UM1996
User manual

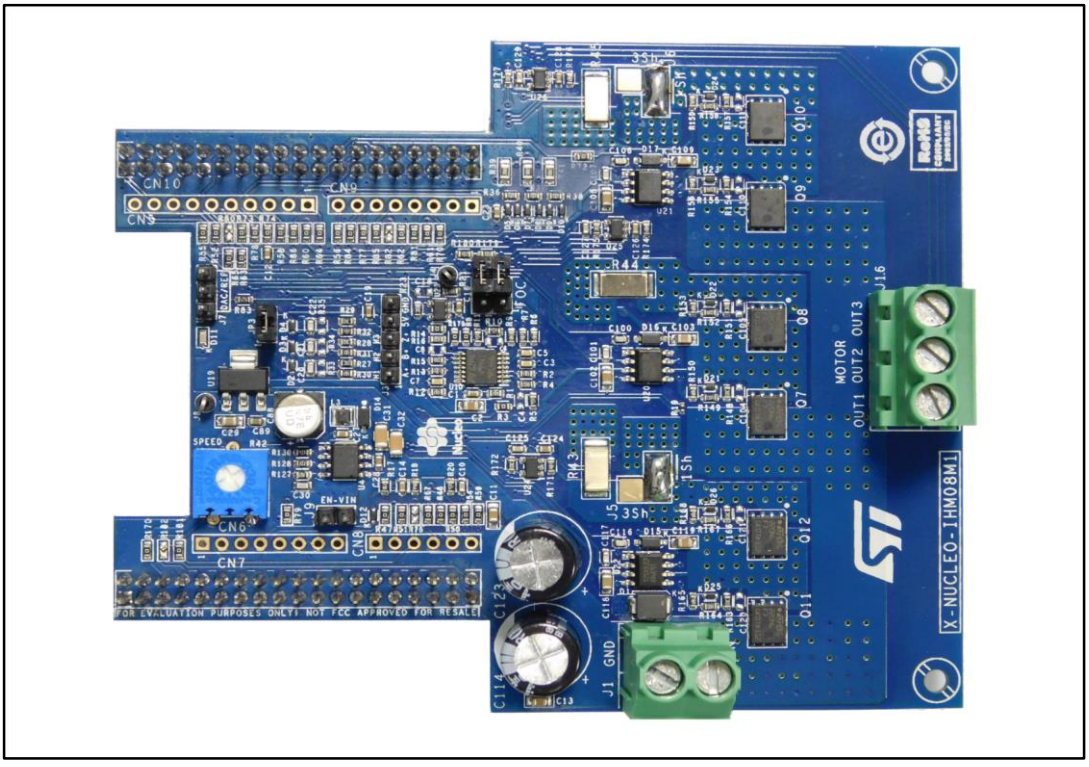
Getting started with X-NUCLEO-IHM08M1 low-voltage BLDC motor driver expansion board based on STL220N6F7 for STM32 Nucleo

Introduction

The X-NUCLEO-IHM08M1 is a three-phase brushless DC motor driver expansion board based on STripFET™ F7 Power MOSFET STL220N6F7 for STM32 Nucleo. It provides an affordable and easy-to-use solution for driving a three-phase brushless DC motor in your STM32 Nucleo project. The X-NUCLEO-IHM08M1 is compatible with the ST morpho connector and supports further stacking of additional boards on a single STM32 Nucleo board. You can also mount the Arduino™ UNO R3 connector.

The X-NUCLEO-IHM08M1 is fully configurable and ready to support different closed loop control scenarios based on sensorless or sensor mode control, and it is compatible with three-shunt or single-shunt current sense measuring. The L6398 IC driver used on this STM32 Nucleo expansion board is a single-chip half bridge gate driver for the N-channel power MOSFET. This combination of the L6398 gate driver and the STL220N6F7 Power MOSFET forms a high current power platform for BLDC motors, while the digital section supported by the STM32 Nucleo board allows for a 6-step or FOC control algorithm solution, which you can select via the firmware. This document describes how to configure the X-NUCLEO-IHM08M1 expansion board to operate with STM32 Nucleo board.

Figure 1: X-NUCLEO-IHM08M1 low-voltage BLDC motor driver expansion board based on STL220N6F7 for STM32 Nucleo



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1 System overview

1.1 Main characteristics

- Three-phase driver board for BLDC/PMSM motors
- Nominal operating voltage range from 8 V to 48 V DC
- 15 A_{RMS} output current
- Operating frequency selectable by firmware
- Overcurrent detection and protection (30 A_{PEAK})
- Thermal measuring and overheating protection
- Full compatible with ST Six Step or ST FOC control algorithm
- Full support for sensorless and sensor mode
- 3-shunt and 1-shunt configurable jumpers for motor current sensing
- Hall / Encoder motor sensor connector and circuit
- Debug connector for DAC, GPIOs, etc.
- Potentiometer available for speed regulation
- User LED
- Compatible with STM32 Nucleo boards
- Equipped with ST morpho connectors
- RoHS compliant

1.2 Target applications

The target applications for the X-NUCLEO-IHM08M1 include:

- Low voltage PMSM motor driver
- Low power fans
- Power tools
- Industrial drives

2 Getting started

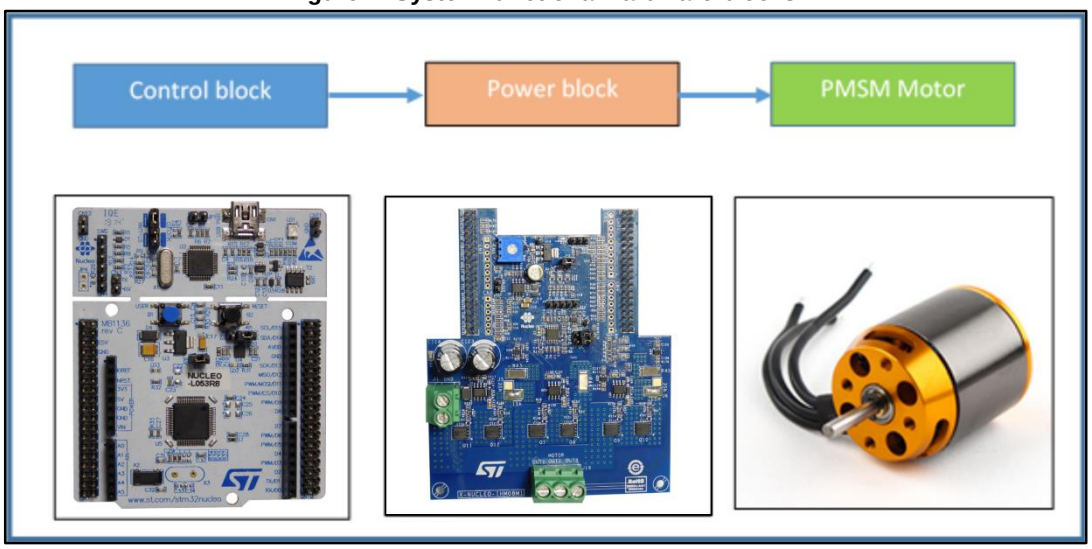
2.1 System architecture

A generic motor control system can be basically schematized as the arrangement of three main functional blocks (see System functional hardware blocks):

- **Control block** accepts user commands to drive a motor. The X-NUCLEO-IHM08M1 is based on the STM32 Nucleo board, which provides all the digital signals for effective motor driving control.
- **Power block** is based on the 3-phase inverter topology. The core of the power block is the embedded L6398 driver, which contains all the necessary active power and analog components to perform low voltage PMSM motor control.
- **Motor** the X-NUCLEO-IHM08M1 is able to proper drive a low voltage BLDC/PMSM motor.

This section describes how to set up different hardware parts before writing and executing an application on the STM32 Nucleo board with the low-voltage BLDC motor driver expansion board.

Figure 2: System functional hardware blocks

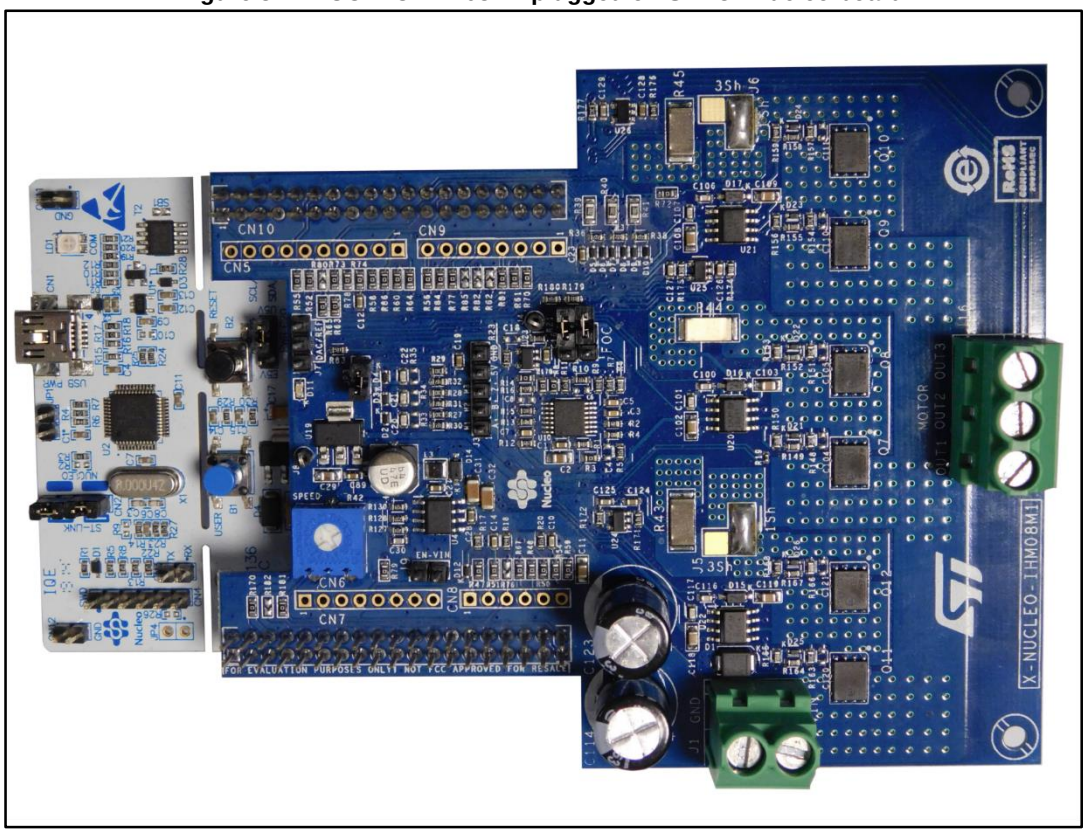


2.2 Building the system

The X-NUCLEO-IHM08M1 expansion board (Power block in the figure above) is a complete hardware development platform for the STM32 Nucleo board allowing effective evaluation of motor control solutions for single BLDC/PMSM motors. For regular board operation, please follow the steps below:

1. Plug the expansion board on an STM32 Nucleo main board (Control block) through the ST morpho connector; there is only one position allowed for this connection. Ensure that the blue (B1) and black (B2) buttons on the STM32 Nucleo board are not covered, as shown below.

Figure 3: X-NUCLEO-IHM08M1 plugged on STM32 Nucleo board



The interconnection between the STM32 Nucleo board and the X-NUCLEO-IHM08M1 expansion board is designed for full-compatibility with a wide range of STM32 Nucleo boards without any solder bridge modifications, except for the removal of resistor R60 on the NUCLEO-F401RE Nucleo board if the X-CUBE-SPN8 firmware is installed.

The stacked system is ready to operate with the connection of a BLDC/PMSM motor. For correct use, please follow the hardware and software settings. For software details, please refer to X-CUBE-SPN8 documentation available on *www.st.com*.

1. Connect the three motor wires U,V,W to the J16 connector.
2. To select the control algorithm (6-step or FOC), ensure no voltage supply is connected.
   On the STM32 NUCLEO board, set jumpers: JP1 open, JP5 (PWR) on E5V side, JP6 (IDD) closed.**On the X-NUCLEO-IHM08M1 expansion board**, set jumpers: J9 open, JP3 closed.
   - For 6-step control (X-CUBE-SPN8 FW), set jumpers: JP1 and JP2 open, J5&J6 on the 1-Sh side. Keep capacitor C5 mounted; in case of poor motor current regulation during startup, reduce its value.
   - For FOC control (STSW-STM32100 FW), set jumpers: JP1 and JP2 closed, J5&J6 on the 3-Sh side. Remove capacitors C3, C5 and C7.
3. Connect the DC supply voltage to the J1 connector. An external power supply is required to power up the power board and the STM32 Nucleo board. Be sure to supply the right power for the connected motor; (e.g., max. 12V and 2A for the BR2804 motor).

When using a different motor rated greater than 12 V, keep jumper J9 on the power board open before applying power-on voltage at J1 to avoid damaging the Nucleo board. To supply the STM32-NUCLEO via usb, connect jumper JP5 between PIN 1 and PIN2. For further details on Nucleo settings, refer to UM1724 at *http://www.st.com*.

2.2.1 Hardware settings

By default, the X-NUCLEO-IHM08M1 provides the power supply voltage for STM32 Nucleo board (+5V on E5V) independently through the power voltage applied at the J1 connector. Removing resistor R170 on the expansion board, you can disconnect internal voltage regulation and select jumper J9 to supply the STM32 Nucleo board directly from J1 connector (see *Table 1: "Jumper settings"*) if, for instance, higher conversion efficiency is required. For this last configuration please read the recommendation below.

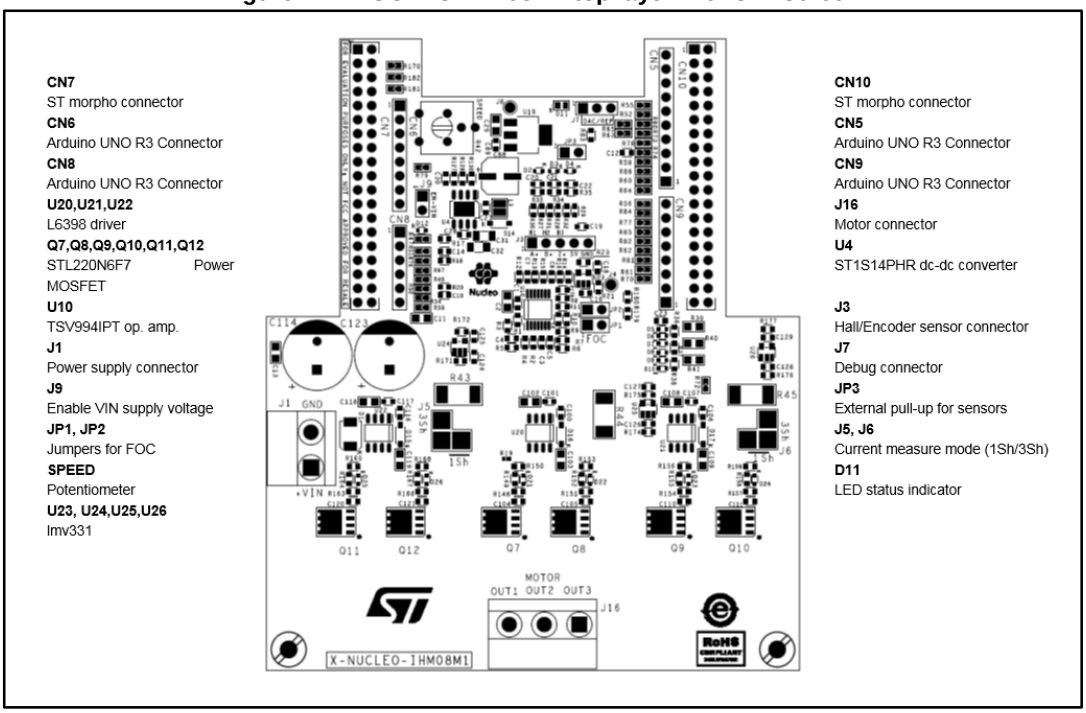
Table 1: Jumper settings

Jumper	Permitted Configurations	Default Condition
JP1	Selection for pull-up insertion (BIAS) in current sensing circuit	OPEN
JP2	Selection for operational amplifier gain modification in current sensing circuit	OPEN
JP3	Selection for enabling pull-up in Hall/Encoder detection circuit	CLOSED
J9	Selection to supply the STM32 Nucleo board through the X-NUCLEO-IHM08M1. **Note:** You should remove jumper J9 before power-on at J1. **Do not** provide more than 12 V DC on J1 when J9 is closed or you risk damaging the STM32 Nucleo board. Jumper JP5 on the STM32 Nucleo board must be connected between PIN 2 and 3 to enable external powering of the STM32 Nucleo board.	OPEN
J5	Selection for single/three shunt configuration. It is set to single shunt by default	1Sh
J6	Selection for single/three shunt configuration. It is set to single shunt by default	1Sh
J7	Debug connector for DAC. It is available for probe connection	OPEN

Table 2: Screw terminals

Screw Terminal	Function
J1	Motor power supply input (8 V to 48 V)
J16	3-phase motor connector

Figure 4: X-NUCLEO-IHM08M1 top layer with silk-screen



The X-NUCLEO-IHM08M1 power block features the ST morpho male pin header connectors (CN7 and CN10) accessible on both sides of the board, which can be used to connect this power board to the STM32 Nucleo board. All the MCU signal and power pins are available on the ST morpho connector.

For further details, please refer to UM1724 document (5.12 STMicroelectronics morpho connector) available on website *www.st.com*.

Table 3: ST morpho connector – CN7

Pin	Default	Signal	Solder Bridge
1	PC10		
2	PC11		
3	PC12		
4	PD2		
5	VDD		
6	E5V	+5 V for STM32 Nucleo supply	R170
7	BOOT0		
8	GND		
9	NC/PF6		
10	NC		
11	NC/PF7		
12	IOREF		
13	PA13		
14	RESET		
15	PA14		

Pin	Default	Signal	Solder Bridge
16	+3V3		
17	PA15	Encoder A/ Hall H1	R79
18	+5V	Encoder/Hall PS voltage	
19	GND		
20	GND		
21	PB7		
22	GND		
23	PC13	Blue button	
24	VIN		J9
25	PC14		
26	NC		
27	PC15		
28	PA0	Curr_fdbk_PhA	R47
29	PH0/PF0/PD0		
30	PA1	VBUS_sensing	R51
31	PH1/PF1/PD1		
32	PA4	DAC_Ch, Potentiometer (1)	R76 N.M., R181
33	VLCD/VBAT		
34	PB0	VL - TIM1_CH2N	R67
35	PC2	Temperature feedback	R54
36	PC1 or PB9(2)	Curr_fdbk_PhB	R48
37	PC3	BEMF1	R59
38	PC0 or PB8(2)	Curr_fdbk_PhC	R50

Notes:

(1)By default the potentiometer is connected on PA4. For DAC usage remove resistor R181.

(2) Refer to user manual UM1724 Table 9: Solder bridges for further details

Table 4: ST morpho connector – CN10

Pin	Default	Signal	Solder Bridge
1	PC9	GPIO_BEMF	R55
2	PC8		
3	PB8		
4	PC6		
5	PB9		
6	PC5	BEMF3	R65
7	AVDD		

Pin	Default	Signal	Solder Bridge
8	U5V(1)		
9	GND		
10	NC		
11	PA5(2)	GPIO/DAC/PWM	R80 N.M.
12	PA12	CPOUT	R52
13	PA6(3)	BKIN	R78
14	PA11	BKIN	R73
15	PA7(4)	UL - TIM1_CH1N	R58
16	PB12		
17	PB6		
18	PB11/NC For NUCLEO-F401RE: remove the R60 resistor if 6-Step control is used (X-CUBE-SPN8)	BEMF2	R60
19	PC7		
20	GND		
21	PA9	VH - TIM1_CH2	R64
22	PB2	LED RED	R83
23	PA8	UH - TIM1_CH1	R56
24	PB1	WL – TIM1_CH3N	R72
25	PB10	Encoder Z/ Hall H3	R84
26	PB15(4)	UL – TIM1_CH1N	R86
27	PB4	CURRENT REF	R77
28	PB14(3)	BKIN	R74
29	PB5	GPIO/DAC/PWM	R85
30	PB13(2)	GPIO/DAC/PWM	R82 N.M.
31	PB3	Encoder B/ Hall H2	R81
32	AGND		
33	PA10	WH - TIM1_CH3	R70
34	PC4	BEMF2	R61
35	PA2		
36	NC/PF5		
37	PA3		
38	NC/PF4		

Notes:

(1)U5V is 5 V power from ST-LINK/V2-1 USB connector and it rises before +5 V

(2) For NUCLEO-F302R8 - pin PA5 is on CN10/pin 30 and PB13 is on CN10/pin 11

(3) For NUCLEO-F302R8 - pin PA6 is on CN10/pin 28 and PB14 is on CN10/pin 13

(4) For NUCLEO-F302R8 - pin PA7 is on CN10/pin 26 and PB15 is on CN10/pin 13

3 Board schematics

Figure 5: Power section

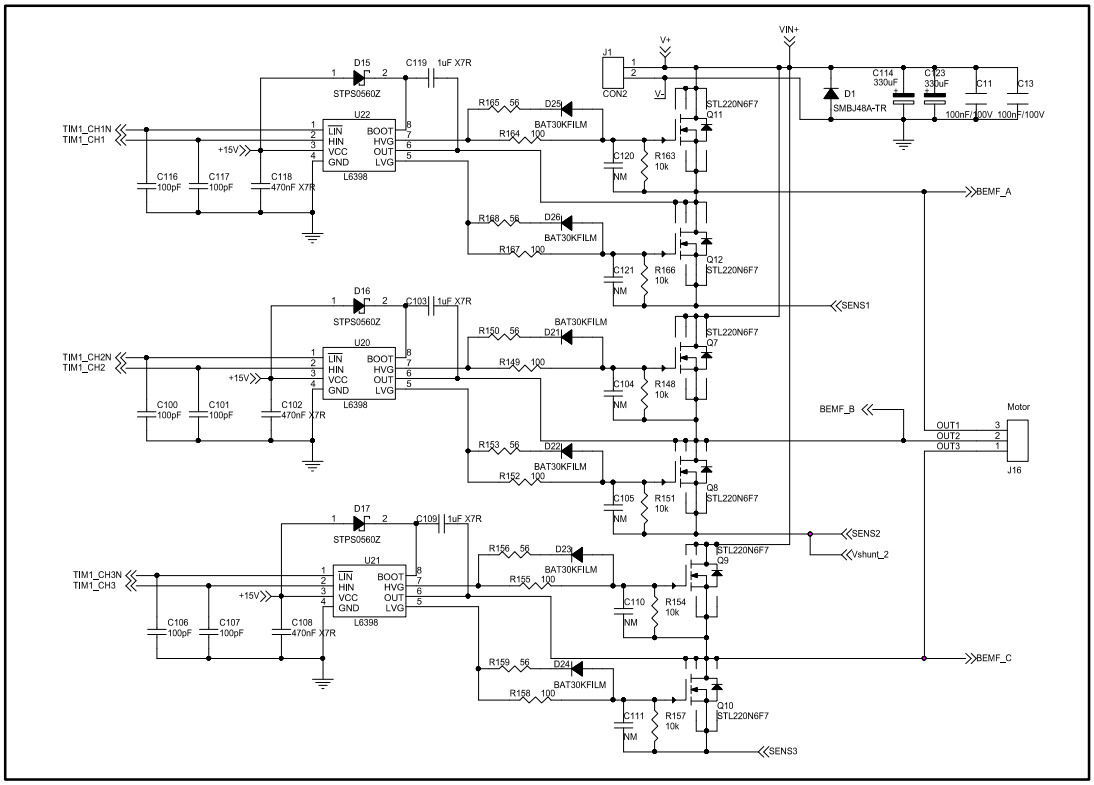


Figure 6: Current sensing and B-emf circuit

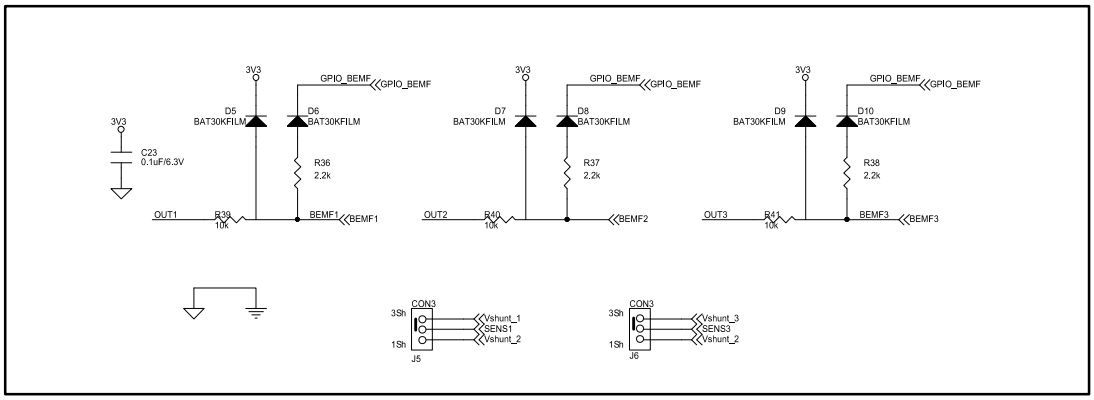


Figure 7: Auxiliary power supply circuit

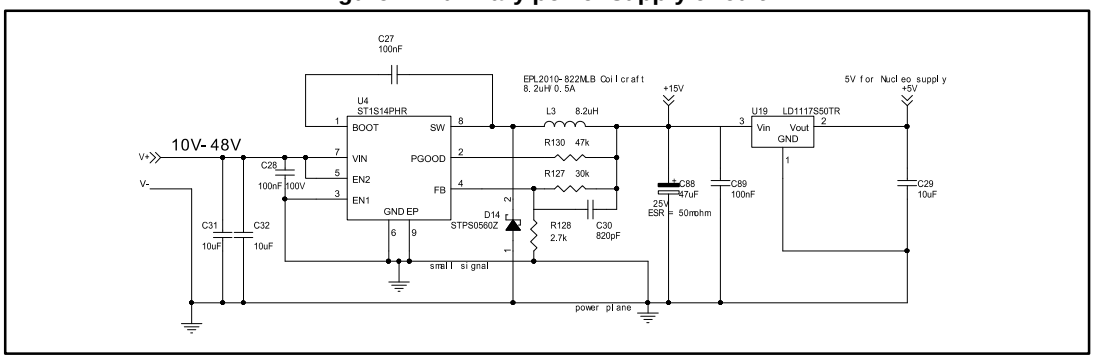


Figure 8: Sensing and Hall/Encoder circuit

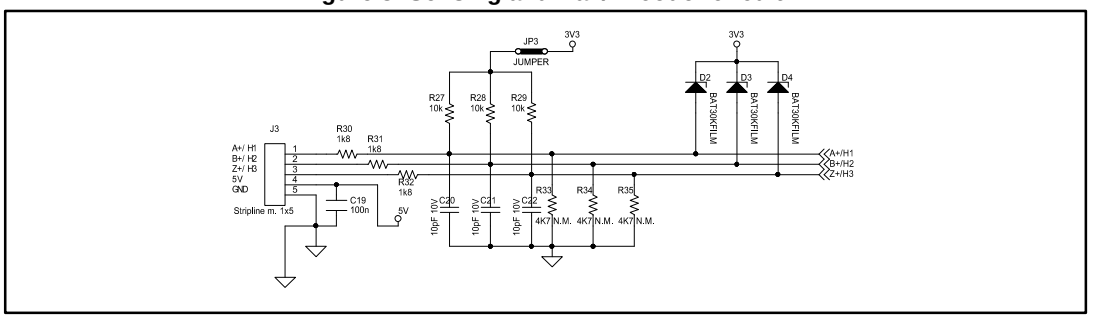


Figure 9: Analog conditioning and current protection circuit

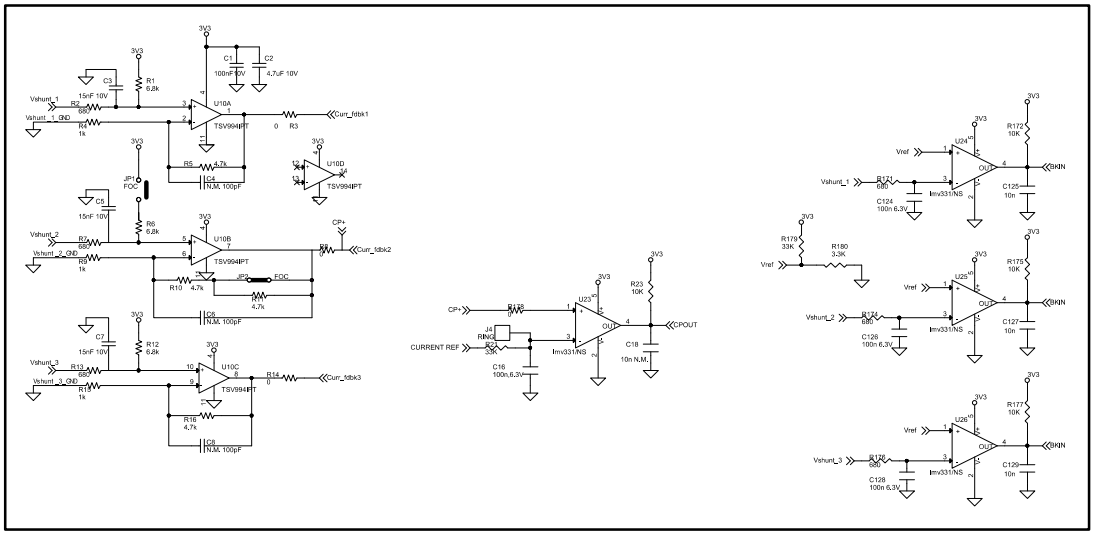
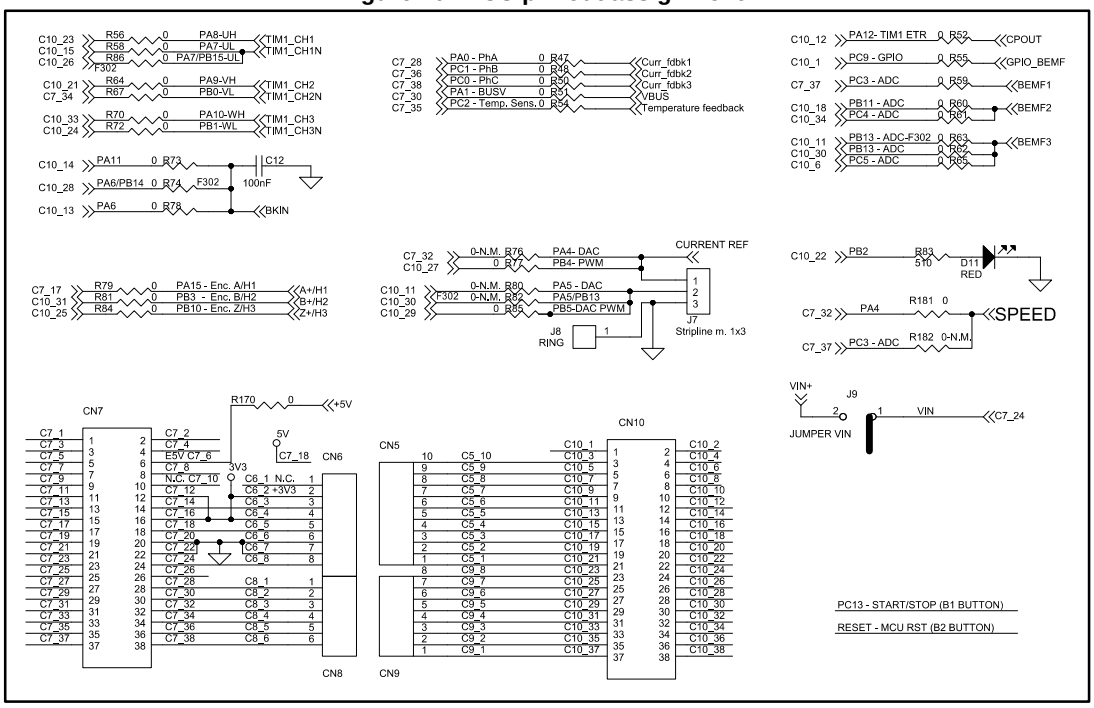


Figure 10: MCU pin-out assignment



4 Circuit description

4.1 Power section

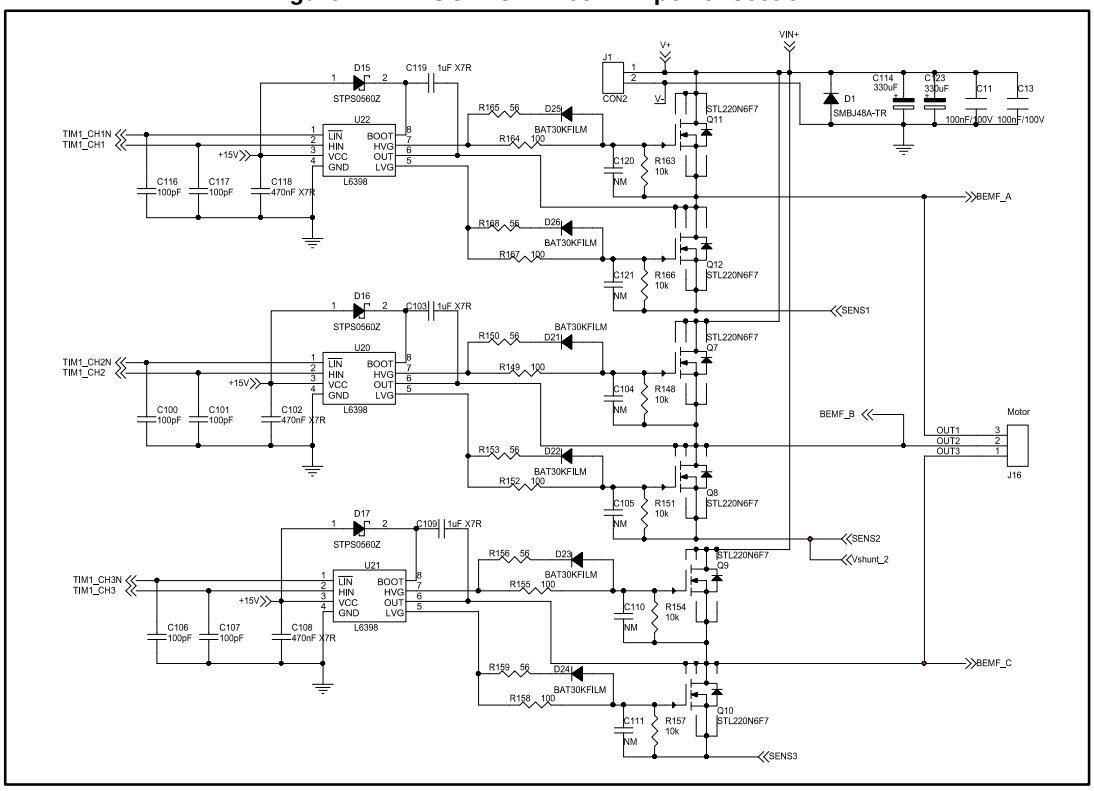
4.1.1 L6398 gate driver and STL220N6F7 STripFET™ F7 Power MOSFET

The main section is based on:

1. **L6398** single-chip half bridge gate driver for the N-channel power MOSFET - a high-voltage device manufactured with the BCD “OFF-LINE” technology. The high side (floating) section is designed to handle a voltage rail of up to 600 V and the logic inputs are CMOS/TTL compatible down to 3.3 V for easy microcontroller/DSP interfacing.
2. **STL220N6F7** 260 A – 60 V N-channel Power MOSFET – based on the STripFET™ F7 technology with an enhanced trench gate structure that results in very low on-state resistance, while also reducing internal capacitance and gate charge for faster and more efficient switching. It features:
   - Among the lowest RDS(on) on the market: 0.0014 Ω
   - Excellent figure of merit (FoM)
   - Low Crss/Ciss ratio for EMI immunity
   - High avalanche ruggedness

Together, these devices form the high current power platform for the BLDC motor. The main supply voltage is provided through an external connector (J1) and you can set jumper (J9) to choose whether the digital section (STM32 Nucleo board) is supplied via USB (USB type A to Mini-B USB cable) or through the expansion board. By default, the STM32 nucleo expansion board provides the supply voltage to the STM32 Nucleo board through its internal voltage regulator, but you can choose to supply it directly from the J1 power connector if higher conversion efficiency is required and if the input voltage is lower than 12 V DC (see *Table 1: "Jumper settings"*).

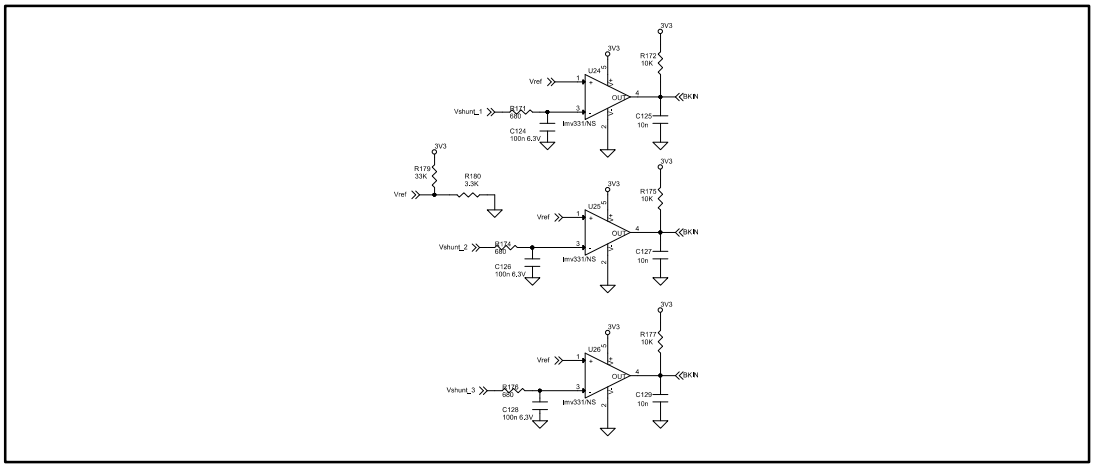
Figure 11: X-NUCLEO-IHM08M1 – power section



4.1.2 Overcurrent detection (OCP) and current sensing measurement

Over Current Protection (OCP) is implemented by hardware with a detection circuit. The current is compared with an embedded current reference (by the MCU) and the output generates a fault condition at the BKIN pin that goes to ground. This pin, connected to STM32 Nucleo board (BKIN Timer function), detects this condition and immediately disables the driving signals (see the schematic below).

Figure 12: X-NUCLEO-IHM08M1 – OCP circuit



The current sensing inputs (refer to the following three schematics) are connected to the sensing resistors and you can choose between a three-shunt or single-shunt configuration through jumpers J5 and J6 (see *jumperSETtable*).

Figure 13: X-NUCLEO-IHM08M1 – Current sensing circuit (1 of 3)

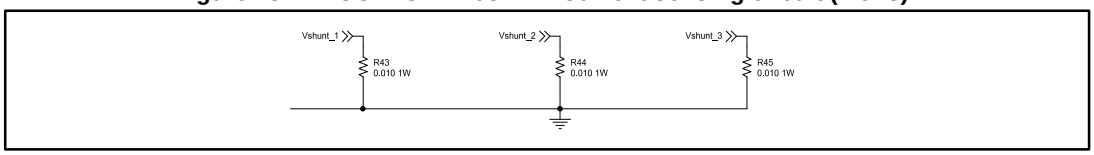


Figure 14: X-NUCLEO-IHM08M1 – Current sensing circuit (2 of 3)

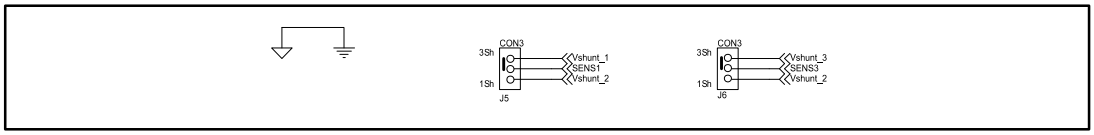
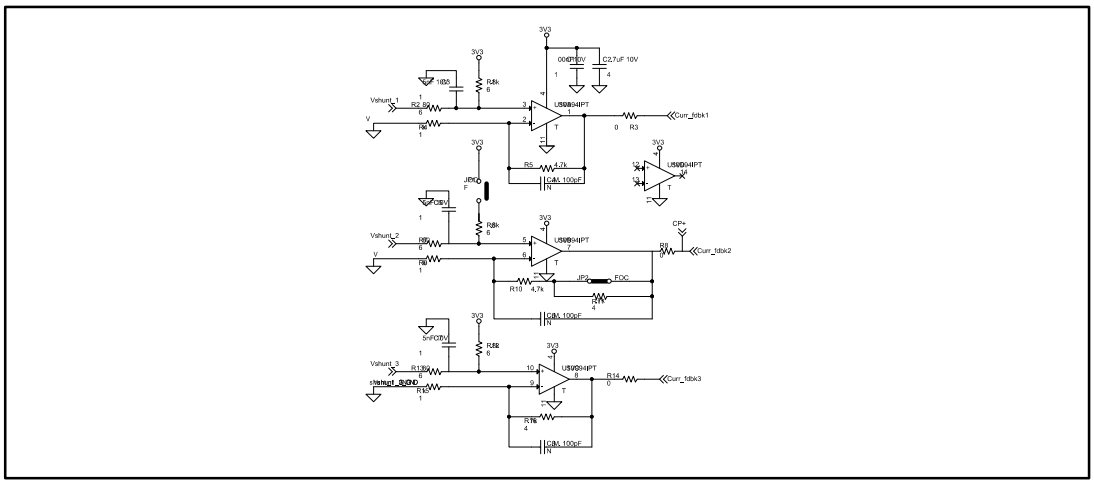


Figure 15: X-NUCLEO-IHM08M1 – Current sensing circuit (3 of 3)

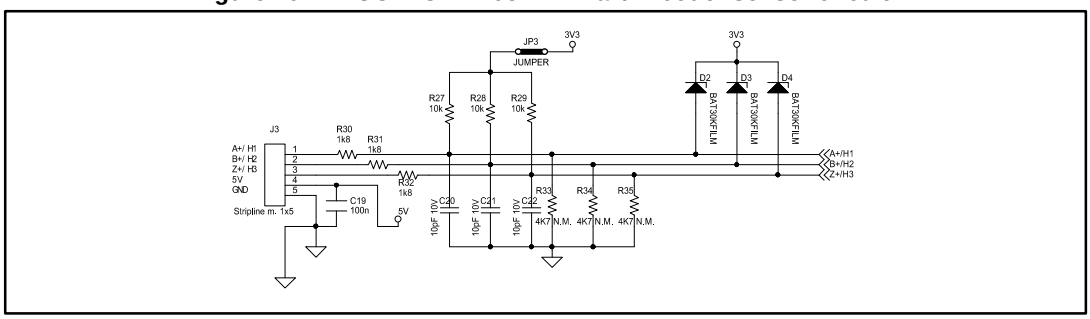


4.2 Analog section

4.2.1 Hall/Encoder motor speed sensor

The X-NUCLEO-IHM08M1 expansion board implements the Hall/Encoder sensor detecting circuit for speed measurement, the schematic for which is given in the figure below. The motor sensor pin, through the J3 connector and an analog circuit, are connected to the STM32 Nucleo board in order to determine motor spin; a +5 V and GND are also provided to power the sensors. Jumper JP3 is available for sensors that require external pull-up (see *jumperSETtable*).

Figure 16: X-NUCLEO-IHM08M1 – Hall/Encoder sensor circuit

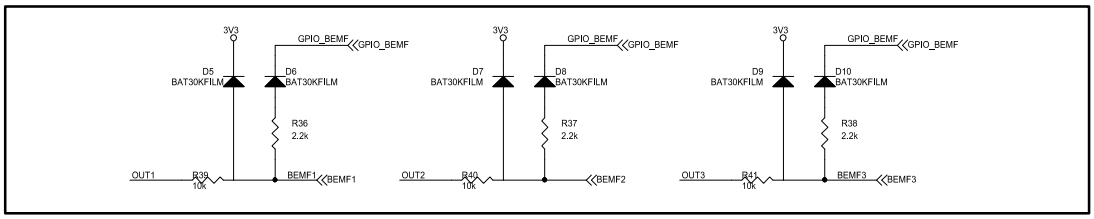


4.3 BEMF detection circuit

The X-NUCLEO-IHM08M1 expansion board provides two hardware solutions for motor position measurement: one based on sensors (refer to *Hall/Encoder motor speed sensor*) and other based on sensorless detection.

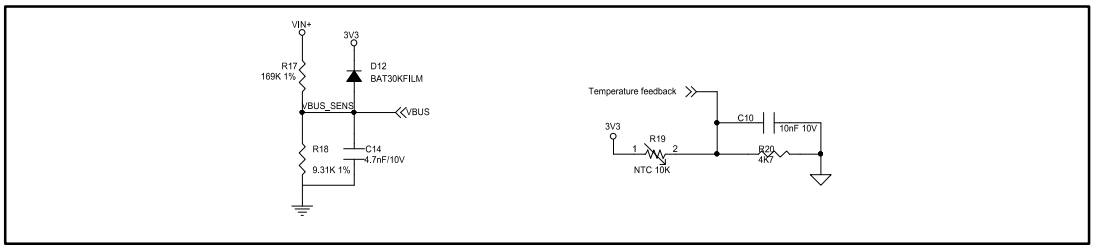
In 6-step driving mode, one of the three phases is left in the high-impedance state and we can detect BEMF zero-crossing events by comparing the voltage of this phase with the center-tap voltage. This signal is acquired through an analog circuit embedded on the board, as shown below.

Figure 17: X-NUCLEO-IHM08M1 – BEMF detection circuit



The X-NUCLEO-IHM08M1 expansion board provides the hardware for bus voltage sensing and temperature measurement. This signal is acquired with a resistor divider and with an embedded NTC (placed close to STL220N6F7 Power MOSFET), as shown below.

Figure 18: X-NUCLEO-IHM08M1 – VBUS and temperature sensing circuit



5 Bill of materials

Table 5: BoM (1 of 2)

Item	Quantity	Reference	Part / Value	Voltage / Watt / Ampere	Type / TECNOLOGY information	Tol.
1	10	C1,C12,C16, C19,C23,C2 7,C89,C124, C126,C128	100nF	50V	Ceramic Multilayer Capacitors X7R	10%
2	1	C2	4.7uF 10V	10V	Ceramic Multilayer Capacitors X7R	20%
3	3	C3,C5,C7	15nF 10V	10V	Ceramic Multilayer Capacitors X7R	10%
4	3	C4,C6,C8	100pF/6.3V	6.3V	Ceramic Multilayer Capacitors X7R	10%
5	4	C10,C125,C 127,C129	10nF 10V	10V	Ceramic Multilayer Capacitors X7R	10%
6	2	C11,C13	100nF	100V	Ceramic Multilayer Capacitors X7R	10%
7	1	C14	4.7nF	10V	Ceramic Multilayer Capacitors X7R	10%
8	1	C18	10nF NM	10V	Ceramic Multilayer Capacitors X7R	10%
9	3	C20,C21,C2 2	10pF	10V	Ceramic Multilayer Capacitors C0G	5%
10	1	C28	100nF	100V	Ceramic Multilayer Capacitors X7R	10%
11	1	C29	10uF	25V	Ceramic Multilayer Capacitors X7R	10%

Item	Quantity	Reference	Part / Value	Voltage / Watt / Ampere	Type / TECNOLOGY information	Tol.
12	1	C88	47uF	25V	Functional Polymer Aluminum Solid Electrolytic Capacitors	0.2
13	1	C30	820pF	25V	Ceramic Multilayer Capacitors X7R	10%
14	2	C31,C32	10uF	50V	Ceramic Multilayer Capacitors X5R	10%
15	6	C100,C101, C106,C107, C116,C117	100pF	6.3V	Ceramic Multilayer Capacitors X7R	10%
16	3	C102,C108, C118	470nF	25V	Ceramic Multilayer Capacitors X7R	10%
17	3	C103,C109, C119	1uF	50V	Ceramic Multilayer Capacitors X7R	10%
18	6	C104,C105, C110,C111, C120,C121	NM	25V	Ceramic Multilayer Capacitors X7R	10%
19	2	C114,C123	330uF	63V	Electrolytic Capacitor	0.2
20	1	D1	SMBJ48A-TR		Transil	
21	16	D2,D3,D4,D 5,D6,D7,D8, D9,D10,D12, D21,D22,D2 3,D24,D25,D 26	BAT30KFILM	30V, 0.3A	ST SCHOTTKY DIODE	
22	1	D11	RED		LED standard - SMD	
23	4	D14,D15,D1 6,D17	STPS0560Z	60V/0.5A	ST POWER SCHOTTKY DIODE	
24	4	JP1,JP2, JP3,J9	JUMPER		2 WAYS STRIP LINE-MALE 2.54mm	

Item	Quantity	Reference	Part / Value	Voltage / Watt / Ampere	Type / TECNOLOGY information	Tol.
25	1	J1	Input connector		2 way 6.35mm PCB terminal block	
26	1	J3	Stripline m. 1x5		5 WAYS STRIP LINE-MALE 2.54mm	
27	2	J4,J8	RING		TEST POINT 1 mm	
28	2	J5,J6	shunt	50A	JUMPER-tin drop	
29	1	J7	Stripline m. 1x3		3 WAYS STRIP LINE-MALE 2.54mm	
30	1	J16	Motor Connector		3 way 6.35mm PCB terminal block	
31	2	CN7,CN10	CN7,CN10 ST_MORPHO_19x2		ELEVATED SOCKET ST MORPHO CONNECTOR 38 PIN (19x2)	
32	2	CN6,CN9	CN6,CN9		8 PIN ELEVATED SOCKET	
33	1	CN5	CN5		10 PIN ELEVATED SOCKET	
34	1	CN8	CN8		6 PIN ELEVATED SOCKET	
35	1	L3	8.2uH	520mA	SMT power inductor	
36	6	Q7,Q8,Q9,Q10,Q11,Q12	STL220N6F7	60V, 220A	Power MOSFETS	
37	3	R1,R6,R12	6.8 kΩ	0.1W	SMD RESISTOR	1%
38	3	R4,R9,R15	1 kΩ	0.1W	SMD RESISTOR	1%
39	4	R5,R10,R11, R16	4.7 kΩ	0.1W	SMD RESISTOR	1%
40	6	R2,R7,R13, R171,R174, R176	680 Ω	0.1W	SMD RESISTOR	1%

Item	Quantity	Reference	Part / Value	Voltage / Watt / Ampere	Type / TECNOLOGY information	Tol.
41	34	R3,R8,R14, R47,R48,R50,R51,R52,R54,R55,R56, R58,R59,R60,R61,R62,R63,R64,R65, R67,R70,R72,R73,R74,R77,R78,R79, R81,R84,R85,R86,R170, R178,R181	0 Ω	0.1W	SMD RESISTOR	
42	1	R17	169 kΩ	0.1W	SMD RESISTOR	1%
43	1	R18	9.31 kΩ	0.1W	SMD RESISTOR	1%
44	1	R19	NTC 10kΩ		NTC Thermistor	1%
45	1	R20	4.7 kΩ	0.1W	SMD RESISTOR	
46	2	R21,R179	33 kΩ	0.1W	SMD RESISTOR	
47	13	R23,R27,R28,R29,R148, R151,R154, R157,R163, R166,R172, R175,R177	10 kΩ	0.1W	SMD RESISTOR	
48	3	R30,R31,R32	1.8 kΩ	0.1W	SMD RESISTOR	
49	3	R33,R34,R35	4.7 kΩ	0.1W	SMD RESISTOR	
50	3	R36,R37,R38	2.2 kΩ	0.1W	SMD RESISTOR	1%
51	3	R39,R40,R41	10 kΩ	0.125W	SMD RESISTOR	
52	1	R42	100 kΩ	1/2W	TRIMMER RESISTOR	10%
53	3	R43,R44,R45	0.01 Ω	3W	10 mΩ SHUNT RESISTOR	1%
54	4	R76,R80,R82,R182	0 N.M.	0.1W	SMD RESISTOR	
55	1	R83	510 Ω	0.1W	SMD RESISTOR	
56	1	R127	30k	0.1W	SMD RESISTOR	

Item	Quantity	Reference	Part / Value	Voltage / Watt / Ampere	Type / TECNOLOGY information	Tol.
57	1	R128	2.7 kΩ	0.1W	SMD RESISTOR	
58	1	R130	47 kΩ	0.1W	SMD RESISTOR	
59	6	R149,R152, R155,R158, R164,R167	100 Ω	0.1W	SMD RESISTOR	
60	6	R150,R153, R156,R159, R165,R168	56 Ω	0.1W	SMD RESISTOR	
61	1	R180	3.3 kΩ	0.1W	SMD RESISTOR	
62	1	U10	TSV994IPT		Operational Amplifier	
63	1	U4	ST1S14PHR	50V,3A	3A Step down switching regulator	
64	1	U19	LD1117S50TR		Low Drop Voltage Regulator	
65	3	U20,U21,U22	L6398	600V	High voltage high and low side driver	
66	4	U23,U24,U25,U26	LMV331	3.3V	Low voltage comparators	
67	4	(*) Jumper			Female 2.54mm jumper	

Table 6: BoM (2 of 2)

Item	Package	Manufacturer	Manufacturer's ordering code / Orderable Part Number	Additional Notes
1	0603	ANY	ANY	
2	0805	TDK	C2012X7R1A475M125AC	
3	0603	ANY	ANY	
4	0603	ANY	ANY	NOT MOUNTED
5	0603	ANY	ANY	
6	0805	ANY	ANY	
7	0603	ANY	ANY	
8	0603	ANY	ANY	NOT MOUNTED
9	0603	ANY	ANY	
10	0603			
11	0805	MURATA	GRM21BR61E106KA73L	

Item	Package	Manufacturer	Manufacturer's ordering code / Orderable Part Number	Additional Notes
12	SMD 6.3mm diameter	Nichicon	RSS1E470MCN1GS	
13	0603	ANY	ANY	
14	1206	MURATA	GRM31CR61H106KA12L	
15	0603	ANY	ANY	
16	0805	ANY	ANY	
17	0805	ANY	ANY	
18	0603	ANY	ANY	NOT MOUNTED
19	Through hole	Nichicon	UPS1J331MHD	
20	SMD	STMicroelectronics	SMBJ48A-TR	
21	SOD-523	STMicroelectronics	BAT30KFILM	
22	SMD 0603	Lite-on	LTST-C193KRKT-5A	
23	SOD-123	STMicroelectronics	STPS0560Z	
24	TH 2.54mm pitch	any		Mount with female jumper (*)
25	TH 6.35 mm pitch	Phoenix Contact	1714955	
26	TH 2.54mm pitch	any		
27	TH	Vero Technologies	20-2137	
28				Tin drop JUMPER in 1sh direction (See assembly drawing)
29	TH 2.54mm pitch	any		
30	TH 6.35 mm pitch	Phoenix Contact	1714968	
31	TH 2.54mm pitch	Samtec	ESQ-119-24-T-D	Alternative:4UCONN 8413 info:Male on top, female on bottom
32	TH 2.54mm pitch	Samtec	ESQ-108-24-T-S	Alternative:4UCONN 15284 Mounting info: Female on top, male on bottom -NOT MOUNTED

Item	Package	Manufacturer	Manufacturer's ordering code / Orderable Part Number	Additional Notes
33	TH 2.54mm pitch	Samtec	ESQ-110-24-T-S	Alternative:4UCONN 15286 Mounting info: Female on top, male on bottom -NOT MOUNTED
34	TH 2.54mm pitch	Samtec	ESQ-106-24-T-S	Alternative: 4UCONN 15282 Mounting info: Female on top, male on bottom -NOT MOUNTED
35	SMD	Coilcraft	EPL2010-822MLB	
36	PowerFlat	STMicroelectronics		
37	0603	ANY	ANY	
38	0603	ANY	ANY	
39	0603	ANY	ANY	
40	0603	ANY	ANY	
41	0603	ANY	ANY	
42	0603	PANASONIC	ERJ3EKF1693V	
43	0603	PANASONIC	ERJ3EKF9311V	
44	0402	TDK	NTCG103JF103F	
45	0603	ANY	ANY	
46	0603	ANY	ANY	
47	0603	ANY	ANY	
48	0603	ANY	ANY	
49	0603	ANY	ANY	NOT MOUNTED
50	0603	ANY	ANY	
51	0805	ANY	ANY	
52	Through hole	Bourns	3386G-1-104LF	
53	2512	KOA Speer	TLR3APDTE10L0F50	
54	0603	ANY	ANY	NOT MOUNTED
55	0603	ANY	ANY	
56	0603	ANY	ANY	
57	0603	ANY	ANY	
58	0603	ANY	ANY	
59	0603	ANY	ANY	
60	0603	ANY	ANY	
61	0603	ANY	ANY	

Item	Package	Manufacturer	Manufacturer's ordering code / Orderable Part Number	Additional Notes
62	TSSOP	STMicroelectronics	TSV994IPT	
63	HSOP8 - exposed pad	STMicroelectronics	ST1S14PHR	
64	SOT-223	STMicroelectronics	LD1117S50TR	
65	SO-8	STMicroelectronics	L6398D	
66	SOT23-5	STMicroelectronics	LMV331ILT	
67				Provided but not assembled

6 X-NUCLEO-IHM08M1 STM32 PMSM FOC SDK parameters

Table 5: STM32 PMSM FOC SDK parameters

parameter	X-NUCLEO-IHM08M1 default value	Unit
ICL shut out	Disabled	
Dissipative brake	Disabled	
Bus voltage sensing	Enabled	
Bus voltage divider	19	
Min rated voltage	8	V
Max rated voltage	50	V
Nominal voltage	12	V
Temperature sensing	Enabled	
V0	1055	mV
T0	25.0	°C
ΔV/ΔT	22.7	mV/°C
Max. working temperature on sensor	110	°C
Overcurrent protection	Enabled	
Comparator threshold	0.30	V
Overcurrent network offset	0	V
Overcurrent network gain	0.01	V/A
Expected overcurrent threshold	30	A
Overcurrent feedback signal polarity	Active low	
Overcurrent protection disabling network	Disabled	
Overcurrent protection disabling network polarity	Any	
Current sensing	Enabled	
Current reading topology	Three shunts or one shunt resistor depending on configuration	
Shunt resistor(s) value	0.010	Ω
Amplifying network gain	5.18	
T-noise	1000	ns
T-rise	1000	ns
U,V,W driver High side driving signal	Active high	
U,V,W driver Low side driving signal complemented from high side	Disabled	
U,V,W driver Low side driving signal polarity	Active low	

7 Revision history

Table 7: Document revision history

Date	Version	Changes
03-Dec-2015	1	Initial release.
18-May-2016	2	Updated *Figure 1: "X-NUCLEO-IHM08M1 low-voltage BLDC motor driver expansion board based on STL220N6F7 for STM32 Nucleo"* Updated *Figure 2: "System functional hardware blocks"* Updated *Section 4.2: "Building the system"* Updated *Table 3: "ST morpho connector – CN7"*

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