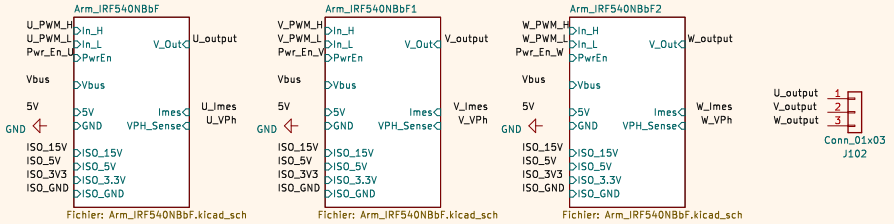
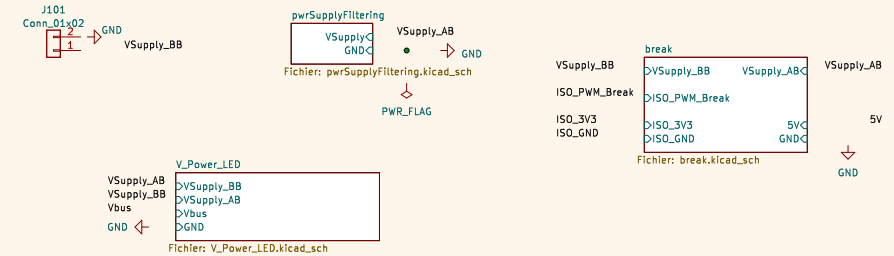
Power Side

Chopper
3x Half-bridges

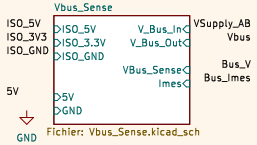


Input Supply and DC/DC converters



Break for reverse current protection

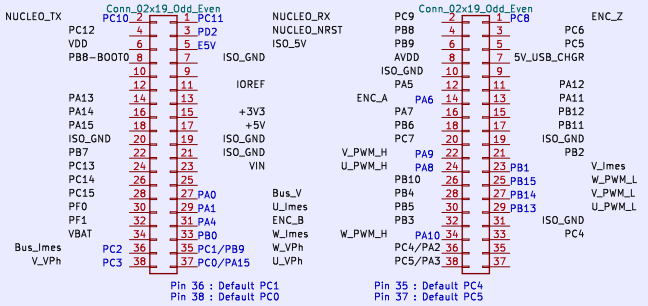
Bus mesurement
Current and voltage



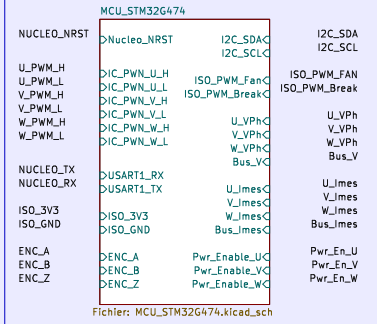
MCU Side

NUCLEO for student programming
NUCLEO-G474RE

Change Jumper JP5 to E5V
Nucleo supplied by ISO_5V

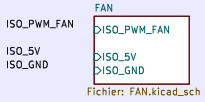


STM32G474RET6 uC for signals analyse and protection
Buttons, leds, screen and rotary encoder connectors

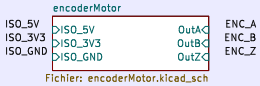


Temperature Sensor based on TCN75A

FAN
2 outputs

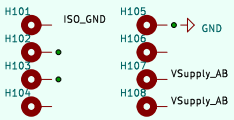


Feedback motor enc

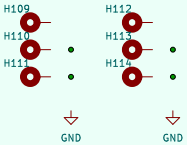


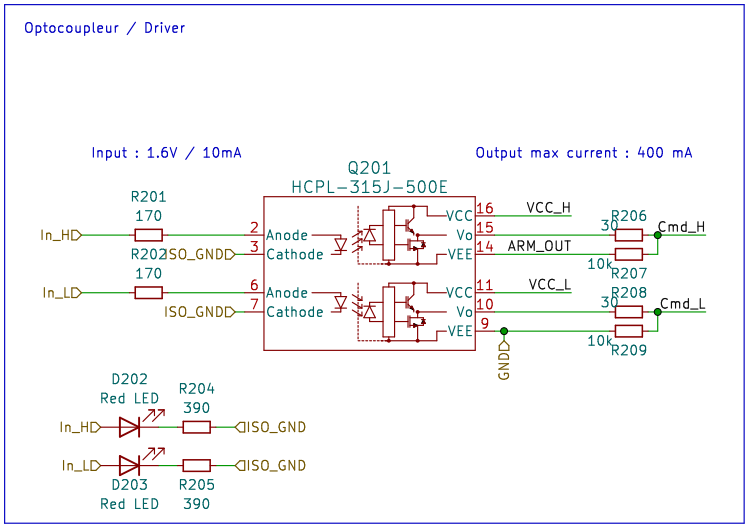
Mounting Holes

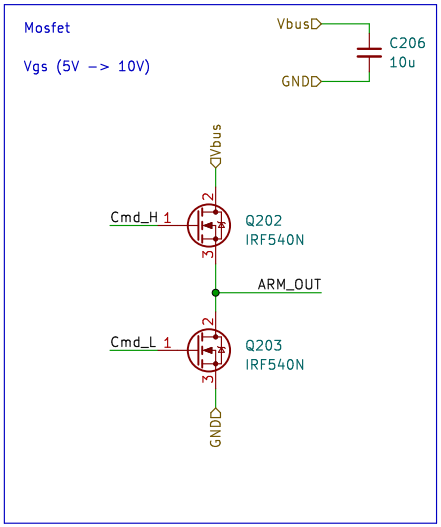
Mounting Holes

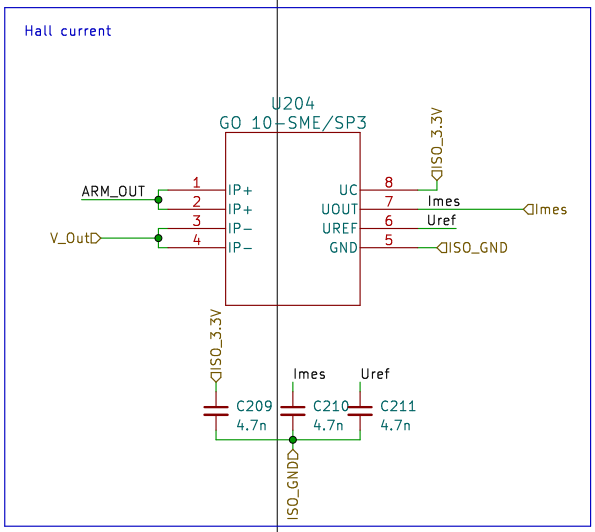


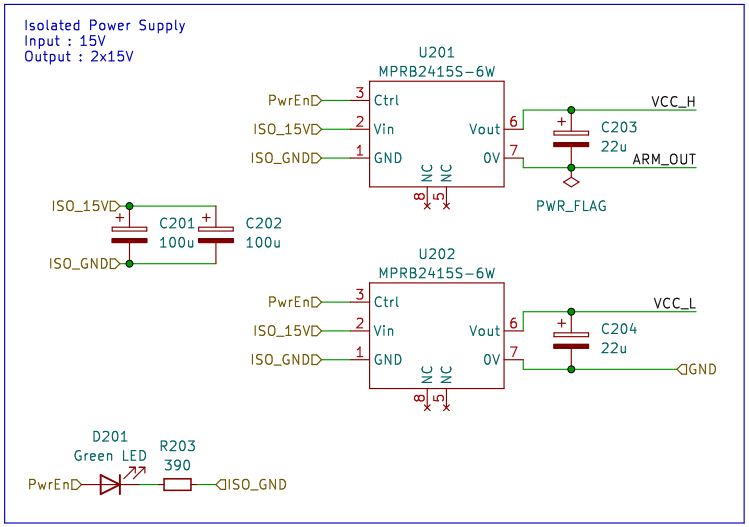
Heatsink

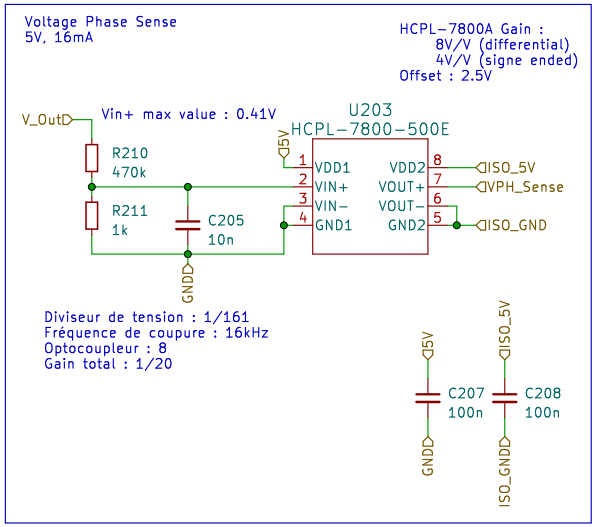


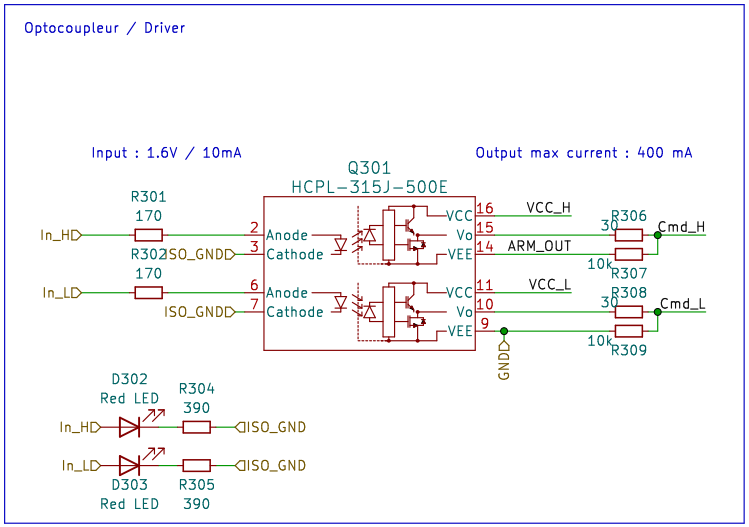

Optocoupleur / Driver
Input : 1.6V / 10mA
Output max current : 400 mA
Q201
HCPL-315J-500E
R201
170
In_HD
R202
170
In_LD
ISO_GND
Anode
Cathode
VCC
Vo
VEE
VCC_H
VCC_L
ARM_OUT
R206
R207
R208
R209
10k
Cmd_H
Cmd_L
GNDD
D202
Red LED
R204
390
D203
Red LED
R205
390

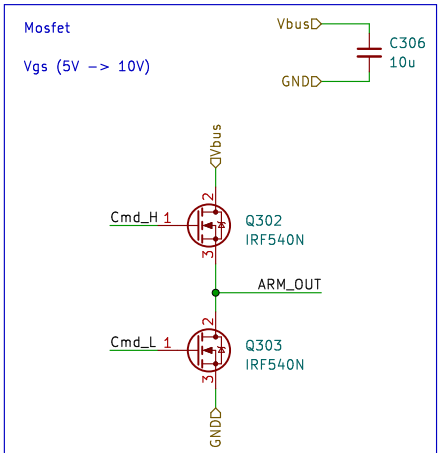

Mosfet
Vgs (5V -> 10V)
Vbus
GNDD
C206
10u
Cmd_H
Cmd_L
Q202
IRF540N
Q203
IRF540N
ARM_OUT

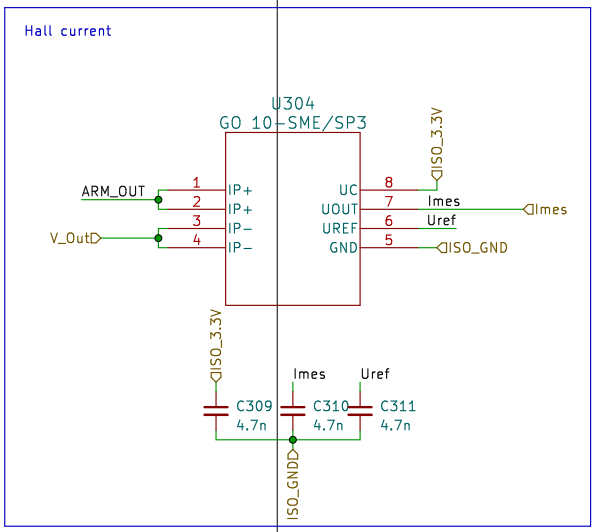

Hall current
U204
GO 10-SME/SP3
ARM_OUT
V_Out
IP+
IP+
IP-
IP-
UC
UOUT
UREF
GND
ISO_3.3V
Imes
Uref
ISO_GND
C209
4.7n
C210
4.7n
C211
4.7n

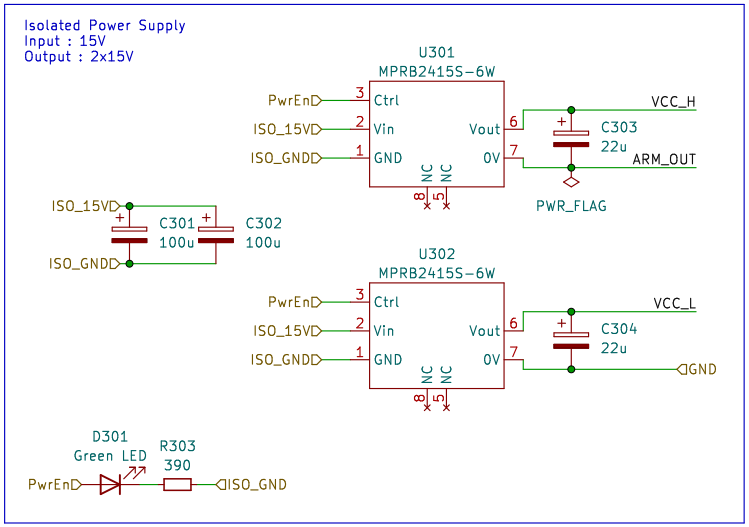

Isolated Power Supply
Input : 15V
Output : 2x15V
U201
MPRB2415S-6W
U202
MPRB2415S-6W
PwrEnD
ISO_15V
ISO_GNDD
Ctrl
Vin
GND
Vout
0V
NC
VCC_H
VCC_L
ARM_OUT
GNDD
C201
100u
C202
100u
C203
22u
C204
22u
PWR_FLAG
D201
Green LED
R203
390

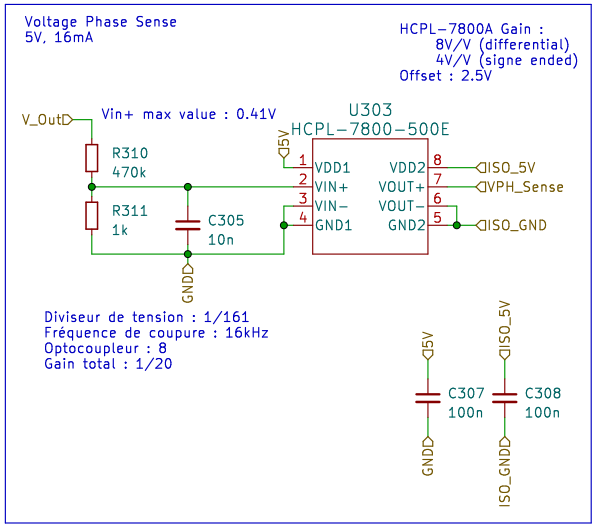

Voltage Phase Sense
5V, 16mA
HCPL-7800A Gain :
8V/V (differential)
4V/V (signe ended)
Offset : 2.5V
V_OutD
Vin+ max value : 0.41V
U203
HCPL-7800-500E
R210
470k
R211
1k
C205
10n
VDD1
VIN+
VIN-
GND1
VDD2
VOUT+
VOUT-
GND2
ISO_5V
VPH_Sense
ISO_GND
5V
GNDD
Diviseur de tension : 1/161
Fréquence de coupure : 16kHz
Optocoupleur : 8
Gain total : 1/20
C207
100n
C208
100n
ISO_GNDD

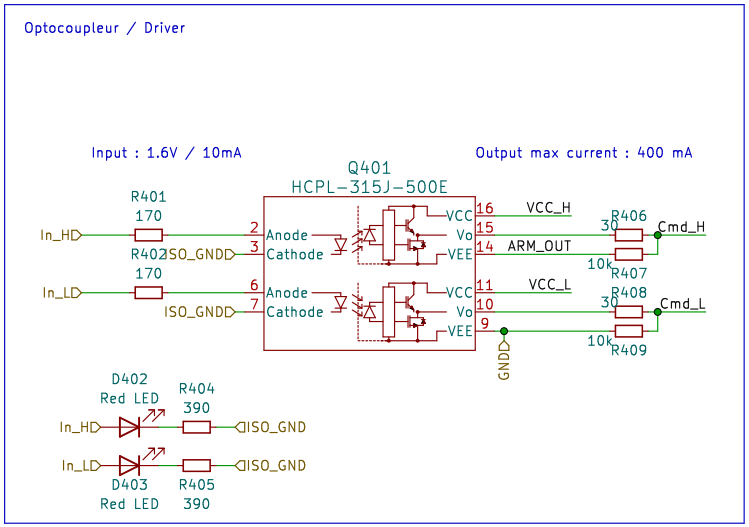

Optocoupleur / Driver
Input : 1.6V / 10mA
Output max current : 400 mA
Q301
HCPL-315J-500E
R301
170
In_HD
R302
170
In_LD
ISO_GNDD
Anode
Cathode
VCC
Vo
VEE
16
15
14
11
10
9
VCC_H
ARM_OUT
VCC_L
GNDD
R306
30
10k
R307
R308
30
10k
R309
Cmd_H
Cmd_L
D302
Red LED
R304
390
D303
Red LED
R305
390
ISO_GND

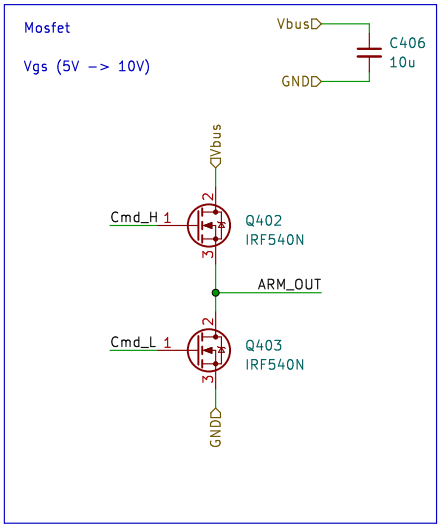

Mosfet
Vgs (5V -> 10V)
Vbus
GNDD
C306
10u
Cmd_H 1
Cmd_L 1
Q302
IRF540N
Q303
IRF540N
ARM_OUT

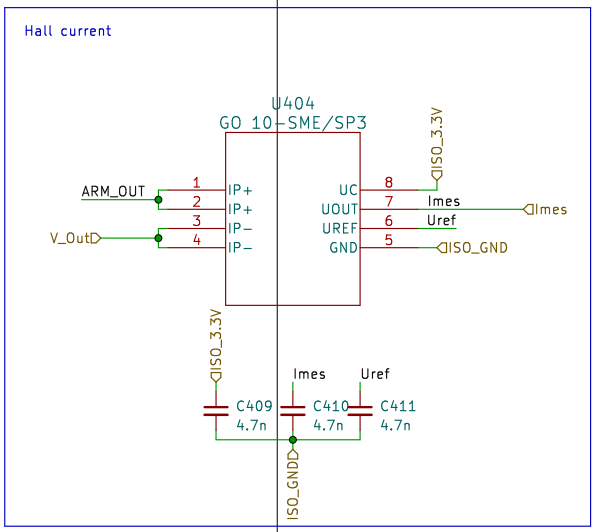

Hall current
U304
GO 10-SME/SP3
ARM_OUT
V_Out
IP+
IP+
IP-
IP-
UC
UOUT
UREF
GND
ISO_3.3V
Imes
Uref
ISO_GND
C309
4.7n
C310
4.7n
C311
4.7n

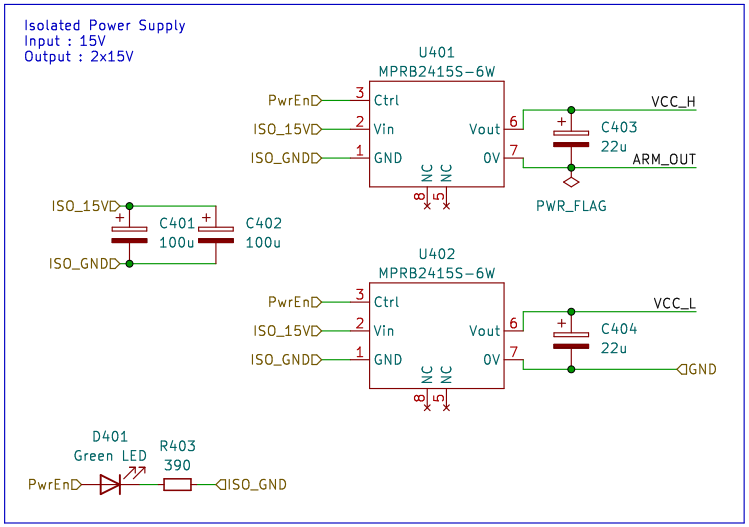

Isolated Power Supply
Input : 15V
Output : 2x15V
U301
MPRB2415S-6W
U302
MPRB2415S-6W
PwrEnD
ISO_15VD
ISO_GNDD
Ctrl
Vin
GND
Vout
0V
NC
VCC_H
VCC_L
ARM_OUT
GND
C303
22u
C304
22u
PWR_FLAG
C301
100u
C302
100u
D301
Green LED
R303
390

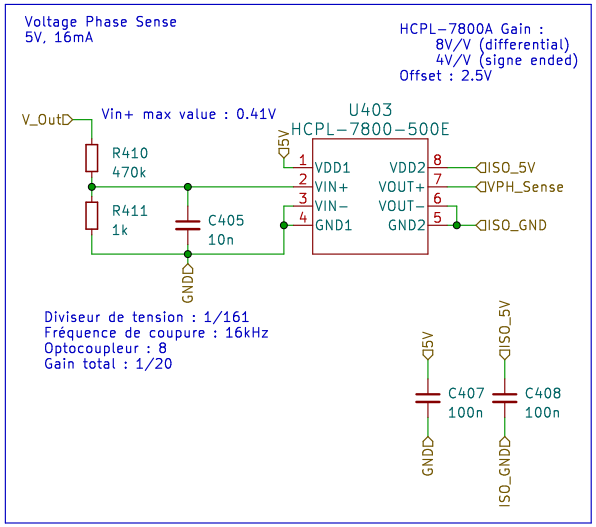

Voltage Phase Sense
5V, 16mA
HCPL-7800A Gain :
8V/V (differential)
4V/V (signe ended)
Offset : 2.5V
V_OutD
Vin+ max value : 0.41V
U303
HCPL-7800-500E
R310
470k
R311
1k
C305
10n
5V
VDD1
VIN+
VIN-
GND1
VDD2
VOUT+
VOUT-
GND2
ISO_5V
VPH_Sense
ISO_GND
GNDD
Diviseur de tension : 1/161
Fréquence de coupure : 16kHz
Optocoupleur : 8
Gain total : 1/20
C307
100n
C308
100n
ISO_GNDD

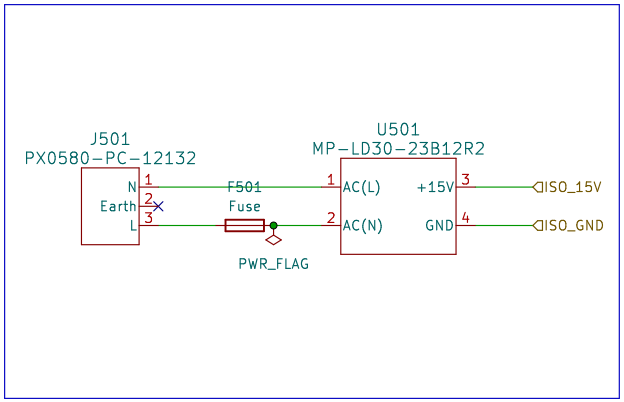

Optocoupleur / Driver
Input : 1.6V / 10mA
Output max current : 400 mA
Q401
HCPL-315J-500E
R401
170
In_HD
R402
170
In_LD
ISO_GND
Anode
Cathode
VCC
Vo
VEE
VCC_H
VCC_L
ARM_OUT
R406
R407
R408
R409
10k
Cmd_H
Cmd_L
GNDD
D402
Red LED
R404
390
D403
Red LED
R405
390
ISO_GND

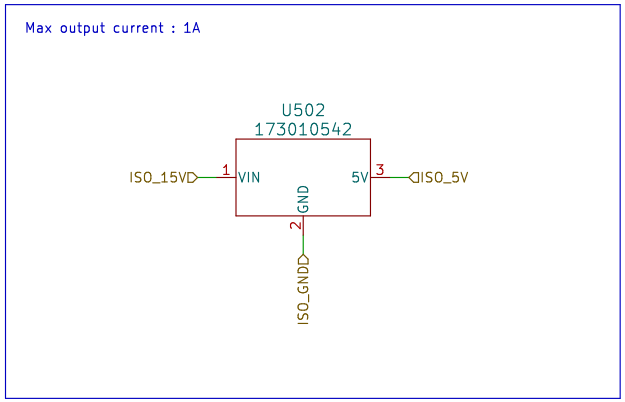

Mosfet
Vgs (5V -> 10V)
Vbus
C406
10u
GNDD
Cmd_H
Cmd_L
Q402
IRF540N
Q403
IRF540N
ARM_OUT

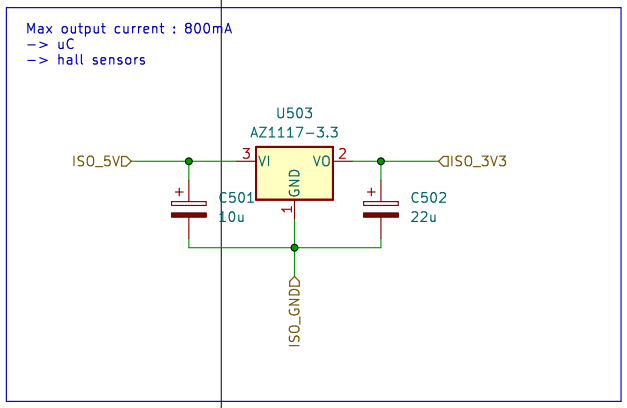

Hall current
U404
GO 10-SME/SP3
ARM_OUT
V_Out
IP+
IP+
IP-
IP-
UC
UOUT
UREF
GND
ISO_3.3V
Imes
Uref
ISO_GND
C409
4.7n
C410
4.7n
C411
4.7n

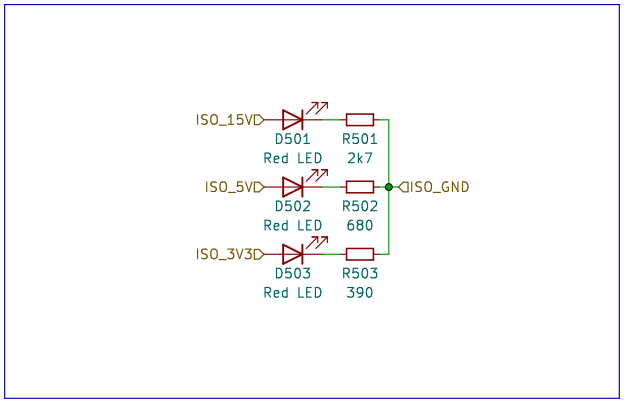

Isolated Power Supply
Input : 15V
Output : 2x15V
U401
MPRB2415S-6W
U402
MPRB2415S-6W
PwrEnD
ISO_15V
ISO_GNDD
Ctrl
Vin
GND
Vout
0V
NC
VCC_H
VCC_L
ARM_OUT
GND
C401
100u
C402
100u
C403
22u
C404
22u
PWR_FLAG
D401
Green LED
R403
390

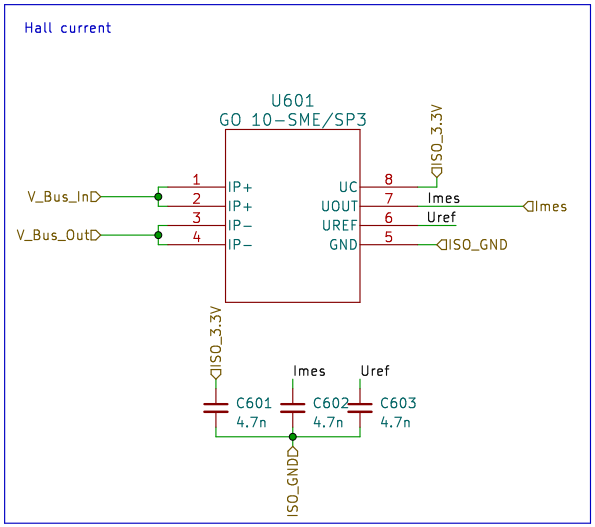

Voltage Phase Sense
5V, 16mA
HCPL-7800A Gain :
8V/V (differential)
4V/V (signe ended)
Offset : 2.5V
V_OutD
Vin+ max value : 0.41V
U403
HCPL-7800-500E
R410
470k
R411
1k
C405
10n
VDD1
VIN+
VIN-
GND1
VDD2
VOUT+
VOUT-
GND2
ISO_5V
VPH_Sense
ISO_GND
GNDD
5V
C407
100n
C408
100n
ISO_GNDD
Diviseur de tension : 1/161
Fréquence de coupure : 16kHz
Optocoupleur : 8
Gain total : 1/20

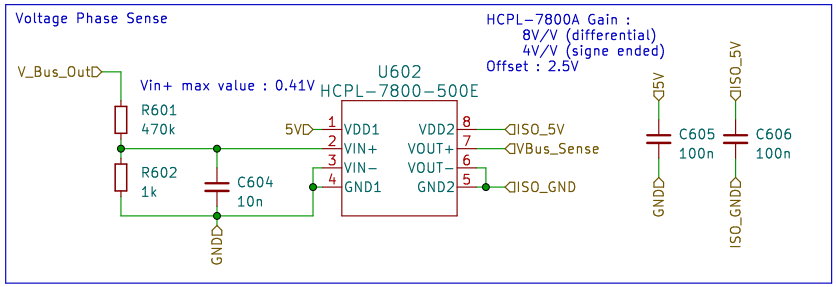

J501
PX0580-PC-12132
N
Earth
L
1
2
3
F501
Fuse
PWR_FLAG
U501
MP-LD30-23B12R2
AC(L)
AC(N)
+15V
GND
ISO_15V
ISO_GND


Max output current : 1A
U502
173010542
ISO_15VD
VIN
GND
5V
ISO_5V
ISO_GNDD

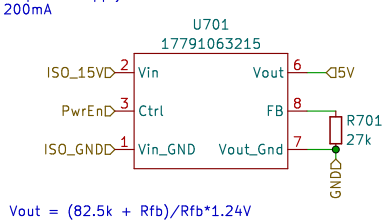

Max output current : 800mA
-> uC
-> hall sensors
U503
AZ1117-3.3
ISO_5VD
VI
GND
VO
ISO_3V3
C501
10u
C502
22u
ISO_GNDD


ISO_15VD
D501
Red LED
R501
2k7
ISO_5VD
D502
Red LED
R502
680
ISO_GND
ISO_3V3D
D503
Red LED
R503
390

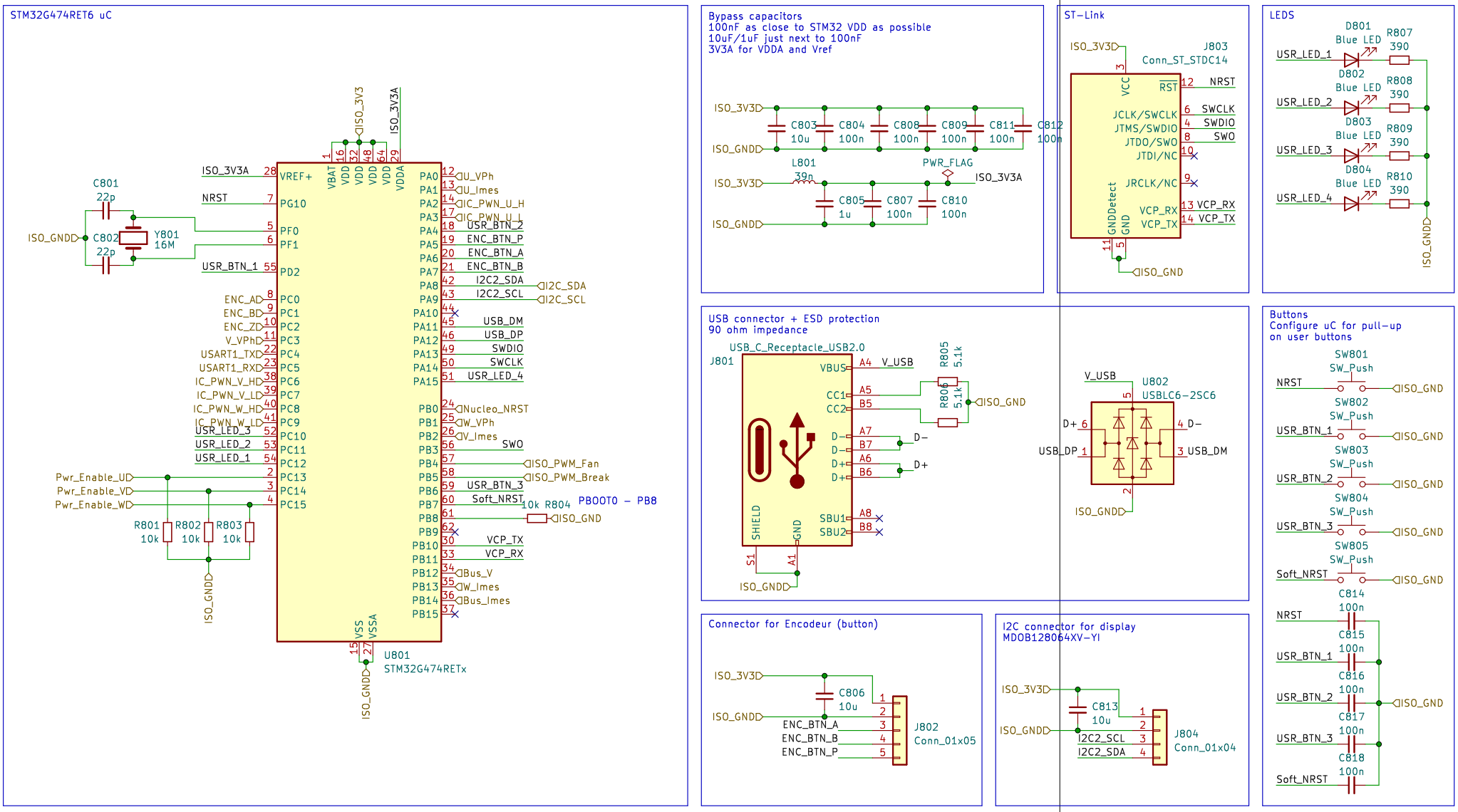

Hall current
U601
GO 10-SME/SP3
V_Bus_In
V_Bus_Out
IP+
IP+
IP-
IP-
UC
UOUT
UREF
GND
Imes
Uref
ISO_3.3V
ISO_GND
Imes
ISO_3.3V
Imes
Uref
C601
4.7n
C602
4.7n
C603
4.7n
ISO_GND

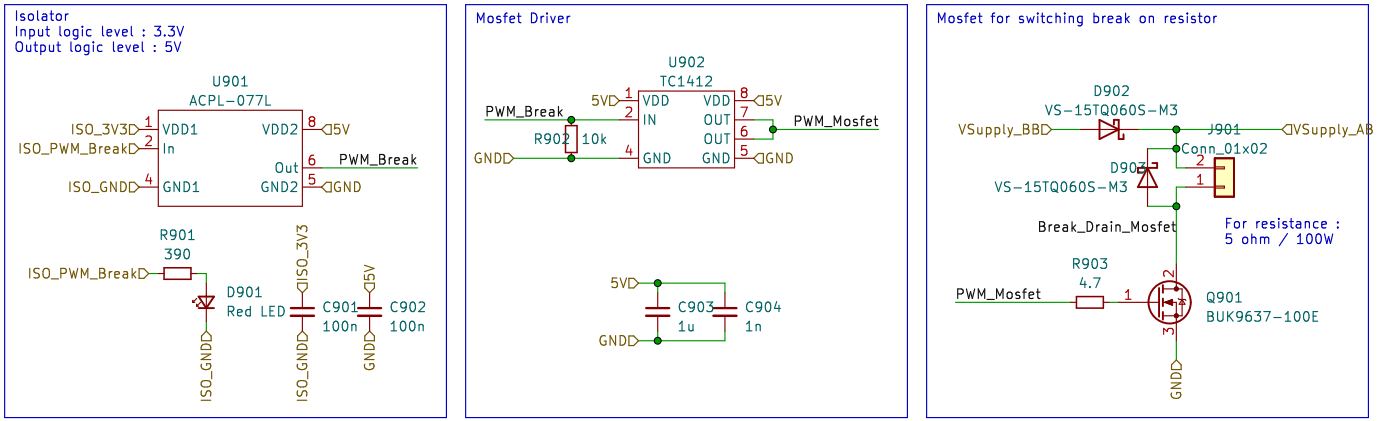

Voltage Phase Sense
HCPL-7800A Gain :
8V/V (differential)
4V/V (signe ended)
Offset : 2.5V
V_Bus_Out
Vin+ max value : 0.41V
R601
470k
R602
1k
C604
10n
GNDD
U602
HCPL-7800-500E
5V
VDD1
VIN+
VIN-
GND1
VDD2
VOUT+
VOUT-
GND2
ISO_5V
VBus_Sense
ISO_GND
5V
C605
100n
GNDD
ISO_5V
C606
100n
ISO_GNDD

Isolated power Supply
5V / 200mA

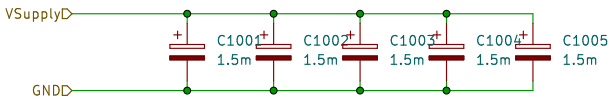


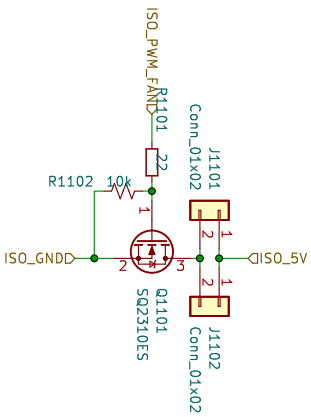
Vout = (82.5k + Rfb)/Rfb*1.24V


STM32G474RET6 uC
U801
STM32G474RETx
C801 22p
C802 22p
Y801 16M
ISO_GNDD
ISO_3V3A
NRST
USR_BTN_1
ENC_AD
ENC_BD
ENC_ZD
V_VPhD
USART1_TXD
USART1_RXD
IC_PWN_V_HD
IC_PWN_V_LD
IC_PWN_W_HD
IC_PWN_W_LD
USR_LED_3
USR_LED_2
USR_LED_1
Pwr_Enable_UD
Pwr_Enable_VD
Pwr_Enable_WD
R801 10k
R802 10k
R803 10k
U_VPh
U_Imes
IC_PWN_U_H
IC_PWN_U_L
USR_BTN_2
ENC_BTN_P
ENC_BTN_A
ENC_BTN_B
I2C2_SDA
I2C2_SCL
USB_DM
USB_DP
SWDIO
SWCLK
USR_LED_4
Nucleo_NRST
W_VPh
V_Imes
SWO
ISO_PWM_Fan
ISO_PWM_Break
USR_BTN_3
Soft_NRST
10k R804
PBOOT0 – PB8
VCP_TX
VCP_RX
Bus_V
W_Imes
Bus_Imes
Bypass capacitors
100nF as close to STM32 VDD as possible
10uF/1uF just next to 100nF
3V3A for VDDA and Vref
C803 10u
C804 100n
C808 100n
C809 100n
C811 100n
C812 100n
L801 39n
PWR_FLAG
C805 1u
C807 100n
C810 100n
ST–Link
J803
Conn_ST_STDC14
SWCLK
SWDIO
SWO
NRST
VCP_RX
VCP_TX
LEDS
D801 Blue LED
D802 Blue LED
D803 Blue LED
D804 Blue LED
R807 390
R808 390
R809 390
R810 390
USR_LED_1
USR_LED_2
USR_LED_3
USR_LED_4
USB connector + ESD protection
90 ohm impedance
J801
USB_C_Receptacle_USB2.0
R805 5.1k
R806 5.1k
V_USB
U802
USBLC6–2SC6
D–
D+
Buttons
Configure uC for pull–up
on user buttons
SW801 SW_Push
SW802 SW_Push
SW803 SW_Push
SW804 SW_Push
SW805 SW_Push
C814 100n
C815 100n
C816 100n
C817 100n
C818 100n
Connector for Encodeur (button)
C806 10u
J802
Conn_01x05
ENC_BTN_A
ENC_BTN_B
ENC_BTN_P
I2C connector for display
MDOB128064XV–YI
C813 10u
J804
Conn_01x04

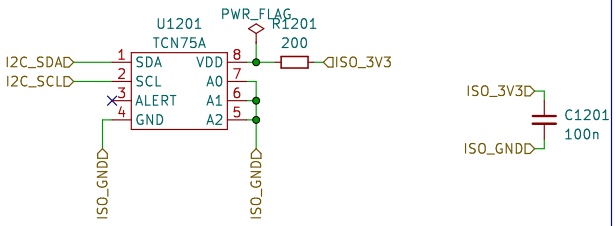

Isolator
Input logic level : 3.3V
Output logic level : 5V
U901
ACPL-077L
ISO_3V3
ISO_PWM_Break
ISO_GND
VDD1
In
GND1
VDD2
Out
GND2
5V
PWM_Break
GND
R901
390
D901
Red LED
C901
100n
C902
100n
ISO_GND
ISO_3V3
5V
Mosfet Driver
U902
TC1412
5VD
PWM_Break
R902
10k
GND
VDD
IN
GND
OUT
PWM_Mosfet
C903
1u
C904
1n
Mosfet for switching break on resistor
D902
VS-15TQ060S-M3
VSupply_BB
J901
VSupply_AB
Conn_01x02
D903
Break_Drain_Mosfet
For resistance :
5 ohm / 100W
R903
4.7
PWM_Mosfet
Q901
BUK9637-100E

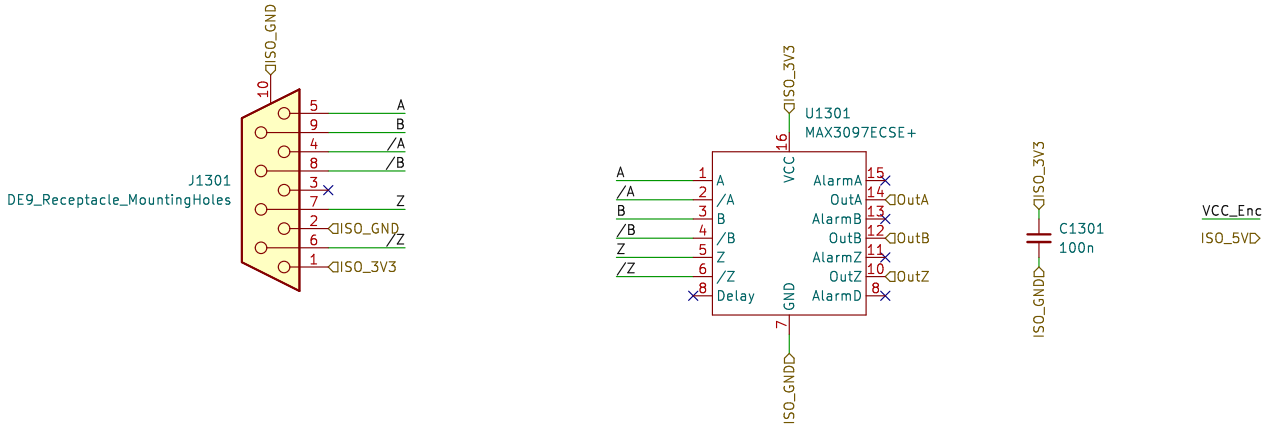
Wurth Capacitor : 861011086027
1.5mF / 200V

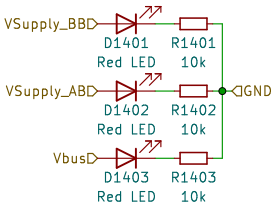



ISO_PWM_FAN
R1101
22
R1102 10k
1
ISO_GND
2
3
Q1101
SQ2310ES
J1101
Conn_01x02
1
2
ISO_5V
J1102
Conn_01x02

TCN75A : temp sensor
I2C Address : 100 1xxx, xxx = A2,A1,A0




J1301
DE9_Receptacle_MountingHoles
10
ISO_GND
5
A
9
B
4
/A
8
/B
3
7
Z
2
ISO_GND
6
/Z
1
ISO_3V3
U1301
MAX3097ECSE+
ISO_3V3
16
VCC
GND
7
ISO_GNDD
A
/A
B
/B
Z
/Z
Delay
1
2
3
4
5
6
8
AlarmA
OutA
AlarmB
OutB
AlarmZ
OutZ
AlarmD
15
14
13
12
11
10
8
OutA
OutB
OutZ
C1301
100n
VCC_Enc
ISO_5V


VSupply_BB
D1401
Red LED
R1401
10k
VSupply_AB
D1402
Red LED
R1402
10k
GND
Vbus
D1403
Red LED
R1403
10k