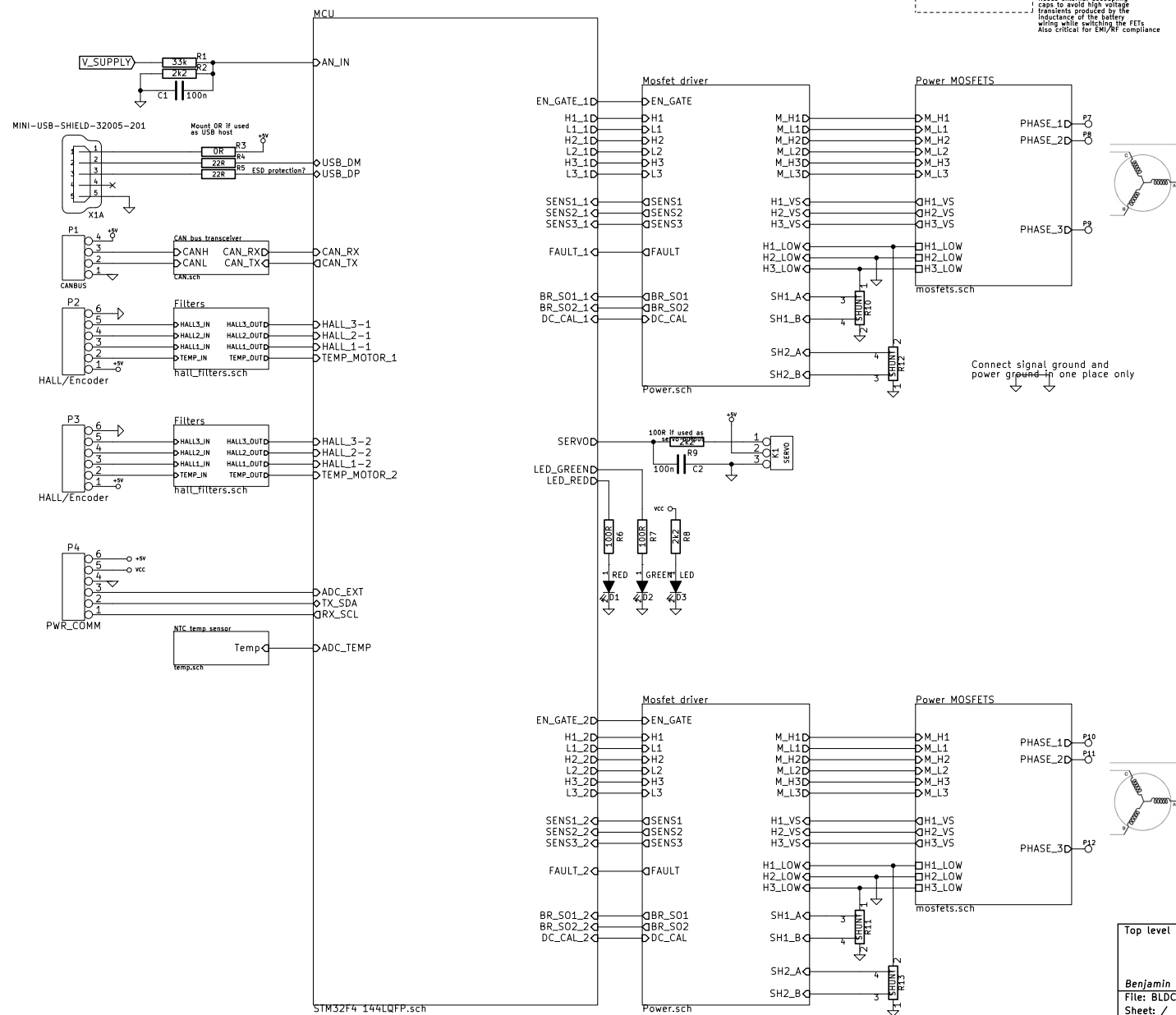
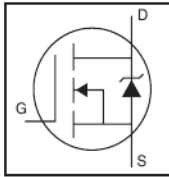


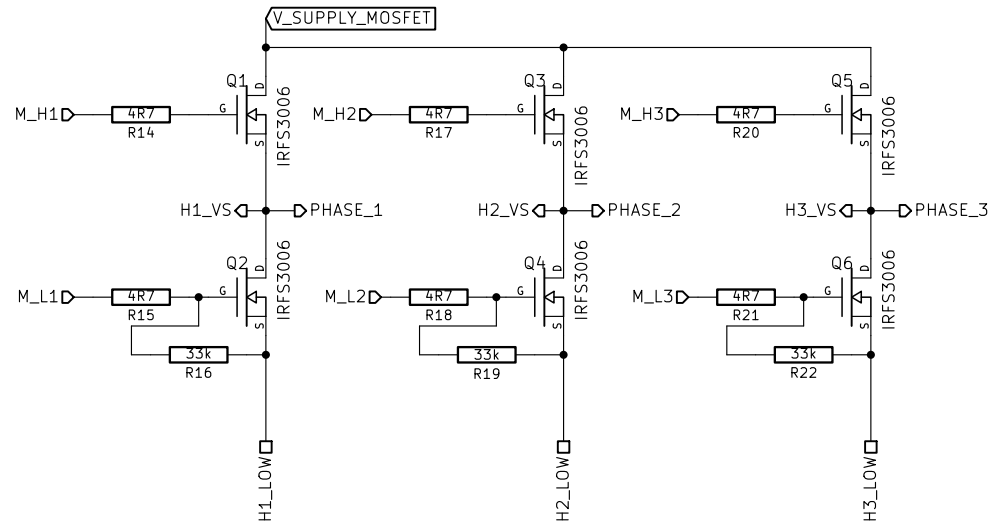
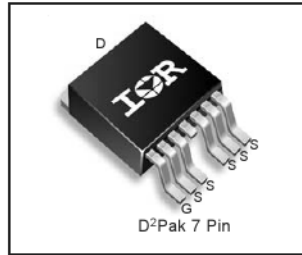
# BLDC motor controller



# HEXFET® Power MOSFET



$V_{DS}$	60V
$R_{DS(on)}$ typ.	1.5m $\Omega$
max.	2.1m $\Omega$
$I_D$ (Silicon Limited)	293A①
$I_D$ (Package Limited)	240A



## Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{DS} = 10\text{V}$ (Silicon Limited)	293①	A
$I_D$ @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{DS} = 10\text{V}$ (Silicon Limited)	207 ②	A
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{DS} = 10\text{V}$ (Package Limited)	240	A
$I_{DS}$	Pulsed Drain Current ③	1172	A
$P_D$ @ $T_C = 25^\circ\text{C}$	Maximum Power Dissipation	375	W
	Linear Derating Factor	2.5	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$dv/dt$	Peak Diode Recovery ④	11	V/ns
$T_J$	Operating Junction and Storage Temperature Range	-55 to +175	°C
$T_{SOL}$	Soldering Temperature, for 10 seconds (1.6mm from case)	300	°C
	Mounting torque, 6-32 or M3 screw	10lb-in (1.1N-m)	

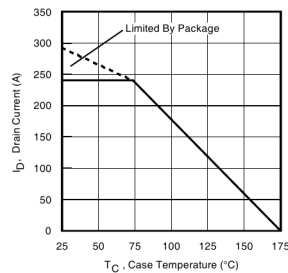


Fig 9. Maximum Drain Current vs. Case Temperature

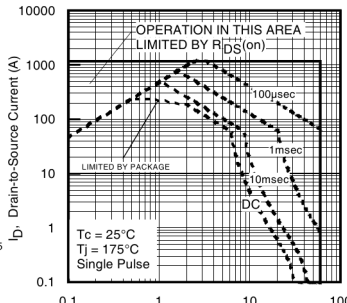
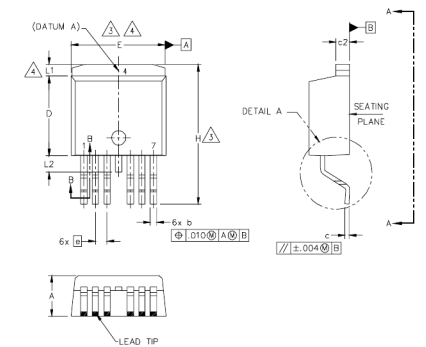


Fig 8. Maximum Safe Operating Area



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File: mosfets.sch

Sheet: /Power MOSFETS/

Title: BLDC Driver 4.6

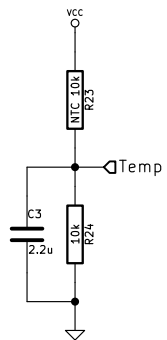
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Date: 16 jan 2015

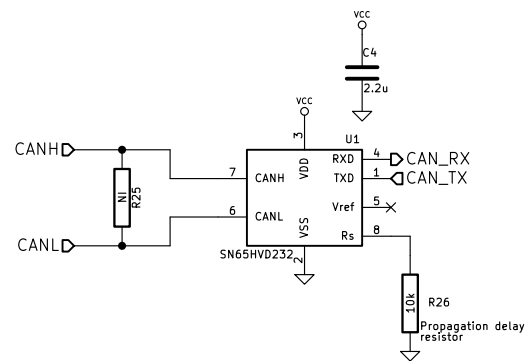
Rev: 4.6

KiCad E.D.A.

Id: 2/10



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Title: NTC resistor temperature sensor		
Size: A4	Date: 16 jan 2015	Rev:
KiCad E.D.A.		Id: 3/10

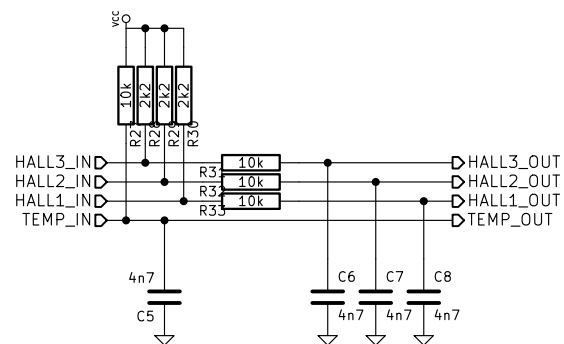


#### Package Types

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

\* Includes Exposed Thermal Pad (EP); see Table 1-2.

Mrk Industries			
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Sheet: /CAN bus transceiver/			
Title: CAN BUS transceiver			
Size: A4	Date: 16 jan 2015	Rev:	
KiCad E.D.A.		Id: 4/10	



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Size: A4	Date: 16 jan 2015	Rev:
KiCad E.D.A.		Id: 5/10

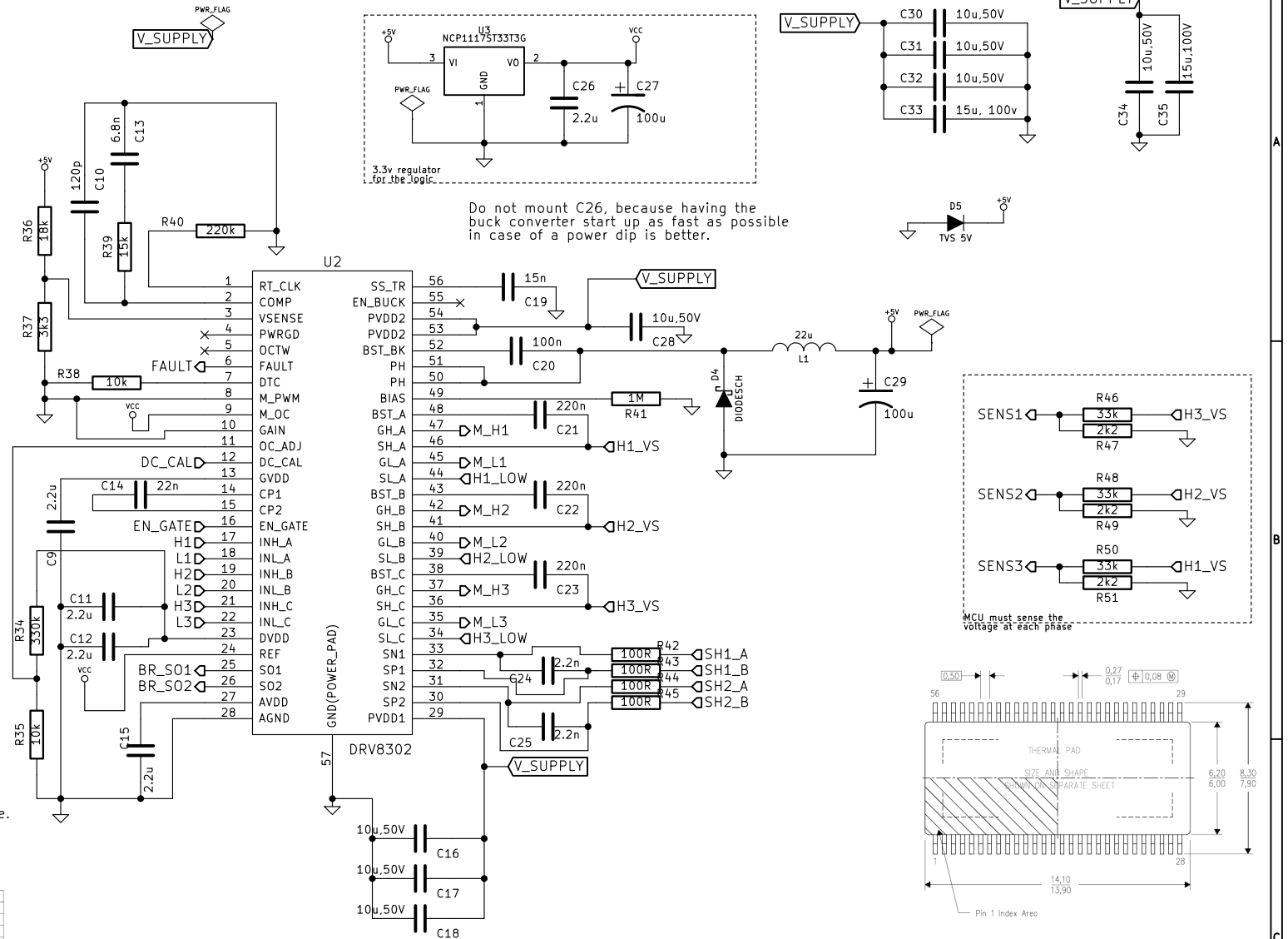
## FEATURES

- 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

Do not mount the resistor R16, because the internal current limit in the DRV8302 does not work with this configuration for some reason. If this resistor is mounted, the DRV8203 will generate faults all the time.

## 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 <sub>AVDD</sub>	External capacitance on AVDD pin (ceramic cap) 20% tolerance	1		µF
C <sub>DVDD</sub>	External capacitance on DVDD pin (ceramic cap) 20% tolerance	1		µF
C <sub>GVDD</sub>	External capacitance on GVDD pin (ceramic cap) 20% tolerance	2.2		µF
C <sub>CP</sub>	Flying cap on charge pump pins (between CP1 and CP2) (ceramic cap) 20% tolerance	22		nF
C <sub>BOOT</sub>	Bootstrap cap (ceramic cap)	100		nF
I <sub>DD1,EN</sub>	Input current of digital pins when EN_GATE is high	100		µA
I <sub>DD1,DIS</sub>	Input current of digital pins when EN_GATE is low	1		µA
C <sub>DI</sub>	Maximum capacitance on digital input pin	10		pF
C <sub>O,OPA</sub>	Maximum output capacitance on outputs of shunt amplifier	20		pF
R <sub>DT</sub>	Dead time control resistor range. Time range is 50ns (-GND) to 500ns (150kΩ) with a linear approximation.	0	150	kΩ
I <sub>FAULT</sub>	FAULT pin sink current. Open-drain V = 0.4 V	2		mA
I <sub>OCTW</sub>	OCTW pin sink current. Open-drain V = 0.4 V	2		mA
V <sub>REF</sub>	External voltage reference voltage for current shunt amplifiers	2	6	V
f <sub>SW</sub>	Operating switching frequency of gate driver	Qg(TOT) = 25 nC or total 30 mA gate drive average current	200	kHz
T <sub>A</sub>	Ambient temperature	-40	125	°C



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Sheet: /Mosfet driver/

Title: BLDC Driver 4.5

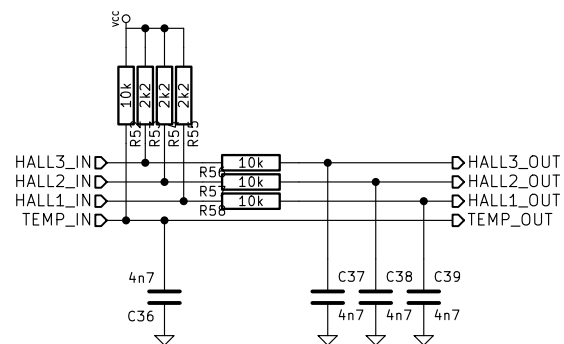
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Date: 16 jan 2015

Rev: 4.5

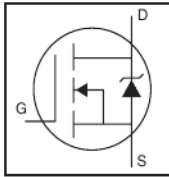
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Id: 6/10

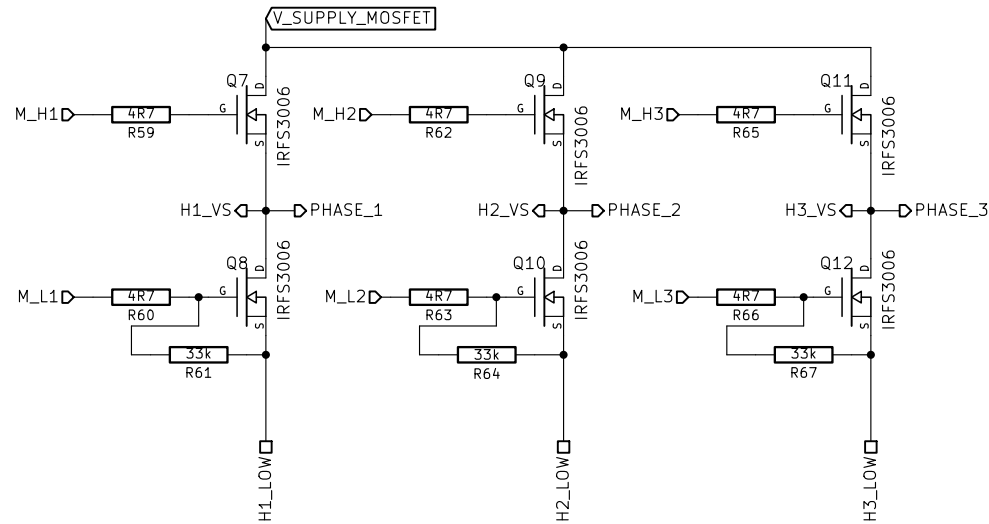
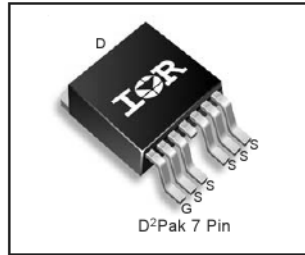


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Sheet: /Filters/		
Title:		
Size: A4	Date: 16 jan 2015	Rev:
KiCad E.D.A.		Id: 7/10

# HEXFET® Power MOSFET



$V_{DS}$	60V
$R_{DS(on)}$ typ.	1.5m $\Omega$
max.	2.1m $\Omega$
$I_D$ (Silicon Limited)	293A①
$I_D$ (Package Limited)	240A



## Absolute Maximum Ratings

Symbol	Parameter	Max.	Units
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{DS} = 10\text{V}$ (Silicon Limited)	293①	A
$I_D$ @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{DS} = 10\text{V}$ (Silicon Limited)	207 ②	A
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{DS} = 10\text{V}$ (Package Limited)	240	A
$I_{DS}$	Pulsed Drain Current ③	1172	A
$P_D$ @ $T_C = 25^\circ\text{C}$	Maximum Power Dissipation	375	W
	Linear Derating Factor	2.5	W/°C
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$dv/dt$	Peak Diode Recovery ④	11	V/ns
$T_J$	Operating Junction and Storage Temperature Range	-55 to +175	°C
$T_{SOL}$	Soldering Temperature, for 10 seconds (1.6mm from case)	300	°C
	Mounting torque, 6-32 or M3 screw	10lb-in (1.1N-m)	

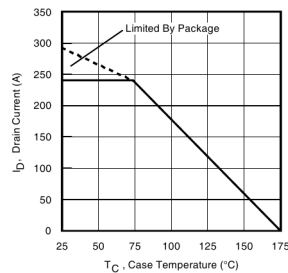


Fig 9. Maximum Drain Current vs. Case Temperature

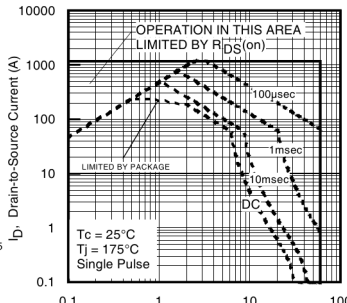
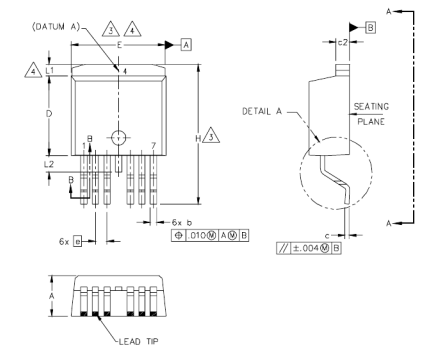


Fig 8. Maximum Safe Operating Area



Benjamin Vedder

File: mosfets.sch

Sheet: /Power MOSFETS/

Title: BLDC Driver 4.6

Size: A4

Date: 16 jan 2015

KiCad E.D.A.

Rev: 4.6

Id: 8/10





# STM32F405xx STM32F407xx

ARM Cortex-M4 32b MCU+FPU, 210DMIPS, up to 1MB Flash/192+4KB RAM, USB OTG/USB-Ethernet, 17 TIMs, 2 ADCs, 15 communication interfaces & camera

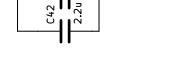
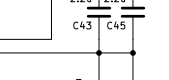
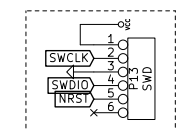
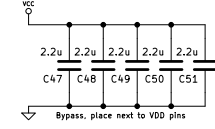
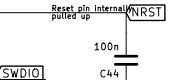
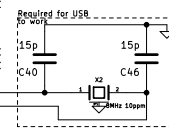
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SENS2_1	35	PA1(ADC123_IN1)	PC15-OSC32_OUT
SENS1_1	36	PA2(ADC123_IN2)	
	37	PA3(ADC123_IN3)	PH0-OSC_IN
ADC_TEMP	41	PA4(ADC12_IN4/DAC1_OUT)	PH1-OSC_OUT
BR_S02_1	42	PA5(ADC12_IN5/DAC2_OUT)	BOOT0(VPP)
BR_S01_1	43	PA6(ADC12_IN6)	PB2-BOOT1
L3_2	44	PA7(ADC12_IN7)	
	45	PA8	
H2_2	46	PA9(OTG_FS_VBUS)	
H1_2	47	PA10	NRST
USB_DM	48	PA11	
USB_DP	49	PA12	
	50	PA13(JTMS-SWDIO)	
	51	PA14(JTCK-SWCLK)	
	52	PA15(JTDI)	
SERVO	53	PB0(ADC12_IN8)	PB3(JTDO/TRACESWO)
HALL_1D	54	PB1(ADC12_IN9)	PB4(NTRST)
HALL_2D	55	PB5	
CAN_RXD	56	PB6	
CAN_TXD	57	PB7	
RX_SCL	58	PB8	
TX_SDA	59	PB9	
DC_CALD	60	PB10	
L3_3	61	PB11	
L2_3	62	PB12	
L1_3	63	PB13(OTG_HS_VBUS)	
	64	PB14	VDD
	65	PB15	VDD
MP_MOTOR	66	PC0(ADC123_IN10)	VDD
AN_IN0	67	PC1(ADC123_IN11)	VDD
LED_GREEN	68	PC2(ADC123_IN12)	VDD
ADC_EXTD	69	PC3(ADC123_IN13)	VSS
TX_SDA	70	PC4(ADC12_IN14)	VSS
RX_SCL	71	PC5(ADC12_IN15)	VSS
EN_GATE	72	PC6	VBAT
HALL_3D	73	PC7	VDDA
FAULTD	74	PC8	VSSA
	75	PC9	VCAP1
	76	PC10	VCAP2
	77	PC11	
	78	PC12	
	79	PC13(RTC_AF1)	
	80	PD0	
	81	PD1	
	82	PD2	
	83	PD3	
	84	PD4	
	85	PD5	
	86	PD6	
	87	PD7	
	88	PD8	
	89	PD9	
	90	PD10	
	91	PD11	
	92	PD12	
	93	PD13	
	94	PD14	
	95	PD15	
	96	PF0	
	97	PF1	
	98	PF2	
	99	PF3(ADC3_IN9)	
	100	PF4(ADC3_IN14)	
	101	PF5(ADC3_IN15)	
	102	PF6(ADC3_IN4)	
	103	PF7(ADC3_IN5)	
	104	PF8(ADC3_IN6)	
	105	PF9(ADC3_IN7)	
	106	PF10(ADC3_IN8)	
	107	PF11	
	108	PF12	
	109	PF13	
	110	PF14	
	111	PF15	
	112	PG0	
	113	PG1	
	114	PG2	
	115	PG3	
	116	PG4	
	117	PG5	
	118	PG6	
	119	PG7	
	120	PG8	
	121	PG9	
	122	PG10	
	123	PG11	
	124	PG12	
	125	PG13	
	126	PG14	
	127	PG15	

STM32F40X\_LQFP64

U4

SENS3_1	34	PA0(ADC123_IN0/WKUP)	PE0	141	
SENS2_1	35	PA1(ADC123_IN1)	PE1	142	
SENS1_1	36	PA2(ADC123_IN2)	PE2	1	
	37	PA3(ADC123_IN3)	PE3	2	
ADC_TEMP	41	PA4(ADC12_IN4/DAC1_OUT)	PE4	3	
BR_S02_1	42	PA5(ADC12_IN5/DAC2_OUT)	PE5	4	
BR_S01_1	43	PA6(ADC12_IN6)	PE6	5	
L3_2	44	PA7(ADC12_IN7)	PE7	58	
	45	PA8	PE8	59	H3_1
	46	PA9(OTG_FS_VBUS)	PE9	60	L3_1
	47	PA10	PE10	63	H2_1
	48	PA11	PE11	64	L2_1
	49	PA12	PE12	65	H1_1
	50	PA13(JTMS-SWDIO)	PE13	66	L1_1
	51	PA14(JTCK-SWCLK)	PE14	67	
	52	PA15(JTDI)	PE15	68	
SERVO	53	PB0(ADC12_IN8)			
HALL_1D	54	PB1(ADC12_IN9)			
HALL_2D	55	PB5			
CAN_RXD	56	PB6			
CAN_TXD	57	PB7			
RX_SCL	58	PB8			
TX_SDA	59	PB9			
DC_CALD	60	PB10			
L3_3	61	PB11			
L2_3	62	PB12			
L1_3	63	PB13(OTG_HS_VBUS)			
	64	PB14			
	65	PB15			
TEMP_MOTOR_1D	66	PC0(ADC123_IN10)			
LED_RED	67	PC1(ADC123_IN11)			
LED_GREEN	68	PC2(ADC123_IN12)			
ADC_EXTD	69	PC3(ADC123_IN13)			
H3_2	70	PC4(ADC12_IN14)			
H2_2	71	PC5(ADC12_IN15)			
H1_2	72	PC6			
EN_GATE_1D	73	PC7			
FAULT_1D	74	PC8			
	75	PC9			
	76	PC10			
	77	PC11			
	78	PC12			
	79	PC13(RTC_AF1)			
HALL_1-2D	80	PD0			
HALL_2-2D	81	PD1			
HALL_3-2D	82	PD2			
	83	PD3			
	84	PD4			
TX_SDA	85	PD5			
RX_SCL	86	PD6			
EN_GATE_2D	87	PD7			
FAULT_2D	88	PD8			
	89	PD9			
	90	PD10			
	91	PD11			
	92	PD12			
	93	PD13			
	94	PD14			
	95	PD15			
DC_CALD	96	PF0			
	97	PF1			
	98	PF2			
SENS3_2	99	PF3(ADC3_IN9)			
SENS2_2	100	PF4(ADC3_IN14)			
SENS1_2	101	PF5(ADC3_IN15)			
TEMP_MOTOR_2D	102	PF6(ADC3_IN4)			
BR_S02_2	103	PF7(ADC3_IN5)			
BR_S01_2	104	PF8(ADC3_IN6)			
	105	PF9(ADC3_IN7)			
	106	PF10(ADC3_IN8)			
	107	PF11			
	108	PF12			
	109	PF13			
	110	PF14			
	111	PF15			
	112	PG0			
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	118	PG6			
	119	PG7			
	120	PG8			
	121	PG9			
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STM32F40X\_LQFP144



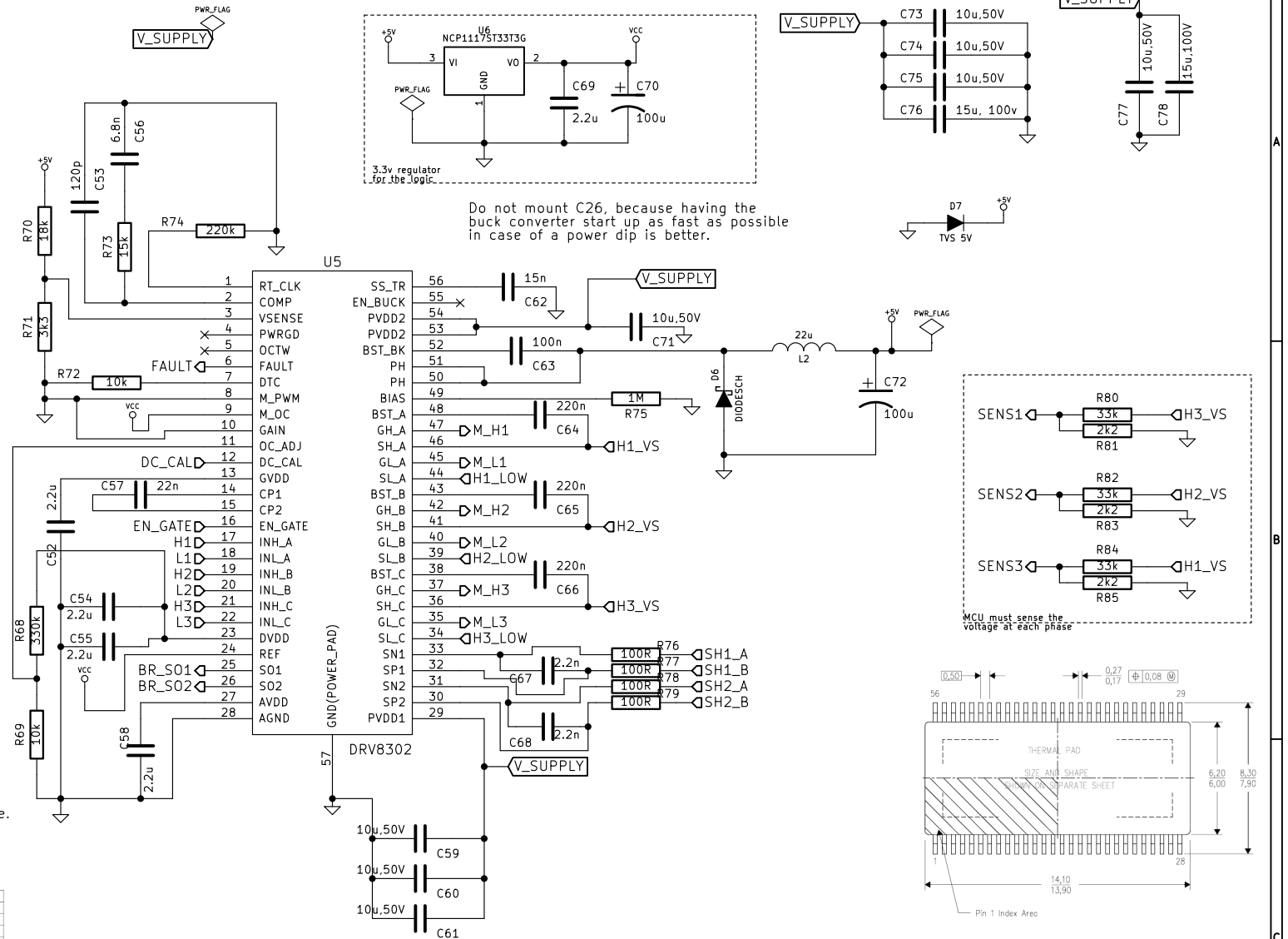
## FEATURES

- 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

Do not mount the resistor R16, because the internal current limit in the DRV8302 does not work with this configuration for some reason. If this resistor is mounted, the DRV8203 will generate faults all the time.

## 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 <sub>AVDD</sub>	External capacitance on AVDD pin (ceramic cap) 20% tolerance	1		µF
C <sub>DVDD</sub>	External capacitance on DVDD pin (ceramic cap) 20% tolerance	1		µF
C <sub>GVDD</sub>	External capacitance on GVDD pin (ceramic cap) 20% tolerance	2.2		µF
C <sub>CP</sub>	Flying cap on charge pump pins (between CP1 and CP2) (ceramic cap) 20% tolerance	22		nF
C <sub>BST</sub>	Bootstrap cap (ceramic cap)	100		nF
I <sub>DDM,EN</sub>	Input current of digital pins when EN_GATE is high	100		µA
I <sub>DDM,DIS</sub>	Input current of digital pins when EN_GATE is low	1		µA
C <sub>DI</sub>	Maximum capacitance on digital input pin	10		pF
C <sub>O,OPA</sub>	Maximum output capacitance on outputs of shunt amplifier	20		pF
R <sub>DT</sub>	Dead time control resistor range. Time range is 50ns (GND) to 500ns (150kΩ) with a linear approximation.	0	150	kΩ
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I <sub>OCTW</sub>	OCTW pin sink current. Open-drain	V = 0.4 V	2	mA
V <sub>REF</sub>	External voltage reference voltage for current shunt amplifiers	2	6	V
f <sub>SW</sub>	Operating switching frequency of gate driver	Qg(TOT) = 25 nC or total 30 mA gate drive average current	200	kHz
T <sub>A</sub>	Ambient temperature	–40	125	°C



Benjamin Vedder

File: Power.sch

Sheet: /Mosfet driver/

Title: BLDC Driver 4.5

Size: A4

Date: 16 jan 2015

Rev: 4.5

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Id: 10/10