STSPIN32G4 demonstration board for three-phase brushless motors

Product status link
EVSPIN32G4
EVSPIN32G4NH
STSPIN32G4

Features

- Input bus voltage from 10 V to 75 V with dedicated monitoring
- Power stage based on the STL110N10F7 power MOSFETs with output current up to 20 Arms (with heatsink mounted) and protected to overcurrent conditions
- STSPIN32G4, high performance three-phase motor controller with embedded STM32G431 MCU:
    - 32-bit ARM® Cortex®-M4 MCU+FPU
    - Up to 170 MHz clock frequency
    - CORDIC mathematical hardware accelerator for trigonometric functions
    - 128 kB Flash memory with proprietary code readout protection (PCROP), securable memory area, 1 kB OTP
    - 32 kB SRAM memory with HW parity check
    - 2 x advanced timers for motor control, 16-bit with up to 6 x PWM channels each
    - 8 x general purpose timers
    - 2 x ADCs 12-bit resolution (up to 19 channels) with 4 Msps conversion rate
    - 4 x 12-bit DAC channels
    - 4 x ultra-fast rail-to-rail comparators
    - 3 x rail-to-rail operational amplifiers usable also in PGA mode
    - Internal high precision voltage reference
    - Up to 40 GPIOs
    - Full set of interfaces: I2C, SPI, UART and CAN
    - VCC buck converter up to 200 mA, with programmable output and embedded MOSFET
    - 3.3 V LDO linear regulator up to 150 mA
    - Low quiescent linear regulator for MCU supply in standby mode
    - Regulators with full set of protection features; thermal shutdown, short-circuit and overload protections
    - 75 V rated gate drivers with 1 A sink/source current and embedded bootstrap diodes
    - Drain-source voltage sensing of each power MOSFET
- Three-shunt or single-shunt configurable current sensing
- Digital Hall sensor and quadrature encored input
- ST-LINK/V2 programmer and debugger
- Arduino UNO connector
- Predisposition for CAN bus
- NTC sensor for power stage temperature monitoring

Application

- Industrial and home automation
- Home appliances such as vacuum cleaners, dryers and cleaning robots
- Servo drives and e-bikes
- Service and automation robots

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- Power and garden tools
- Pumps and fans
- Drones and aeromodelling

Description

The EVSPIN32G4 is a demonstration board based on the STSPIN32G4 system in package and STL110N10F7 power MOSFETs. The STSPIN32G4 integrates in a 9x9 mm VFQFPN package, a triple high-performance half-bridge gate driver with a rich set of programmable features and one mixed signal STM32G431 microcontroller.

The integrated operational amplifiers for current sensing, the drain-source voltage sensing of each power MOSFET and comparators for overcurrent protection make it a fully integrated solution for motor control.

Thanks to the integrated voltage regulators both the gate driver and control logic supplies can be generated starting from the motor supply without dedicated circuitry.

The board ensures a full evaluation of the STSPIN32G4 and is designed for driving three-phase brushless DC motors and provides an easy-to-use solution for STSPIN32G4 evaluation in different applications such as power tools, e-Bikes, fans, and home appliances.

The board can be configured in three-shunt or single-shunt supporting both sensor-less and sensor-based control algorithms.

The Arduino connector enables the EVSPIN32G4 to be interfaced with expansion boards, such as MEMS sensors or Bluetooth transceivers, while predisposition for CAN bus allows interconnection with master or slave modules to build complex motion control systems.

The on-board ST-LINK/V2 programmer speeds up and simplifies the debugging of microcontroller firmware.

1 Specifications

Table 1. EVSPIN32G4 specifications

Parameter		Value
Supply voltage	Nominal	From 10 V to 75 V
Maximum output current with heatsink (EVSPIN32G4)	Peak	35 A
	Continuous[1]	20 Arms
Maximum output current without heatsink (EVSPIN32G4NH)	Peak	25 A
	Continuous[1]	15 Arms

1. *Maximum current at ambient temperature of 25°C. Actual maximum current could be limited by power dissipation.*

Ratings of the board can be found in Table 1. The EVSPIN32G4NH is the board version without heatsink.

The schematic of the EVSPIN32G4 evaluation board (from Figure 1 to Figure 6) and bill of material (Table 2) are reported below.

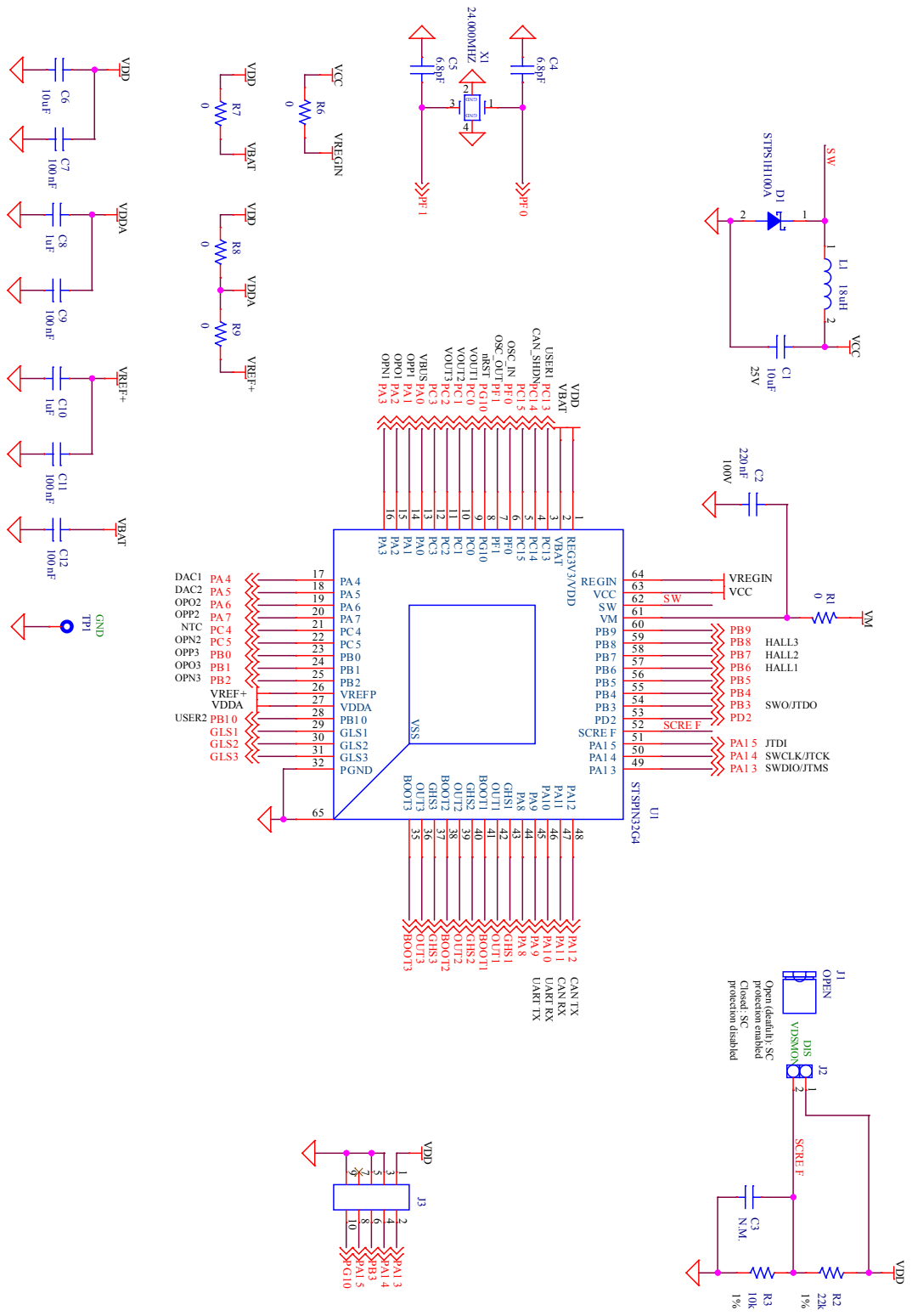**Figure 1. EVSPIN32G4 schematic (1 of 6): STSPIN32G4**

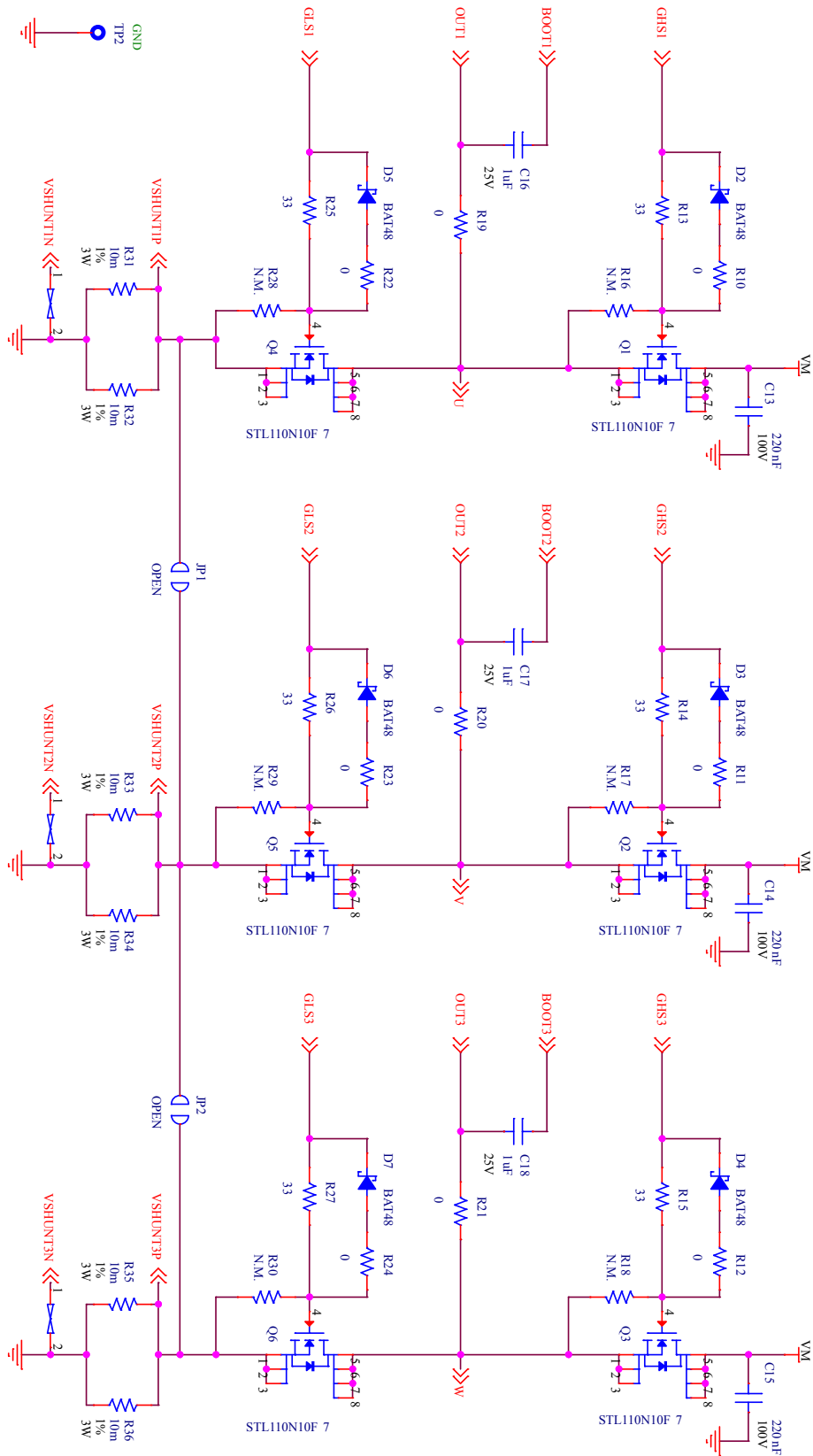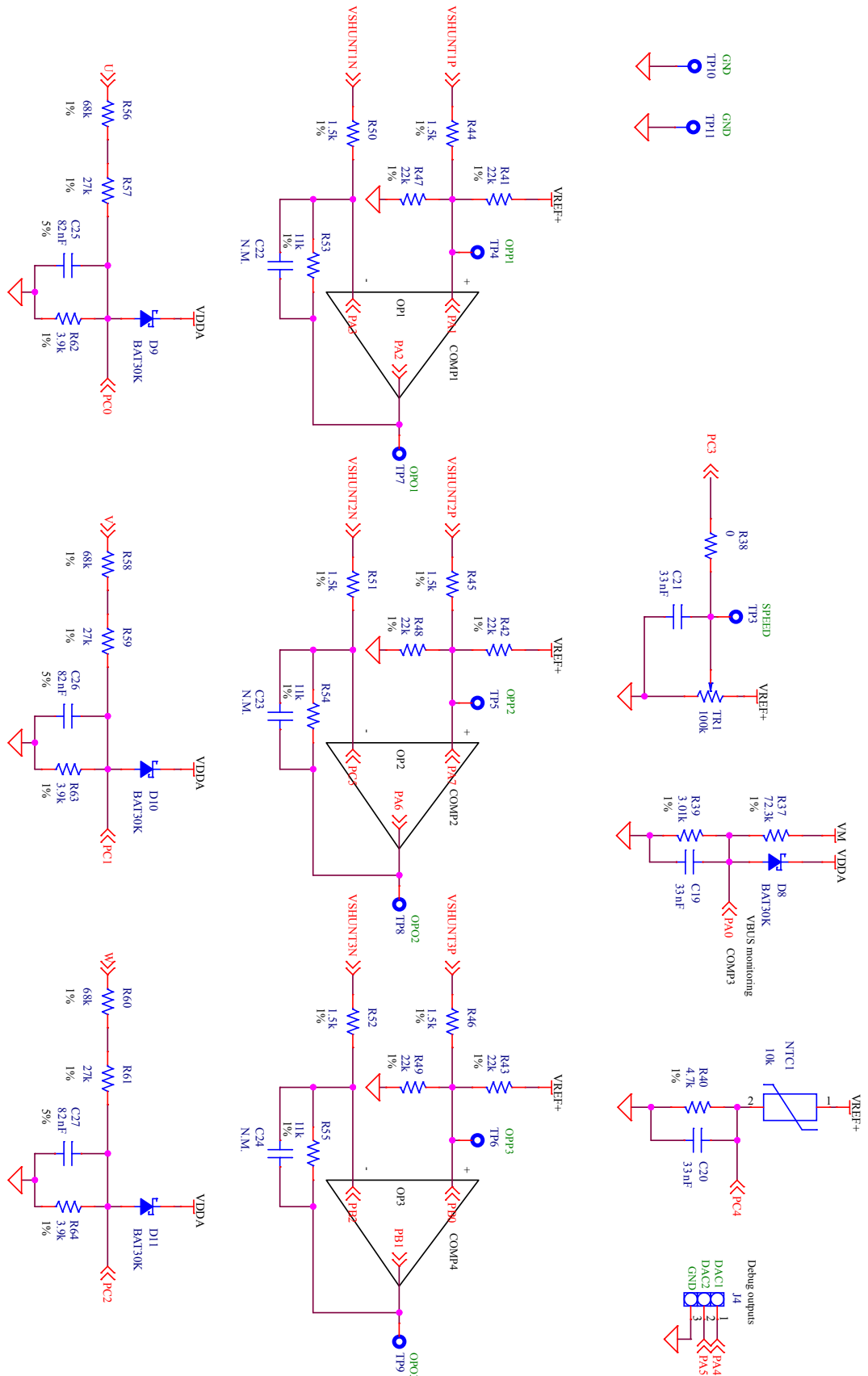**Figure 2. EVSPIN32G4 schematic (2 of 6): Power stage**

Figure 3. EVSPIN32G4 schematic (3 of 6): Sensing
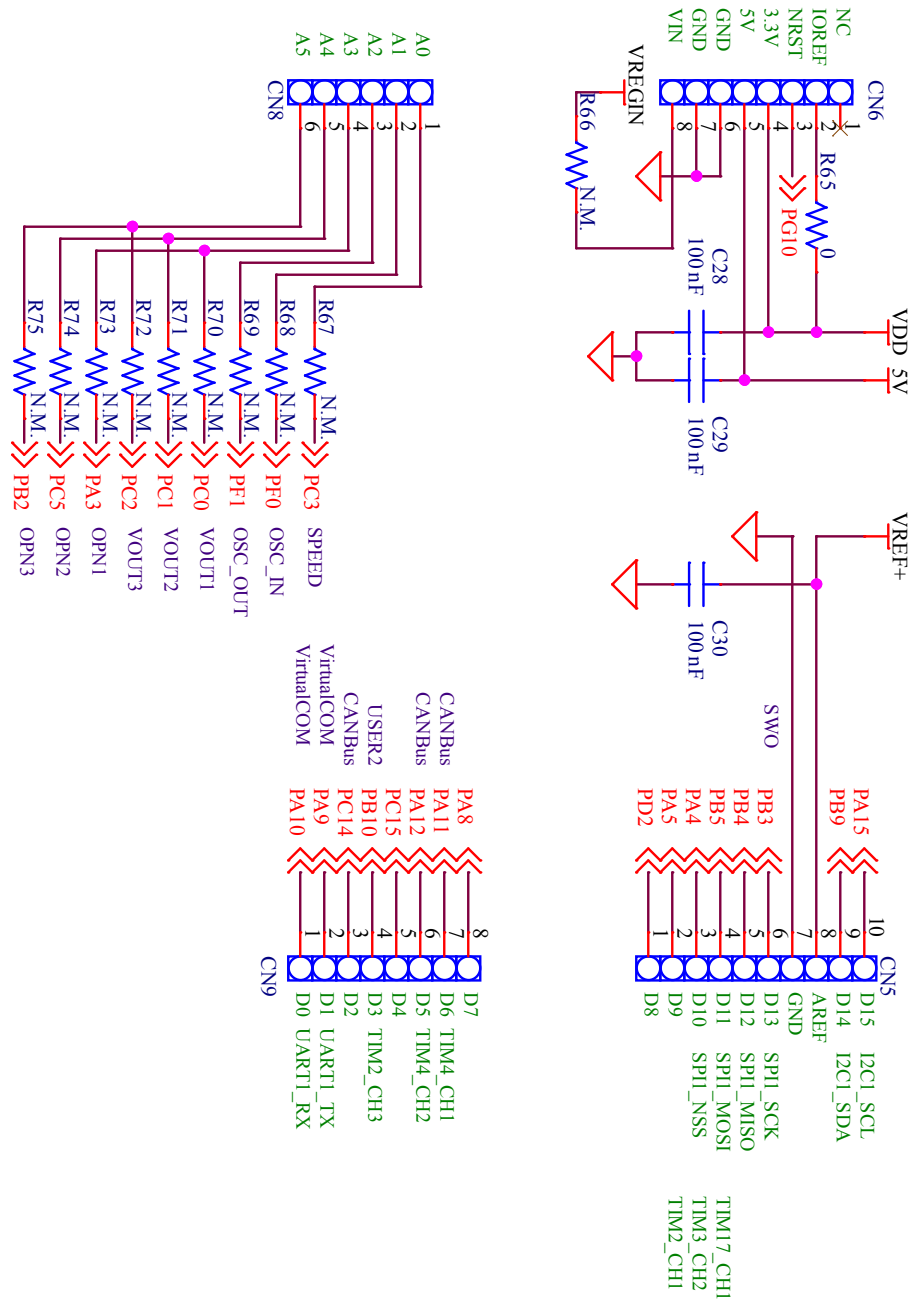
Figure 4. EVSPIN32G4 schematic (4 of 6): Arduino connector

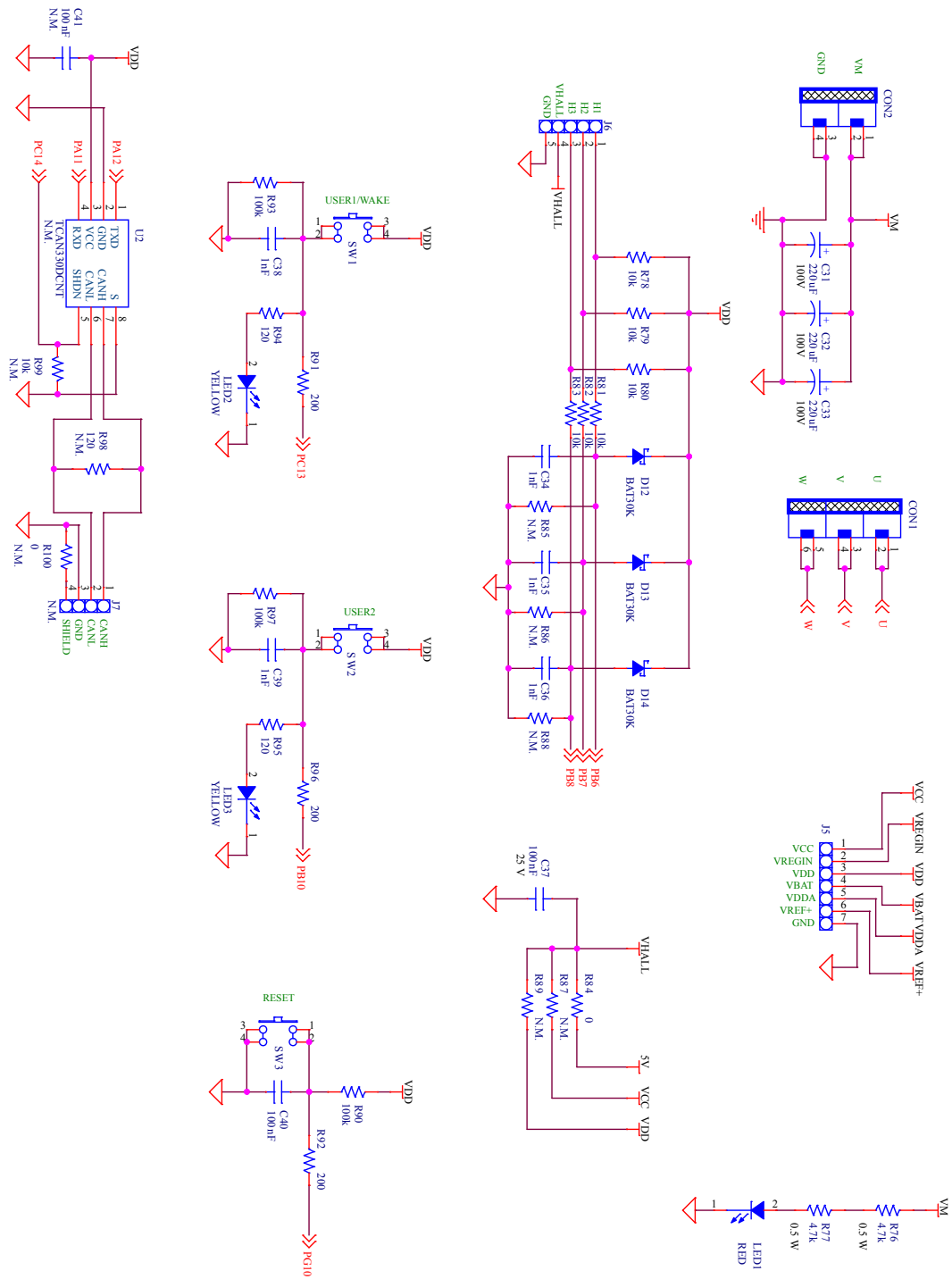**Figure 5. EVSPIN32G4 schematic (5 of 6): Inputs and outputs**
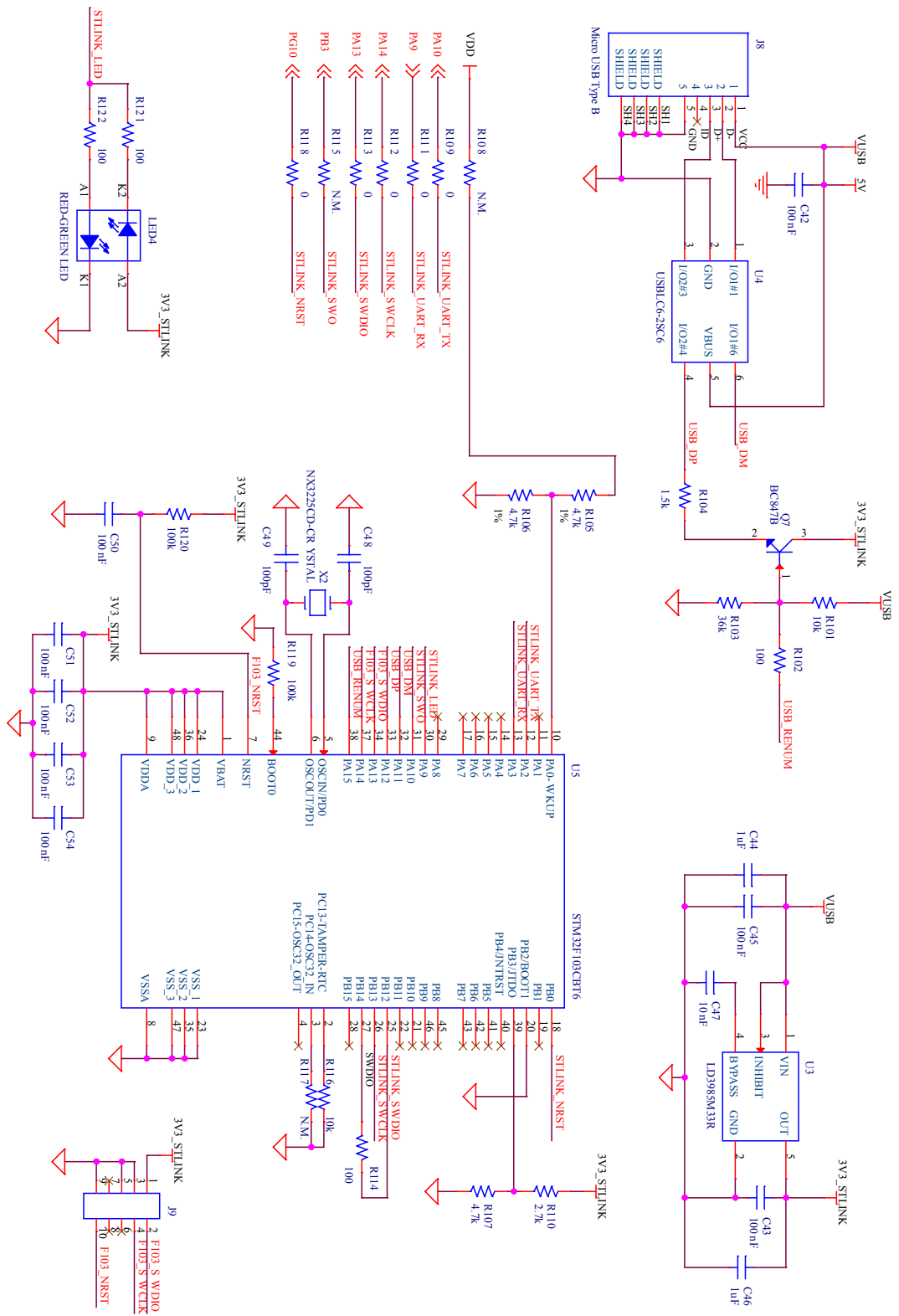
Figure 6. EVSPIN32G4 schematic (6 of 6): ST-LINK/V2

Table 2. EVSPIN32G4 bill of materials

Item	Q.ty	Reference	Description	Value
1	1	CN5	Sil socket straight 10 pos, 2.54 mm	Strip-P2_54-10P-female
2	2	CN6, CN9	Sil socket straight 8 pos, 2.54 mm	Strip-P2_54-8P-female
3	1	CN8	Sil socket straight 6 pos, 2.54 mm	Strip-P2_54-6P-female
4	1	CON1	5.0 mm horizontal entry screwless connector	2834082-2-TE
5	1	CON2	5.0 mm horizontal entry screwless connector	2834082-1-TE
6	1	C1	SMT ceramic capacitor 0805	10 uF, 25 V, 10%
7	4	C2, C13, C14, C15	SMT ceramic capacitor 0805	220 nF, 100 V, 10%
8	4	C3, C22, C23, C24	SMT ceramic capacitor 0603	N.M.
9	2	C4, C5	SMT ceramic capacitor 0402	6.8 pF, 6.3 V, 0.25 pF
10	1	C6	SMT ceramic capacitor 0805	10 uF, 6.3 V, 10%
11	16	C7, C9, C11, C12, C28, C29, C30, C40, C42, C43, C45, C50, C51, C52, C53, C54	SMT ceramic capacitor 0603	100 nF, 6.3 V, 10%
12	4	C8, C10, C44, C46	SMT ceramic capacitor 0603	1 uF, 6.3 V, 10%
13	3	C16, C17, C18	SMT ceramic capacitor 0805	1 uF, 25 V, 10%
14	3	C19, C20, C21	SMT ceramic capacitor 0603	33 nF, 6.3 V, 10%
15	3	C25, C26, C27	SMT ceramic capacitor 0603	82 nF, 6.3 V, 5%
16	3	C31, C32, C33	THT electrolytic capacitor D500p200	220 uF, 100 V, 20%
17	5	C34, C35, C36, C38, C39	SMT ceramic capacitor 0603	1 nF, 6.3 V, 10%
18	1	C37	SMT ceramic capacitor 0603	100 nF, 25 V, 10%
19	1	C41	SMT ceramic capacitor 0603	N.M.
20	1	C47	SMT ceramic capacitor 0603	10 nF, 6.3 V, 10%
21	2	C48, C49	SMT ceramic capacitor 0603	100 pF, 6.3 V, 10%
22	1	D1	High voltage power schottky rectifier	STPS1H100A, 100 V
23	6	D2, D3, D4, D5, D6, D7	Small signal schottky diode	BAT48, 40 V
24	7	D8, D9, D10, D11, D12, D13, D14	Small signal schottky diodes	BAT30K, 30 V
25	1	HS1[1]	Heatsink	RAWA410-0
26	2	JP1, JP2	SMT jumper	Open
27	1	J1	Jumper	Open
28	1	J2	Strip connector 2 pos, 2.54 mm	Strip 1x2
29	2	J3, J9	Strip connector 2x5, pitch 2.54 mm	Strip 2x5
30	1	J4	Strip connector 3 pos, 2.54 mm	Strip 1x3
31	1	J5	Strip connector 7 pos, 2.54 mm	Strip 1x7
32	1	J6	Strip connector 5 pos, 2.54 mm	Strip 1x5
33	1	J7	Strip connector 4 pos, 2.54 mm	N.M.
34	1	J8	USB receptacle-MINI B	Micro USB type B
35	1	LED1	WL-SMCW SMT Mono-color chip LED Waterclear	Red
36	2	LED2, LED3	WL-SMCW SMT Mono-color chip LED Waterclear	Yellow

Item	Q.ty	Reference	Description	Value
37	1	LED4	LED indicators, PLCC-4 red/yellow green	Red-green
38	1	L1	WE-PD2 SMT power inductor	18uH, 1A
39	3	NET1, NET2, NET3	PCB short	N.M.
40	1	NTC1	NTC thermistor 0603	10k, 1%
41	6	Q1, Q2, Q3, Q4, Q5, Q6	N-channel 100 V, 5 mΩ typ., 107 A STripFET F7 Power MOSFET	STL110N10F7
42	1	Q7	NPN general purpose transistor	BC847B
43	13	R1, R6, R7, R8, R9, R38, R65, R84, R109, R111, R112, R113, R118	SMT resistor 0805	0, 0.1 W, 5%
44	7	R2, R41, R42, R43, R47, R48, R49	SMT resistor 0603	22k, 0.1W, 1%
45	1	R3	SMT resistor 0603	10k, 0.1 W, 1%
46	9	R10, R11, R12, R19, R20, R21, R22, R23, R24	SMT resistor 0603	0, 0.1 W, 5%
47	6	R13, R14, R15, R25, R26, R27	SMT resistor 0603	33, 0.1 W, 5%
48	6	R16, R17, R18, R28, R29, R30	SMT resistor 0805	N.M.
49	6	R31, R32, R33, R34, R35, R36	SMT resistor 2512	10 m, 3 W, 1%
50	1	R37	SMT resistor 0603	72.3k, 0.1 W, 1%
51	1	R39	SMT resistor 0603	3.01k, 0.1 W, 1%
52	3	R40, R105, R106	SMT resistor 0603	4.7k, 0.1 W, 1%
53	6	R44, R45, R46, R50, R51, R52	SMT resistor 0603	1.5k, 0.1 W, 1%
54	3	R53, R54, R55	SMT resistor 0603	11k, 0.1 W, 1%
55	3	R56, R58, R60	SMT resistor 0603	68k, 0.1 W, 1%
56	3	R57, R59, R61	SMT resistor 0603	27k, 0.1 W, 1%
57	3	R62, R63, R64	SMT resistor 0603	3.9k, 0.1 W, 1%
58	15	R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R87, R89, R100, R108, R115	SMT resistor 0805	N.M.
59	2	R76, R77	SMT resistor 0805	4.7k, 0.5 W, 5%
60	8	R78, R79, R80, R81, R82, R83, R101, R116	SMT resistor 0603	10k, 0.1 W, 5%
61	4	R85, R86, R88, R117	SMT resistor 0603	N.M.
62	5	R90, R93, R97, R119, R120	SMT resistor 0603	100k, 0.1 W, 5%
63	3	R91, R92, R96	SMT resistor 0603	200, 0.1 W, 5%
64	2	R94, R95	SMT resistor 0603	120, 0.1 W, 5%
65	1	R98	SMT resistor 0603	120, 0.1 W, 5%
66	1	R99	SMT resistor 0603	10k, 0.1 W, 5%

Item	Q.ty	Reference	Description	Value
67	4	R102, R114, R121, R122	SMT resistor 0603	100, 0.1 W, 5%
68	1	R103	SMT resistor 0603	36k, 0.1 W, 5%
69	1	R104	SMT resistor 0603	1.5k, 0.1 W, 5%
70	1	R107	SMT resistor 0603	4.7k, 0.1 W, 5%
71	1	R110	SMT resistor 0603	2.7k, 0.1 W, 5%
72	8	SC1, SC2, SC3, SC4, SC5, SC6, SC7, SC8	M3 Cheese-head screw	M3
73	4	SP1, SP2, SP3, SP4	M3 F-F Hexagonal spacer 20 mm	222424
74	3	SW1, SW2, SW3	Tactile switches - 6x6 J-bend SMT	6x6 J-bend SMT
75	1	TIM1[1]	Thermally conductive Gap filler, 150x150 mm sp.0,5 mm.	7074645
76	2	TP1, TP2	40x71 mils SMD PAD	TP-SMD-S1751-46R
77	7	TP3, TP4, TP5, TP6, TP7, TP8, TP9	Test point - PCB 1.5 mm diameter	N.M.
78	2	TP10, TP11	TP for Probe	N.M.
79	1	TR1	3/8 Square Trimpot trimming potentiometer, side adjust	100k
80	**1**	**U1**	**3-phase brushless motor controller embedding STM32G431 MCU**	**STSPIN32G4**
81	1	U2	TCAN33x 3.3-V CAN Transceivers with CAN FD (Flexible Data Rate)	N.M.
82	1	U3	Ultra-low drop and low noise BiCMOS voltage regulators	LD3985M33R
83	1	U4	Very low capacitance ESD protection	USBLC6-2SC6
84	1	U5	Medium-density performance line ARM®-based 32-bit MCU with 128 Kb Flash, USB, CAN, 7 timers, 2 ADCs, 9 com. interfaces	STM32F103CBT6
85	1	X1	IoT optimized low profile quartz crystal	24.000 MHz
86	1	X2	Crystal 8.0000MHz 8PF SMD	8.0000 MHz

1.   *Not provided with EVSPIN32G4NH*

2 Waste and recycling

The evaluation board is not to be disposed of as urban waste. At the end of its life cycle, differentiated waste collection must be followed. Consult the local authorities for more information on the proper disposal channels and recycling centers. It is mandatory to collect separately the evaluation board and make sure it is delivered to the appropriate waste management and recycling centers. As of 15 August 2018, in all countries belonging to the European Union, the evaluation board is subject to the requirements of WEEE Directive **2012/19/EU**, and therefore it is forbidden to dispose of the evaluation board as undifferentiated waste or with other domestic waste. Incorrect disposal of the evaluation board may cause damage to the environment and may incur fines based on specific countries' rules, regulations, and laws.

Revision history

Table 3. Document revision history

Date	Version	Changes
15-Mar-2021	1	Initial release.

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