
**STEVAL-IHM042V1: low voltage dual motor control board
based on the STM32F303 MCU and L6230 monolithic driver**

Introduction

The STEVAL-IHM042V1 evaluation board is designed as a dual motor field-oriented control (FOC) complete evaluation platform featuring STMicroelectronics' ARM Cortex™-M4F 32-bit core-based STM32F303CC microcontroller with floating point support and two DMOS fully integrated L6230 3-phase motor drivers.

This platform has been designed as an integrated evaluation environment for motor control applications in the range of 8 V - 48 V of DC bus voltage (which is extendable up to 52 V) and nominal power up to 10 W for each motor driver, exploiting the computational power of the STM32F303CC microcontroller with internal 48 KB SRAM and 256 KB Flash, 4 ADCs, 2 DACs, 7 comparators, 4 operational amplifiers with programmable gains, SWD debugging and the L6230 DMOS driver with 2.8 A output peak current, non-dissipative overcurrent detection/protection, cross conduction protection, uncommitted comparator, thermal shutdown, and undervoltage lockout.

The STEVAL-IHM042V1 is provided with a USB-to-serial interface specific for real-time data exchange performed by an STM32F103C8 already programmed with the STM32 Virtual COM Port firmware.

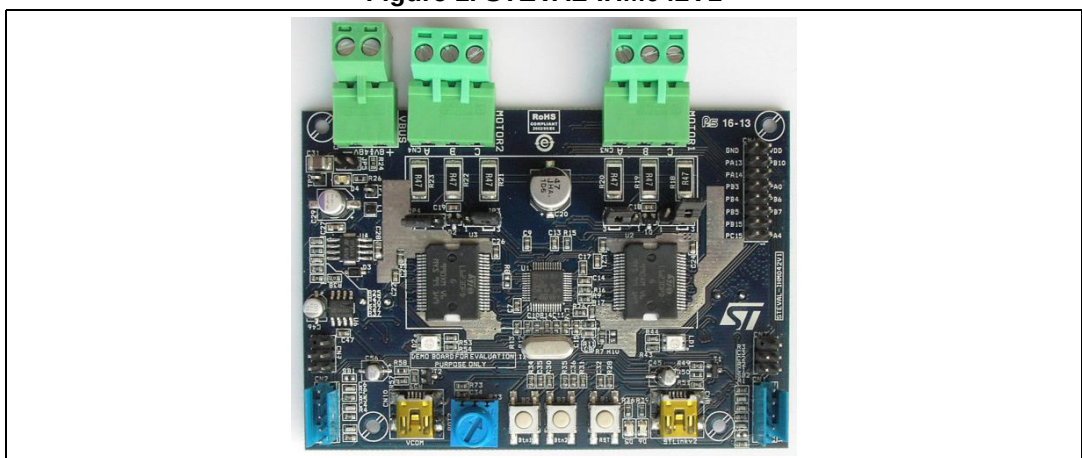
The ST Link, in-circuit debugger and programmer, is embedded in the board allowing the user to program and debug the STM32F303CC microcontroller directly with a USB cable using a compatible toolset.

With dedicated hardware evaluation features, the STEVAL-IHM042V1 board is designed to help developers evaluate the device and develop their own applications.

The STEVAL-IHM042V1 can be used together with the STM32 PMSM single/dual FOC SDK and constitutes a complete motor control evaluation and development platform.

The evaluation board can be ordered using order code STEVAL-IHM042V1.

Figure 1. STEVAL-IHM042V1



Contents

1	Features	3
2	Block diagram and layout	4
3	Board schematics	6
4	Jumper settings	11
5	Using the STEVAL-IHM042V1 with the STM32 FOC firmware library .	12
6	Bill of material	13
7	Technical issues	16
8	Revision history	17

1 Features

- STMicroelectronics' ARM™ Cortex-M4F core-based STM32F303CC microcontroller
- Two L6230 monolithic power stages in a PowerSO package featuring overcurrent and thermal protection
- Simultaneous field-oriented control (FOC) of two PMSM motors
- Embedded ST Link in-circuit debugger and programmer with SWD support
- USB-to-serial interface for real-time control via ST's motor control workbench
- 3-shunt or single-shunt current sensing topology for each driver easily selectable through jumpers
- DC voltage range from 8 V to 48 V (extendable up to 52 V)
- Maximum load current of 1.4 Arms (2.8 A peak) for each output
- Integrated DC-DC regulator (3.3 V)
- Optional control interface through trimmer and general-purpose buttons
- Reset button
- Two LEDs
- DACs outputs
- Two Hall sensor/encoder inputs

2 Block diagram and layout

[Figure 2](#) shows the block diagram of the STEVAL-IHM042V1. The inner white square represents the active area. The components inside the active area are the minimum required to perform the dual motor drive.

The board has been developed in two layers. [Figure 3](#) shows the layout of the top layer while [Figure 4](#) shows the bottom layer.

Figure 2. Block diagram

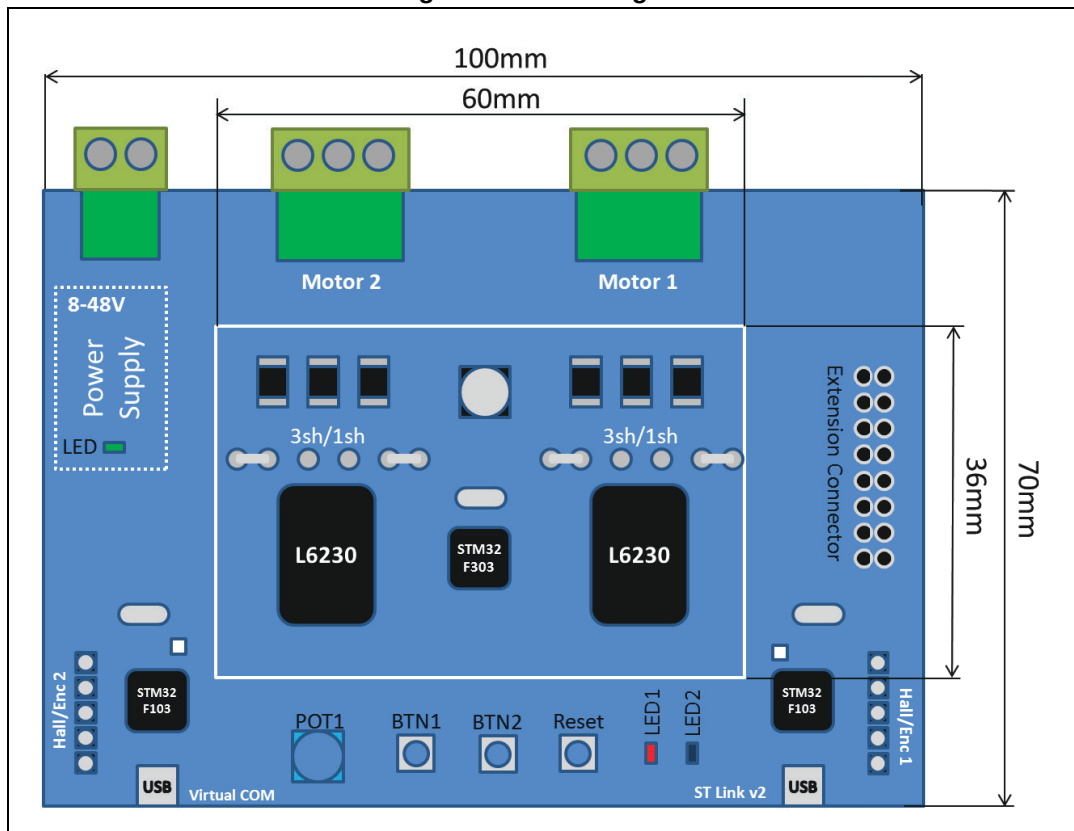


Figure 3. Layout - top layer

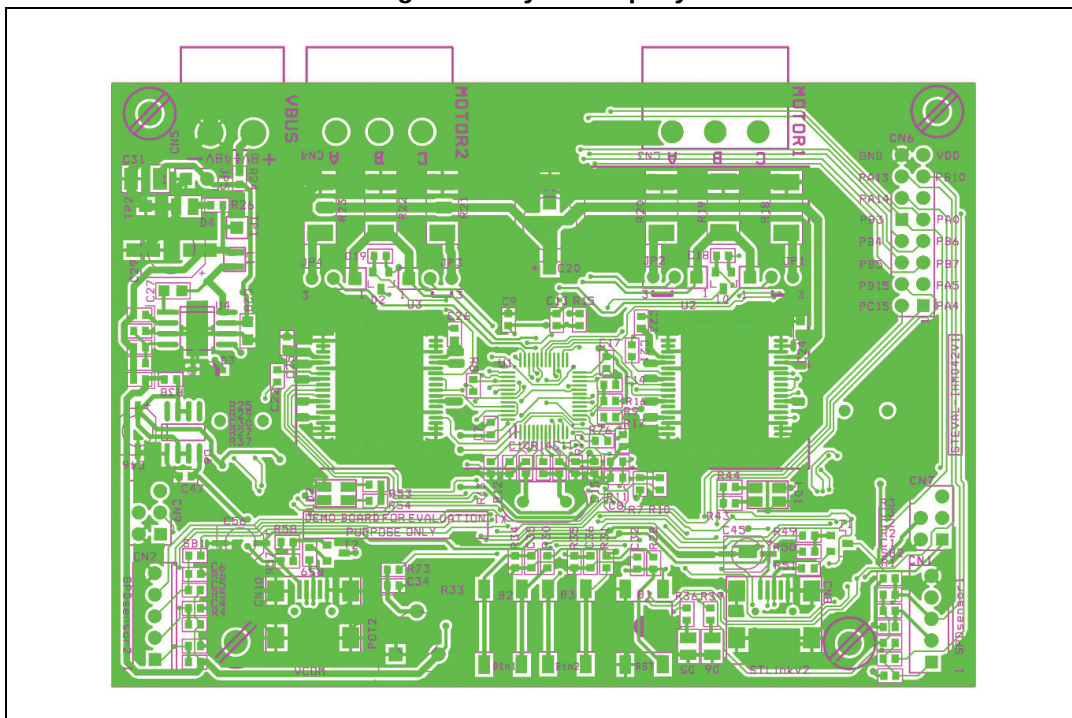
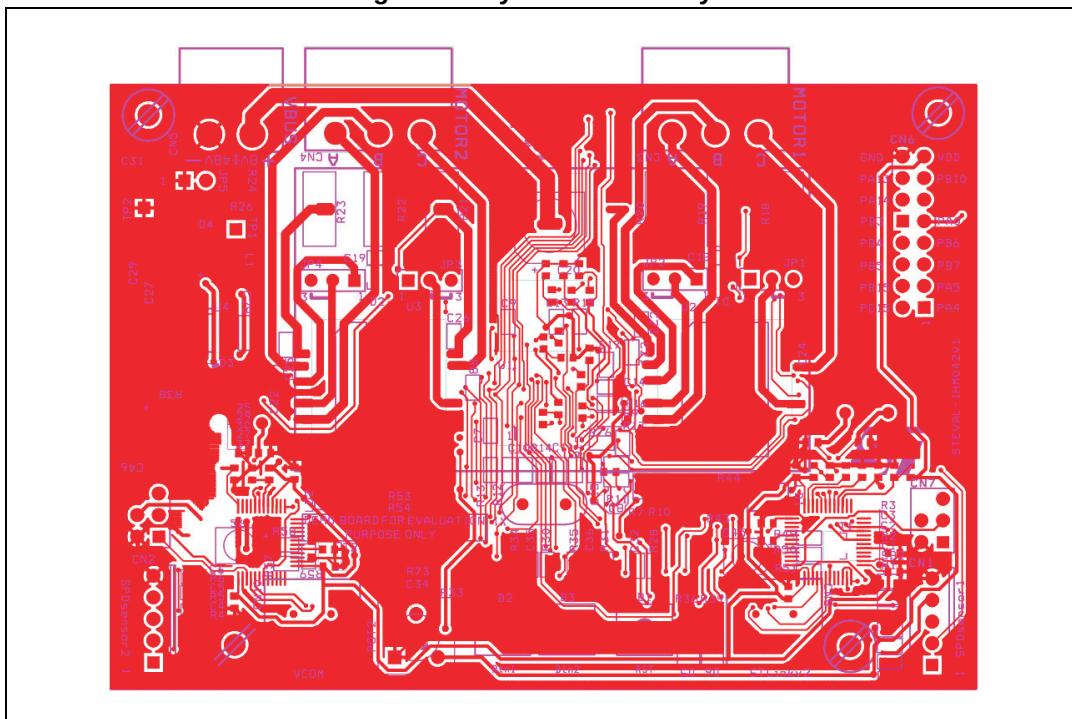
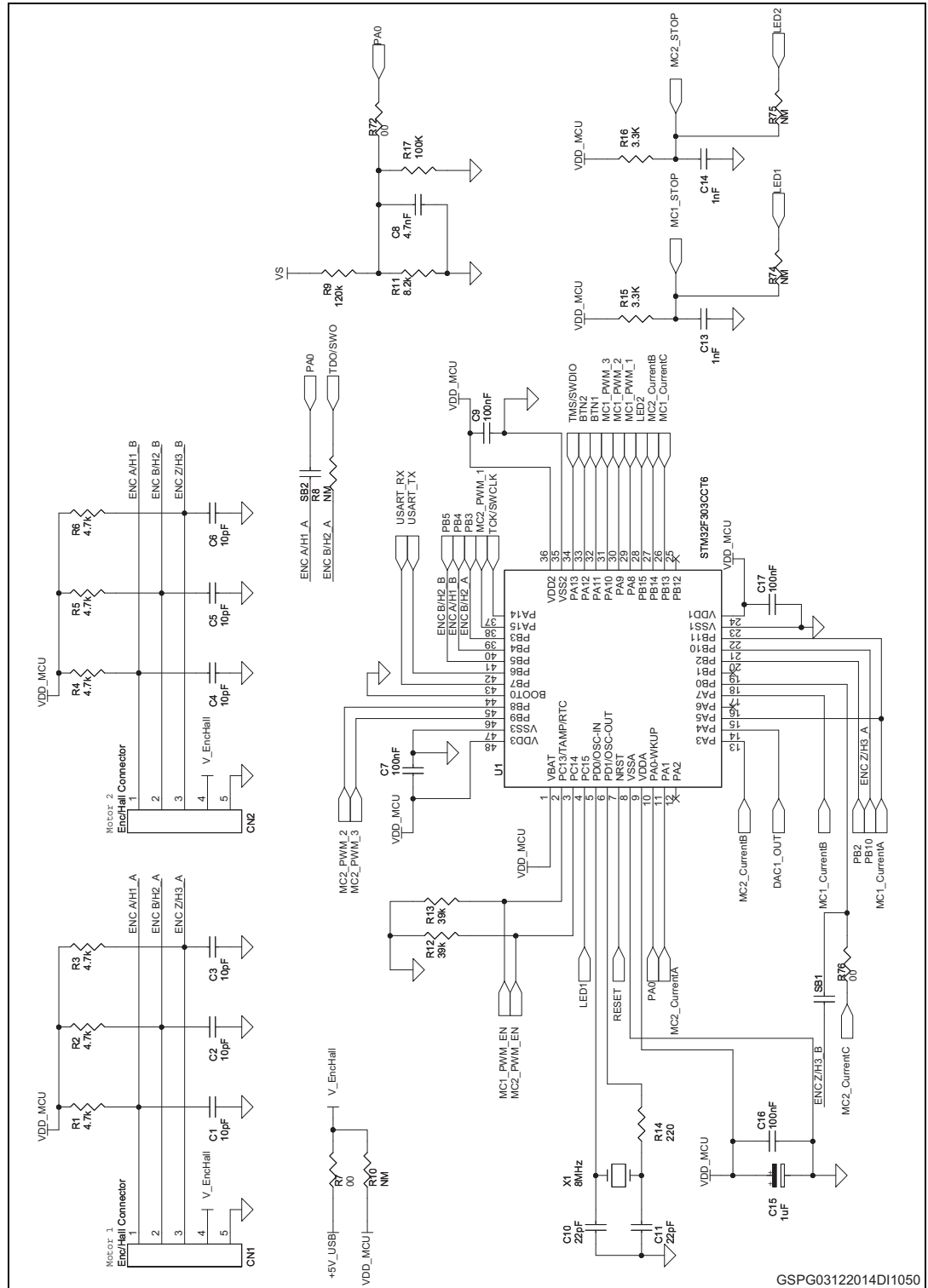


Figure 4. Layout - bottom layer



3 Board schematics

Figure 5. Schematic (1 of 5)



GSPG03122014DI1050

Figure 6. Schematic (2 of 5)

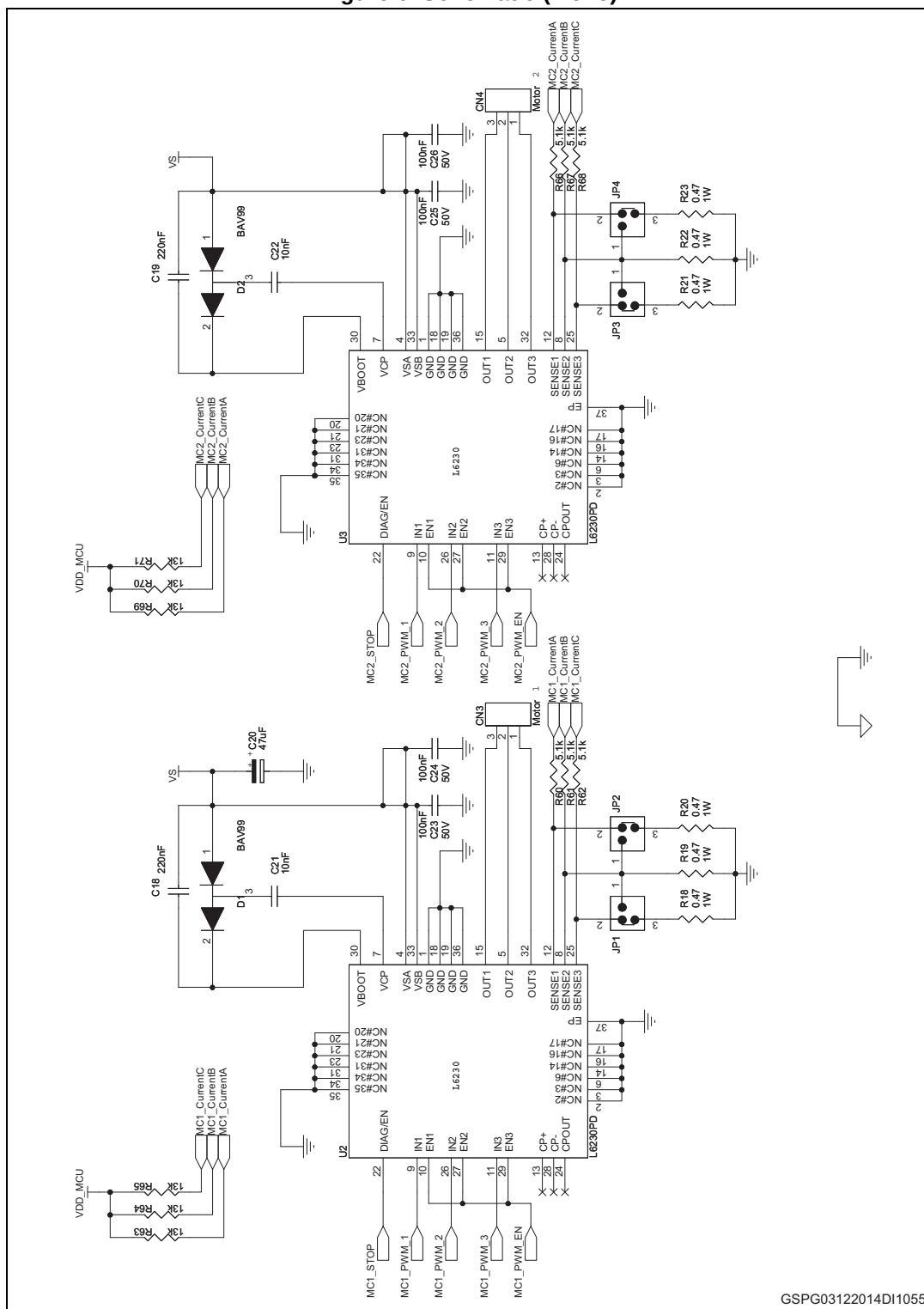


Figure 7. Schematic (3 of 5)



GSPG03122014DI1105

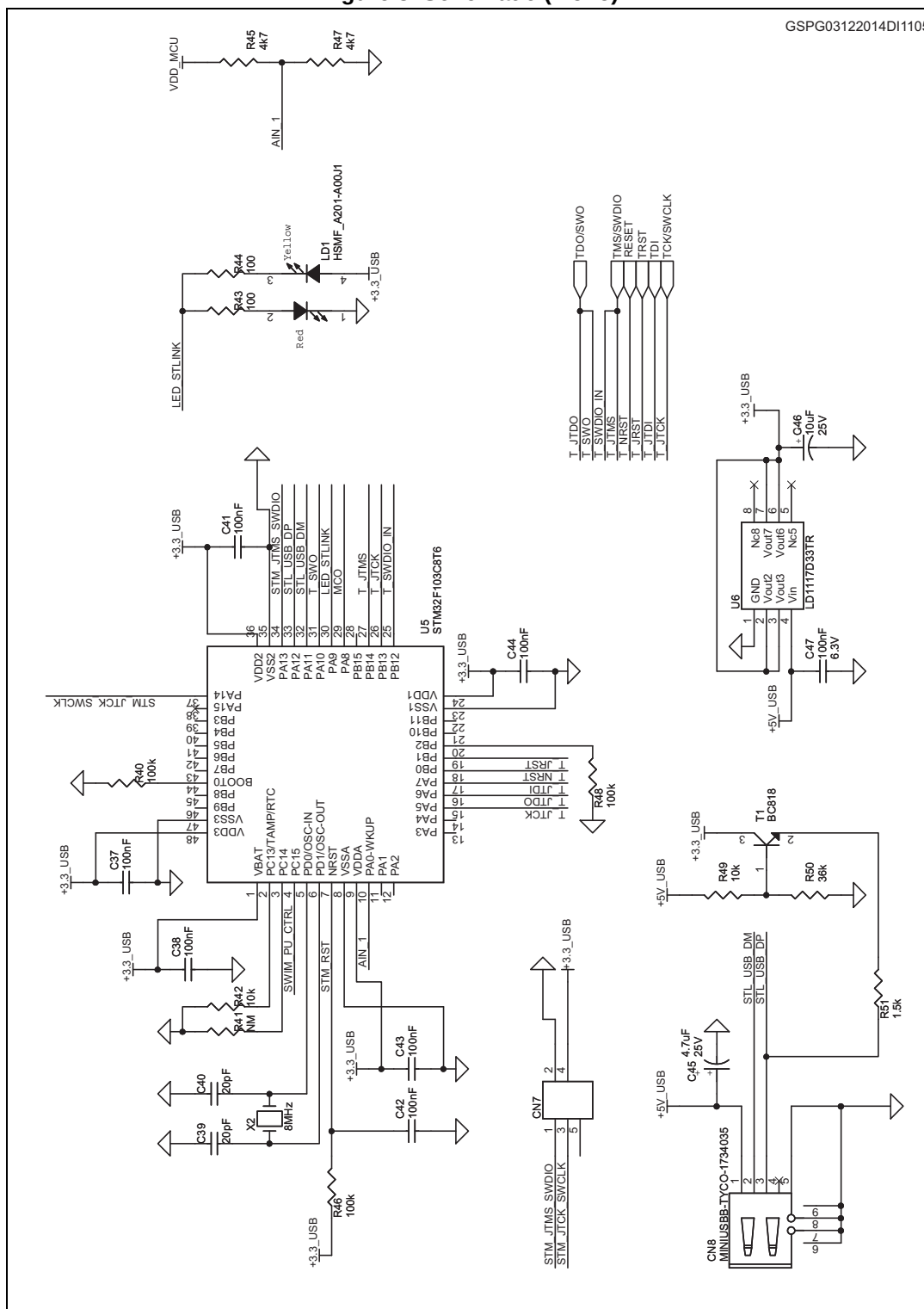
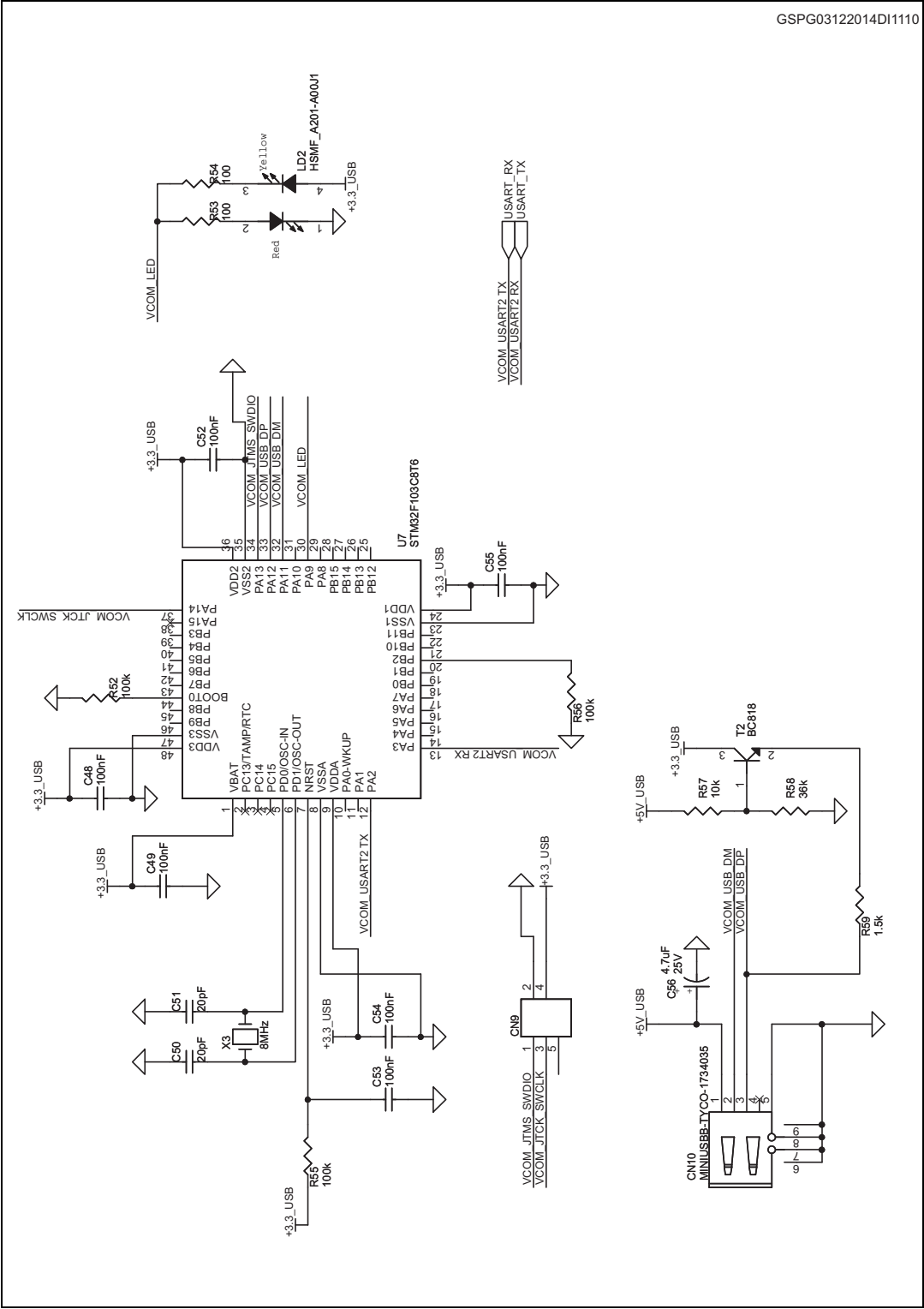


Figure 9. Schematic (5 of 5)



4 Jumper settings

[Table 1](#) gives a detailed description of the jumpers used.

Table 1. Jumper settings

Jumper	Selection	Description
JP1, JP2	Both between 1-2	Selects the single-shunt current reading for motor 1
	Both between 2-3 (default)	Selects the three-shunt current reading for motor 1
JP3, JP4	Both between 1-2	Selects the single-shunt current reading for motor 2
	Both between 2-3 (default)	Selects the three-shunt current reading for motor 2
R7	Mounted (0 Ω) (default)	Motor sensors (Hall or encoder) are supplied from CN8 or CN10 (USB +5 V). Keep R10 not mounted.
	Not mounted	(USB +5 V) not connected to motor sensors (Hall or encoder)
R10	Mounted (0 Ω)	Motor sensors (Hall or encoder) are supplied from Vdd micro (+3.3 V). Remove in this case R7.
	Not mounted (default)	Vdd micro (+3.3 V) not connected to motor sensors (Hall or encoder)
R24	Mounted (0 Ω)	VBUS (CN5) 8 V - 48 V supplies the DC-DC converter
	Not mounted	JP5 (8 V - 48 V) supplies the DC-DC converter VBUS (CN5) 0 - 52 V
R36	Mounted (590 Ω) (default)	LED D5 driven by microcontroller (PC15). Keep R74 open.
	Not mounted	LED D5 not connected to microcontroller
R37	Mounted (0 Ω) (default)	STM32F303CC is supplied by DC-DC converter
	Not mounted	STM32F303CC is not supplied by DC-DC converter
R38	Mounted (0 Ω) (default)	STM32F303CC is supplied by USB CN8 or CN10
	Not mounted	STM32F303CC is not supplied by USB CN8 or CN10
R39	Mounted (0 Ω) (default)	LED D6 driven by microcontroller (PB15). Keep R75 open.
	Not mounted	LED D6 not connected to microcontroller
R72	Mounted (0 Ω)(default)	Bus voltage sensing connected to PB2 (ADC2_IN12). Keep R73 not mounted.
	Not mounted	Bus voltage sensing not connected to PB2 (ADC2_IN12)
R73	Mounted (0 Ω)	Connect Pot1 to PB2 (ADC2_IN12). Remove in this case R72.
	Not mounted (default)	Pot1 not connected to PB2 (ADC2_IN12)
R74	Mounted (0 Ω)	DIAG/EN signal from U2 (emergency signal motor 1) connected to microcontroller (PC15). Remove in this case R36.
	Not mounted (default)	DIAG/EN signal from U2 (emergency signal motor 1) not connected to microcontroller
R75	Mounted (0 Ω)	DIAG/EN signal from U3 (emergency signal motor 2) connected to microcontroller (PB15). Remove in this case R39.
	Not mounted (default)	DIAG/EN signal from U3 (emergency signal motor 2) not connected to microcontroller

5 Using the STEVAL-IHM042V1 with the STM32 FOC firmware library

The “STM32 FOC firmware library” performs the field-oriented control (FOC) of one or two permanent magnet synchronous motors (PMSM) in both sensor and sensorless configurations.

It is possible to configure the firmware to work with the STEVAL-IHM042V1 board and to establish real-time communication for debugging/tuning purposes using ST's motor control workbench.

For more information or updates visit ST's website at www.st.com or contact the nearest ST sales office.

6 Bill of material

Table 2. Bill of material

Item	Quantity	Reference	Part	Tolerance	Description
1	3	B1,B2,B3	BUTTON		Surface mount tactile switch
2	2	CN1,CN2	Enc/Hall Connector		
3	2	CN3,CN4	Motor		3 ways connector male 90° 5.08 mm
4	1	CN5	CON2		2 ways connector male 90° 5.08 mm
5	1	CN6			8 way dual row strip line connector (male connector) 2.54 mm pitch
6	2	CN7,CN9			3 way dual row strip line connector (male connector) 2.54 mm pitch
7	2	CN8,CN10	MINIUSBB-TYCO-		USB mini connector female
8	6	C1,C2,C3,C4,C5,C6	10 pF	5%	SMD mult.ceramic cap.
9	20	C7,C9,C16,C17,C32,C34,C35,C36,C37,C38,C41,C4	100 nF	5%	SMD mult.ceramic cap.
10	1	C8	4.7 nF	5%	SMD mult.ceramic cap.
11	2	C10,C11	22 pF	5%	SMD mult.ceramic cap.
12	2	C13,C14	1 nF	5%	SMD mult.ceramic cap.
13	1	C15	1 uF	10%	SMD mult.ceramic cap.
14	2	C18,C19	220 nF	5%	SMD mult.ceramic cap.
15	1	C20	47 uF	20%	Aluminium electrolytic capacitor
16	2	C21,C22	10 nF	5%	SMD mult.ceramic cap.
17	4	C23,C24,C25,C26	100 nF	5%	SMD mult.ceramic cap.
18	2	C27,C28	100 nF		SMD mult.ceramic cap.
19	1	C29	47 uF	20%	Aluminium electrolytic capacitor
20	1	C30	820 pF	5%	SMD mult.ceramic cap.
21	1	C31	10 uF	20%	High value multilayer ceramic capacitors
22	4	C39,C40,C50,C51	20 pF	5%	SMD mult.ceramic cap.
23	2	C45,C56	4.7 uF	20%	Aluminium electrolytic capacitor
24	1	C46	10 uF	20%	Aluminium electrolytic capacitor

Table 2. Bill of material (continued)

Item	Quantity	Reference	Part	Tolerance	Description
25	1	C47	100 nF	5%	SMD MULT.CERAMIC CAP.
26	2	D1,D2	BAV99		Small signal diode
27	1	D3	STPS0560Z		Power schottky rectifier
28	1	D4	GREEN LED		SMT LED
29	1	D5	RED		SMT LED
30	1	D6	BLU		SMT LED
31	4	JP1,JP2,JP3,JP4	STRIPLINE 1X3		3 ways strip line-male 2.54 mm
32	1	JP5	STRIPLINE 1X2		2 ways strip line-male 2.54 mm
33	2	LD1,LD2	HSMF_A201-A00J1		SMT LED two-color
34	1	L1	8.2 uH		SMT power inductor
35	7	R1,R2,R3,R4,R5,R6,R28	4.7 k	1%	
36	6	R7,R37,R38,R72,R73,R76	0	1%	
37	5	R8,R10,R41,R74,R75	NM	1%	
38	1	R9	120 k	1%	
39	1	R11	8.2 k	1%	
40	2	R12,R13	39 k	1%	
41	1	R14	220	1%	
42	2	R15,R16	3.3 K	1%	
43	7	R17,R40,R46,R48,R52,R55, R56	100 k	1%	
44	6	R18,R19,R20,R21,R22,R23	0.47	1%	
45	1	R24	0R	1%	
46	1	R25	47 k	1%	
47	1	R26	330	1%	
48	5	R27,R34,R35,R45,R47	47 k	1%	
49	1	R29	27 k	1%	
50	6	R30,R31,R43,R44,R53,R54	100	1%	
51	1	R33	10 k	10%	Trimmer Cermet
52	2	R36,R39	590	1%	
53	3	R42,R49,R57	10 k	1%	
54	2	R50,R58	36 k	1%	
55	2	R51,R59	1.5 k	1%	
56	6	R60,R61,R62,R66,R67,R68	5.1 k	1%	
57	6	R63,R64,R65,R69,R70,R71	13 k	1%	

Table 2. Bill of material (continued)

Item	Quantity	Reference	Part	Tolerance	Description
58	1	TP1	3V3		1 way strip line male
59	1	TP2	GND		1 way strip line male
60	2	T1,T2	BC818		NPN Transistor
61	1	U1	STM32F303CCT6		
62	2	U2,U3	L6230PD		
63	1	U4	ST1S14PHR		
64	2	U5,U7	STM32F103C8T6		
65	1	U6	LD1117D33TR		
66	3	X1,X2,X3	8MHz		8 MHzCrystal

7 Technical issues

- DIAG/EN signal from U2 (emergency signal motor 1) can't be used in PB12 (TIM1 BRK) because it is used by OP AMP4 Out. It can be connected to PC15 through R74 used just as a GPIO, LED1 must be disabled unmounting the resistor R36 in this case.
- DIAG/EN signal from U3 (emergency signal motor 2) can't be used in PA6 (TIM8 BRK) because it is used by OP AMP2 Out. It can be connected to PB15 through R75 used just as a GPIO, LED2 must be disabled unmounting the resistor R39 in this case.

8 Revision history

Table 3. Document revision history

Date	Revision	Changes
29-Apr-2014	1	Initial release.
26-Mar-2015	2	Modified: Section 3

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