H2

L2

H3

L3

SENS1

SENS2

SENS3

FAULT

BR_SO1

BR_SO2

DC_CAL

Mosfet driver

Power.sch

Power MOSFETS

mosfets.sch

PHASE_1

PHASE_2

PHASE_3

H1_LOW

H2_LOW

H3_LOW

SH1_A

SH1_B

SH2_A

SH2_B

SHUNT R54

SHUNT R53

100R R36

100R R37

2k2 R22

RED

GREEN

LED

SERVOD

K1

SERVOD

2k2 R5

100n C3

5V

Connect signal ground and power ground in one place only

V_SUPPLY

P4

P5

Voltage supply (0 - 60v)

Needs external decoupling caps to avoid high voltage transients produced by the inductance of the battery wiring while switching the FETs

Also critical for EMI/RF compliance

Top level

Benjamin Vedder

Sheet: /

File: BLDC_4.sch

Title: BLDC Driver 4.10

Size: A4

Date: 21 aug 2015

Rev: 4.10

KiCad E.D.A. kicad 0.201510030351+624130ubuntu15.10.1-product

Id: 1/7

BLDC motor controller

V_SUPPLY

39k R3

2k2 R4

100n C2

MINI-USB-SHIELD-32005-201

Mount OR if used as USB host R6

22R 103

22R 104

FSD protection?

X1A

P101

CANBUS

CAN bus transceiver

CAN_H CAN_RXD

CAN_L CAN_TXD

CAN_RX CAN_TX

Filters

HALL3_IN HALL3_OUTD

HALL2_IN HALL2_OUTD

HALL1_IN HALL1_OUTD

TEMP_IN TEMP_OUTD

HALL_3 HALL_2 HALL_1 TEMP_MOTOR

hall_filters.sch

P1

HALL/Encoder

P3

PWR_COMM

SCK_ADC_EXT

TX_SDA

RX_SCL_MOSI

MISO_RX_SCL

SCK_ADC_EXT TX_SDA NSS RX_SCL_MOSI MISO_ADC_EXT2

NTC temp sensor

Temp

temp.sch

STM32F4 64LQFP.sch

EN_GATED

H1D L1D H2D L2D H3D L3D

SENS1 SENS2 SENS3

FAULT

BR_SO1 BR_SO2 DC_CALD

Mosfet driver

EN_GATE

M_H1D M_L1D M_H2D M_L2D M_H3D M_L3D

H1_VSD H2_VSD H3_VSD

H1_LOWD H2_LOWD H3_LOWD

SH1_A SH1_B SH2_A SH2_B

SHUNT R54

SHUNT R53

Power MOSFETS

PHASE_1 P9

PHASE_2 P7

PHASE_3 P6

mosfets.sch

Connect signal ground and power ground in one place only

SERVOD

100R if used as servo output

2k2 R5

100n C3

K1 SERVO

LED_GREEND LED_REDD

100R R36

100R R37

2k2 R22

RED GREEN LED

D2 D1 D3

Top level

Benjamin Vedder

Sheet: /

File: BLDC_4.sch

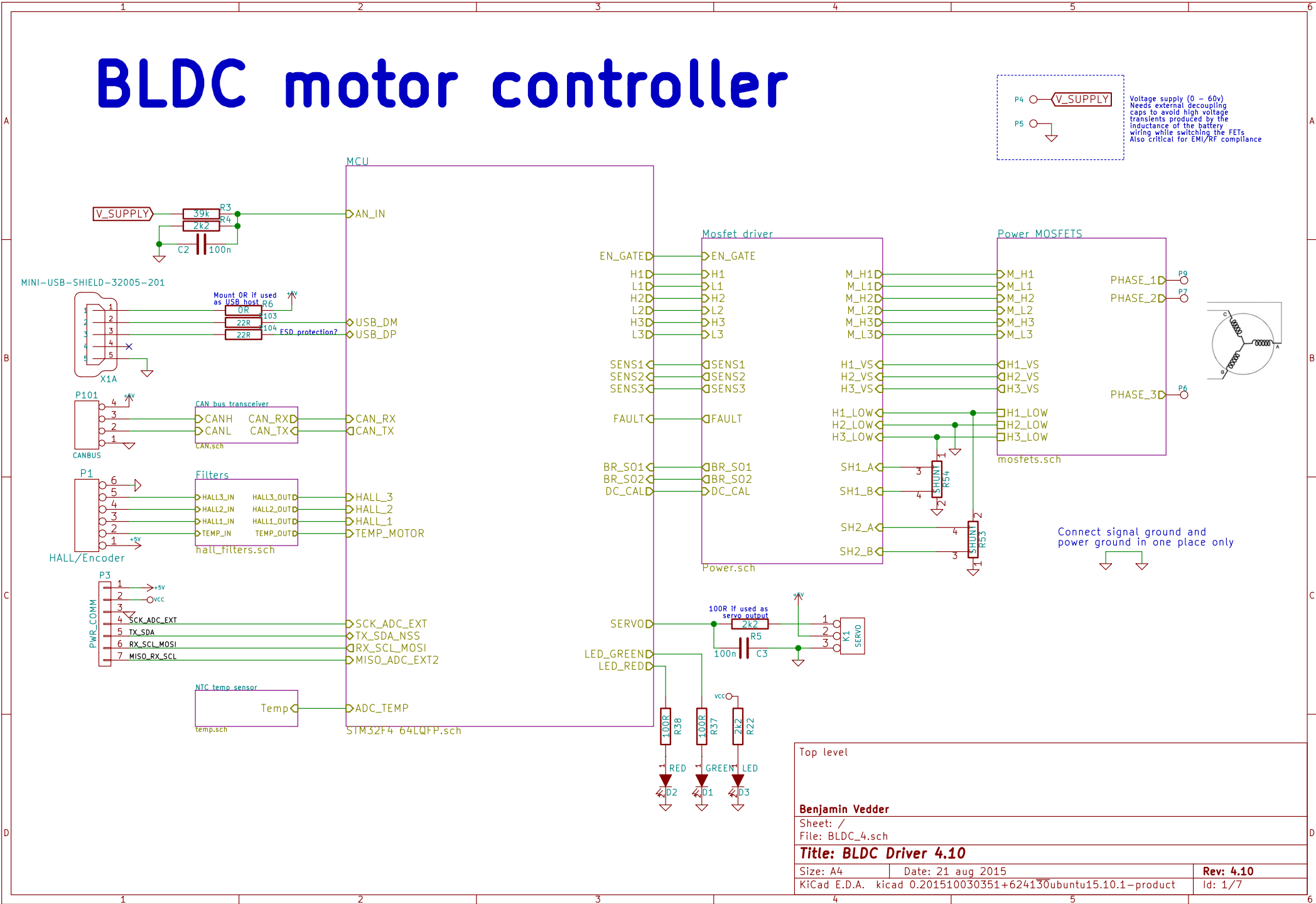
Title: BLDC Driver 4.10

Size: A4 Date: 21 aug 2015

KiCad E.D.A. kicad 0.201510030351+624130ubuntu15.10.1-product

Rev: 4.10

Id: 1/7



BLDC motor controller

V_SUPPLY

39k R3

2k2 R4

100n C2

MINI-USB-SHIELD-32005-201

Mount OR if used as USB host R6

22R 103

22R 104

FSD protection?

X1A

P101

CANBUS

CAN bus transceiver

CAN_RX

CAN_TX

CAN_RX

CAN_TX

Filters

HALL3_IN

HALL3_OUT

HALL2_IN

HALL2_OUT

HALL1_IN

HALL1_OUT

TEMP_IN

TEMP_OUT

HALL_3

HALL_2

HALL_1

TEMP_MOTOR

hali_filters.sch

P1

HALL/Encoder

P3

PWR_COMM

SCK_ADC_EXT

TX_SDA_NSS

RX_SCL_MOSI

MISO_ADC_EXT2

NTC temp sensor

Temp

temp.sch

STM32F4 64LQFP.sch

Mosfet driver

EN_GATE

H1

L1

H2

L2

H3

L3

SENS1

SENS2

SENS3

FAULT

BR_SO1

BR_SO2

DC_CAL

Power MOSFETS

PHASE_1

PHASE_2

PHASE_3

M_H1

M_L1

M_H2

M_L2

M_H3

M_L3

H1_VS

H2_VS

H3_VS

H1_LOW

H2_LOW

H3_LOW

SH1_A

SH1_B

SH2_A

SH2_B

SHUNT R54

SHUNT R53

mosfets.sch

Power.sch

SERVOD

100R if used as servo output

2k2

100n C3

K1

SERVOD

LED_GREEN

LED_RED

100R R38

100R R37

2k2 R22

RED

GREEN

LED

D2

D1

D3

Connect signal ground and power ground in one place only

V_SUPPLY

P4

P5

Voltage supply (0 - 60v)

Needs external decoupling caps to avoid high voltage transients produced by the inductance of the battery wiring while switching the FETs

Also critical for EMI/RF compliance

Top level

Benjamin Vedder

Sheet: /

File: BLDC_4.sch

Title: BLDC Driver 4.10

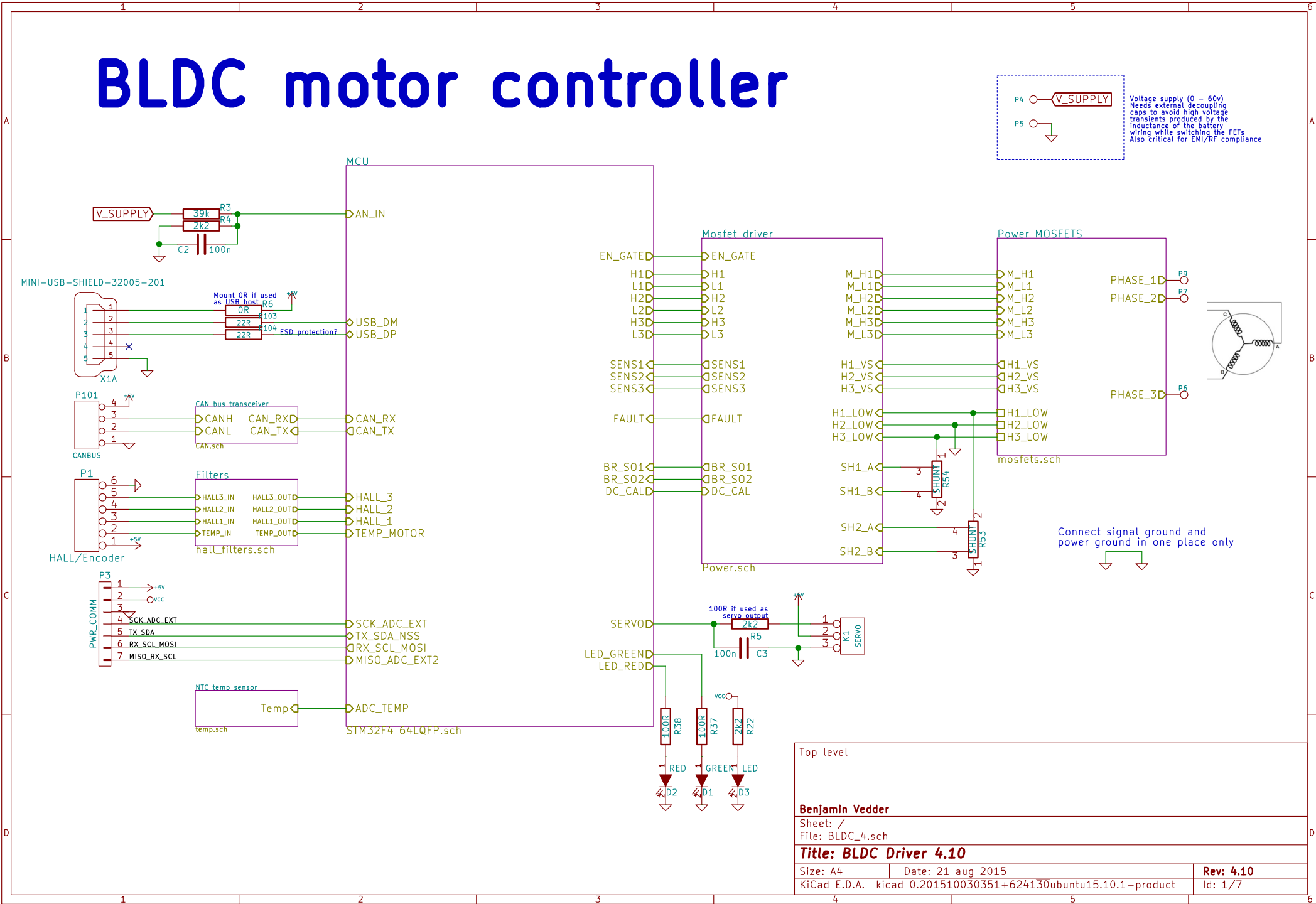
Size: A4

Date: 21 aug 2015

Rev: 4.10

KiCad E.D.A. kicad 0.201510030351+624130ubuntu15.10.1-product

Id: 1/7



BLDC motor controller

V_SUPPLY

39k R3

2k2 R4

100n C2

AN_IN

MINI-USB-SHIELD-32005-201

Mount OR if used as USB host R6

22R 103

22R 104

USB_DM

USB_DP

FSD protection?

X1A

P101

CANBUS

CAN bus transceiver

CAN_RX

CAN_TX

CAN_RX

CAN_TX

Filters

HALL3_IN

HALL2_IN

HALL1_IN

TEMP_IN

HALL3_OUT

HALL2_OUT

HALL1_OUT

TEMP_OUT

HALL_3

HALL_2

HALL_1

TEMP_MOTOR

hall_filters.sch

P1

HALL/Encoder

P3

PWR_COMM

SCK_ADC_EXT

TX_SDA

RX_SCL

MOSI

MISO

RX_SCL

SCL

ADC_TEMP

NTC temp sensor

Temp

temp.sch

STM32F4 64LQFP.sch

Mosfet driver

EN_GATE

H1

L1

H2

L2

H3

L3

SENS1

SENS2

SENS3

FAULT

BR_SO1

BR_SO2

DC_CAL

Power MOSFETS

PHASE_1

PHASE_2

PHASE_3

H1_LOW

H2_LOW

H3_LOW

SH1_A

SH1_B

SH2_A

SH2_B

mosfets.sch

Connect signal ground and power ground in one place only

SERVOD

2k2 R5

100n C3

LED_GREEN

LED_RED

100R R36

100R R37

2k2 R22

RED LED

GREEN LED

LED

Top level

Benjamin Vedder

Sheet: /

File: BLDC_4.sch

Title: BLDC Driver 4.10

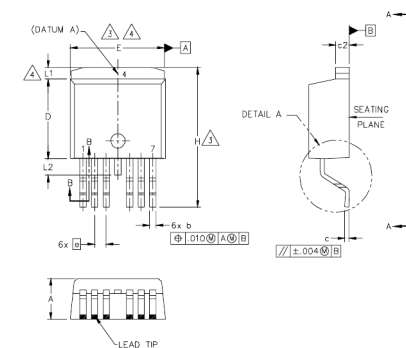
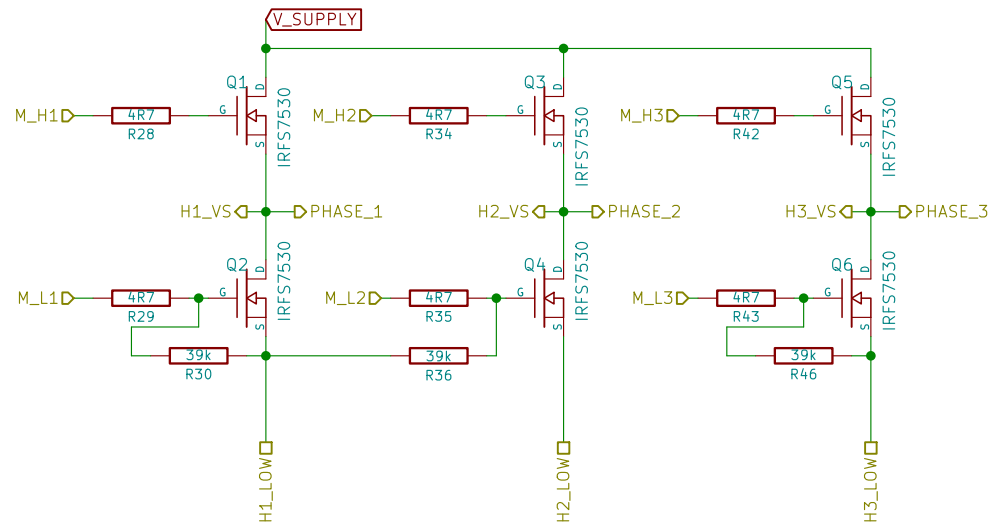
Size: A4

Date: 21 aug 2015

Rev: 4.10

KiCad E.D.A. kicad 0.201510030351+624130ubuntu15.10.1-product

Id: 1/7



Benjamin Vedder

Sheet: /Power MOSFETS/

File: mosfets.sch

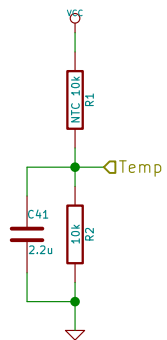
Title: BLDC Driver 4.10

Size: A4 Date: 21 aug 2015

KiCad E.D.A. kicad 0.201510030351+624130ubuntu15.10.1-product

Rev: 4.10

Id: 2/7



Benjamin Vedder

Sheet: /NTC temp sensor/
File: temp.sch

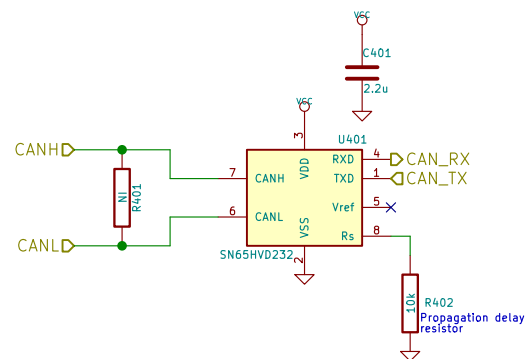
Title: BLDC Driver 4.10

Size: A4 Date: 21 aug 2015

Rev: 4.10

KiCad E.D.A. kicad 0.201510030351+624130ubuntu15.10.1-product

Id: 3/7



Package Types

MCP2561 PDIP, SOIC 	MCP2562 PDIP, SOIC
MCP2561 3x3 DFN* 	MCP2562 3x3 DFN*

* Includes Exposed Thermal Pad (EP); see [Table 1-2](#).

Benjamin Vedder

Sheet: /CAN bus transceiver/

File: CAN.sch

Title: BLDC Driver 4.10

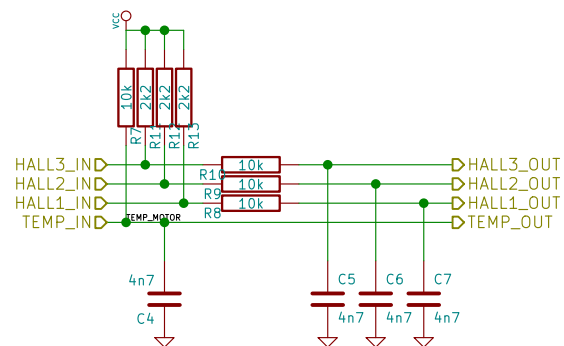
Size: A4

Date: 21 aug 2015

Rev: 4.10

KiCad E.D.A. kicad 0.201510030351+624130ubuntu15.10.1-product

Id: 4/7



Benjamin Vedder

Sheet: /Filters/
File: hall_filters.sch

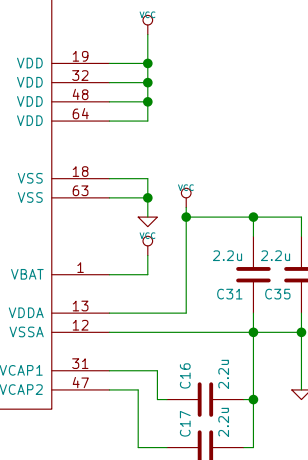
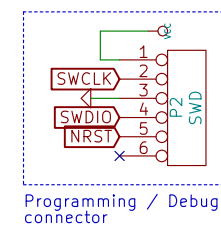
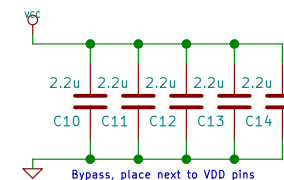
Title: BLDC Driver 4.10

Size: A4 Date: 21 aug 2015
KiCad E.D.A. kicad 0.201510030351+624130ubuntu15.10.1-product

Rev: 4.10
Id: 5/7



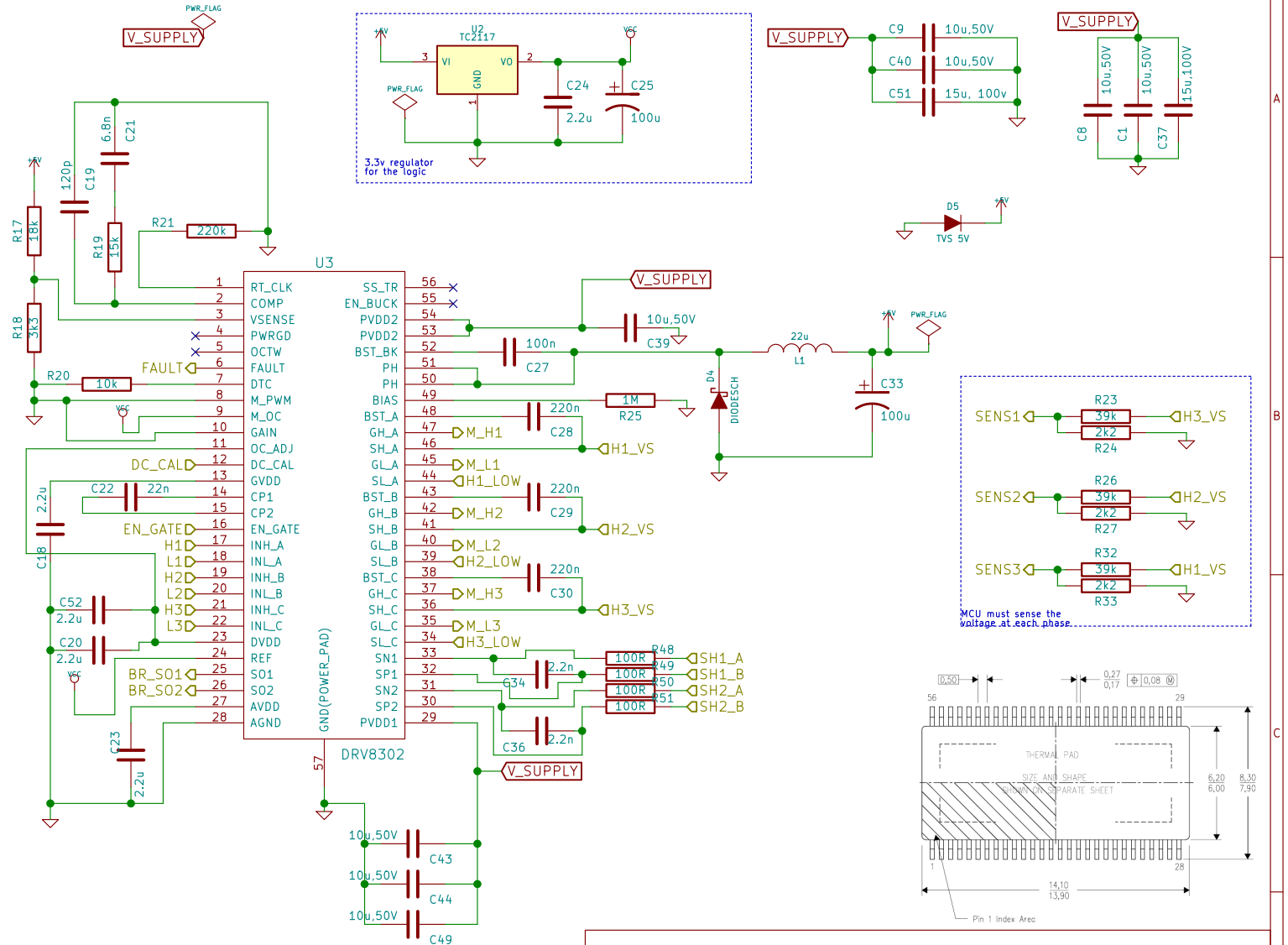
SENS3▷	14	PA0(ADC123_IN0/WKUP)
SENS2▷	15	PA1(ADC123_IN1)
SENS1▷	16	PA2(ADC123_IN2)
ADC_TEMP▷	17	PA3(ADC123_IN3)
TX_SDA_NSS▷	20	PA4(ADC12_IN4/DAC1_OUT)
SCK_ADC_EXT▷	21	PA5(ADC12_IN5/DAC2_OUT)
MISO_ADC_EXT2▷	22	PA6(ADC12_IN6)
RX_SCL_MOSI▷	23	PA7(ADC12_IN7)
H3▷	41	PA8
H2▷	42	PA9(OTG_FS_VBUS)
H1▷	43	PA10
USB_DM▷	44	PA11
USB_DP▷	45	PA12
BR_S02▷	26	PB0(ADC12_IN8)
BR_S01▷	27	PB1(ADC12_IN9)
SERVO▷	57	PB5
HALL_1▷	58	PB6
HALL_2▷	59	PB7
CAN_RX▷	61	PB8
CAN_TX▷	62	PB9
RX_SCL_MOSI▷	29	PB10
TX_SDA_NSS▷	30	PB11
DC_CAL▷	33	PB12
L3▷	34	PB13(OTG_HS_VBUS)
L2▷	35	PB14
L1▷	36	PB15
TEMP_MOTOR▷	8	PC0(ADC123_IN10)
×	9	PC1(ADC123_IN11)
AN_IN▷	10	PC2(ADC123_IN12)
×	11	PC3(ADC123_IN13)
LED_GREEN▷	24	PC4(ADC12_IN14)
LED_RED▷	25	PC5(ADC12_IN15)
TX_SDA_NSS▷	37	PC6
RX_SCL_MOSI▷	38	PC7
×	39	PC8
×	40	PC9
EN_GATE▷	51	PC10
HALL_3▷	52	PC11
FAULT▷	53	PC12
×	2	PC13(RTC_AF1)
×	54	PD2



Id: 6/7

FEATURES

- Operating Supply Voltage 8V–60V
- 2.3A Sink and 1.7A Source Gate Drive Current Capability
- Integrated Dual Shunt Current Amplifiers With Adjustable Gain and Offset
- Integrated Buck Converter to Support up to 1.5A External Load
- Independent Control of 3 or 6 PWM Inputs
- Bootstrap Gate Driver With 100% Duty Cycle Support
- Programmable Dead Time to Protect External FETs from Shoot Through
- Programmable Overcurrent Protection of External MOSFETs
- Thermally Enhanced 56-Pin TSSOP Pad Down DCA Package



RECOMMENDED OPERATING CONDITIONS

	MIN	TYP	MAX	UNITS
PVDD1	DC supply voltage PVDD1 for normal operation	8	60	V
PVDD2	DC supply voltage PVDD2 for buck converter	3.5	60	V
C _{AVDD}	External capacitance on AVDD pin (ceramic cap) 20% tolerance	1		µF
C _{DVDD}	External capacitance on DVDD pin (ceramic cap) 20% tolerance	1		µF
C _{GVDD}	External capacitance on GVDD pin (ceramic cap) 20% tolerance	2.2		µF
C _{CP}	Flying cap on charge pump pins (between CP1 and CP2) (ceramic cap) 20% tolerance	22		nF
C _{BST}	Bootstrap cap (ceramic cap)	100		nF
I _{DD1}	Input current of digital pins when EN_GATE is high	100		µA
I _{DD2}	Input current of digital pins when EN_GATE is low	1		µA
C _{INL}	Maximum capacitance on digital input pin	10		pF
C _{OUT}	Maximum output capacitance on outputs of shunt amplifier	20		pF
R _{DT}	Dead time control resistor range. Time range is 50ns (-GND) to 500ns (150kΩ) with a linear approximation.	0	150	kΩ
I _{FAULT}	FAULT pin sink current. Open-drain V = 0.4 V	2		mA
I _{OCTW}	OCTW pin sink current. Open-drain V = 0.4 V	2		mA
V _{REF}	External voltage reference voltage for current shunt amplifiers	2	6	V
f _{SW}	Operating switching frequency of gate driver	Qg(TOT) = 25 nC or total 30 mA gate drive average current	200	kHz
T _A	Ambient temperature	-40	125	°C

Benjamin Vedder

Sheet: /Mosfet driver/
File: Power.sch

Title: BLDC Driver 4.10

Size: A4 Date: 21 aug 2015

KiCad E.D.A. kicad 0.201510030351+624130ubuntu15.10.1-product

Rev: 4.10

Id: 7/7