UM3398

User manual

Getting started with EVLSPIN32G0A1/A2/B1/B2 brushless motor driver evaluation boards

Introduction

The EVLSPIN32G0A1, EVLSPIN32G0A2, EVLSPIN32G0B1, and EVLSPIN32G0B2 are 3-phase brushless motor driver boards based on the STSPIN32G0 family of devices.

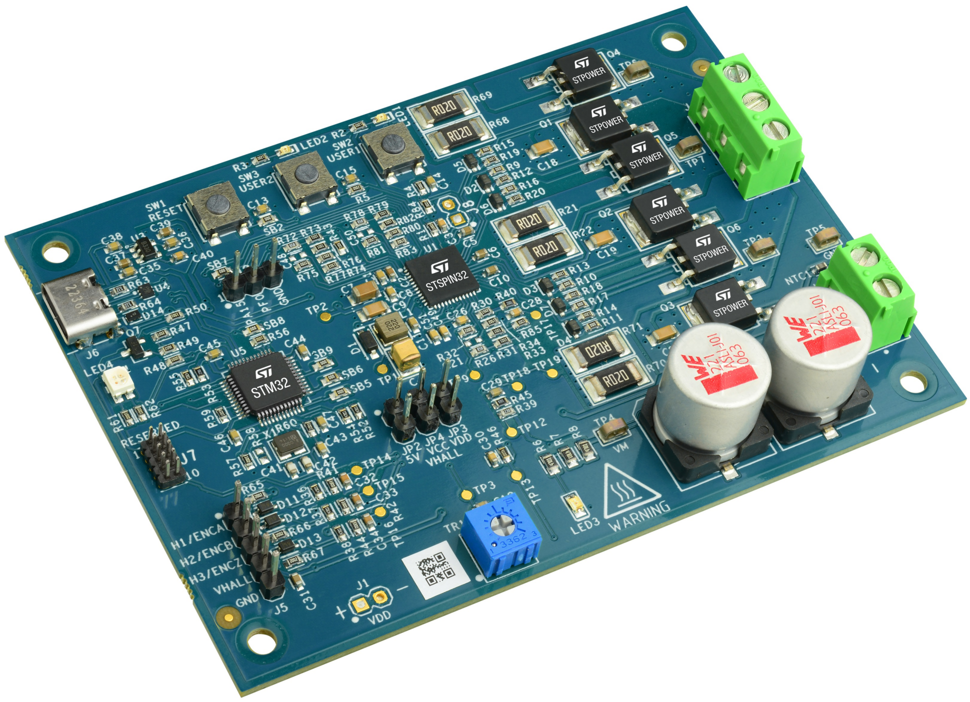
Each board provides a three-shunt (EVLSPIN32G0A1 and EVLSPIN32G0A2) or single-shunt (EVLSPIN32G0B1 and EVLSPIN32G0B2) sensing topology suitable for high-performance Field Oriented Control algorithms and a full set of protections: voltage monitoring, PCB temperature monitoring, overcurrent comparator, and UVLO on gate driver supplies.

A dedicated connector allows interfacing with both digital Hall-effect based position sensors and incremental encoders.

The user can program and debug the firmware through the onboard STLINK V2-1 that also offers UART communication via virtual COM and direct binary download (mass storage peripheral).

The boards, in combination with the STM32 Motor Control SDK, are designed to support engineers in testing, developing, and validating motor control designs for applications such as power tools, home appliances, fans, and pumps.

Figure 1. **EVLSPIN32G0A2 evaluation board**



1 Safety and operating instructions

1.1 General terms

During assembly, testing, and operation, the evaluation board poses several inherent hazards, including bare wires, moving or rotating parts, and hot surfaces.

Danger: *There is a danger of serious personal injury or death due to electrical shock, property damage, and burnt hazards if the kit or components are improperly used or installed incorrectly.*

In particular:

- Do not touch or modify the hardware when the power supply is present.
- Do not connect or disconnect the wirings when the power supply is present.
- Do not touch the components or the heatsink.
- Do not cover the board.
- Do not put the board in contact with flammable materials or with materials releasing smoke when heated.
- After operation, allow the board to cool down before touching it.

All operations involving transportation, installation and use, and maintenance must be performed by skilled technical personnel able to understand and implement national accident prevention regulations. For the purposes of these basic safety instructions, “skilled technical personnel” are suitably qualified people who are familiar with the installation, use, and maintenance of power electronic systems.

1.2 Intended use of the evaluation board

The evaluation board is designed for demonstration purposes only and must not be used for electrical installations or machinery. Technical data and information concerning its usage are detailed in the documentation and should be strictly observed.

1.3 Installing the evaluation board

- The installation and cooling of the evaluation board must be in accordance with the specifications and target application.
- The motor-drive converters must be protected against excessive strain. Components should not be bent or altered during transportation or handling.
- No contact must be made with other electronic components or conduction materials.
- The board contains electrostatically sensitive components that are prone to damage if used incorrectly.
- Do not mechanically damage or destroy the electrical components (potential health risks).

1.4 Operating the evaluation board

To properly operate the board, follow these safety rules.

1. Work area safety:
   - The work area must be clean and tidy.
   - Do not work alone when boards are energized.
   - Do not leave the board unattended when energized.
   - Protect against inadvertent access to the area where the board is energized using suitable barriers and signs.
   - A system architecture that supplies power to the evaluation board must be equipped with additional control and protective devices in accordance with the applicable safety requirements (that is, compliance with technical equipment and accident prevention rules).
   - Use a non-conductive and stable work surface.
   - Use adequately insulated clamps and wires to attach measurement probes and instruments.
2. Electrical safety
   - Take care to remove any dirt from the board before use. Only products and tools dedicated to cleaning electronic circuits must be used for this purpose.
   - Remove the power supply from the board and electrical loads before wiring and connecting probes or other measuring equipment.
   - Once the setup is complete, energize the board.
   - Do not touch the evaluation board when it is energized or immediately after it has been disconnected from the voltage supply as several parts and power terminals containing potentially energized capacitors need time to discharge.
   - Do not touch the boards after disconnection from the voltage supply as several parts like heatsinks and transformers may still be at dangerous temperature levels.
   - The board is not electrically isolated from the DC input.
   - The USB interface of the board does not insulate the host computer from the power supply voltage.
   - Onboard potentiometer and buttons must be used paying attention to avoiding direct contact with live contacts nearby.
3. Personal safety:
   - Always wear suitable personal protective equipment such as insulating gloves and safety glasses.
   - Take adequate precautions and install the board in such a way to prevent accidental touch, such as protecting shields.

2 Features

The following are the common features for all the evaluation boards:

- Input voltage from 7 V to 45 V
- Output current up to 15 A_{rms}
- Power stage based on STD140N6F7 MOSFETs
- 3.3 V buck regulator embedded in STSPIN32G0 SiP
- 12 V LDO regulator embedded in STSPIN32G0 SiP
- Digital Hall sensors and encoder input
- Overcurrent comparator
- Bus voltage sensing
- PCB temperature sensing
- Embedded ST-LINK/V2-1 (Virtual COM + Mass storage + SWD debugger and programmer)
- Easy user interface with buttons and potentiometer.

Each board also provides specific features:

EVLSPIN32G0A1 and EVLSPIN32G0A2:

- Three-shunt current sensing compatible with Field Oriented Control algorithm

EVLSPIN32G0B1 and EVLSPIN32G0B2:

- Single-shunt current sensing compatible with both Field Oriented Control and 6STEP algorithms.
- Back EMF sensing for 6STEP sensorless algorithm.
- Current limiter with adjustable reference.

EVLSPIN32G0A1 and EVLSPIN32G0B1:

- High precision reference voltage (VREF+).

3 Getting started

The evaluation boards are supported by the STM32 Motor Control software development kit (SDK) allowing to drive a motor in a few simple steps.

3.1 Hardware and software requirements

Before starting, check the following requirements:

- A PC with a free USB port and the software below already installed:
  - STM32 Motor Control SDK (version 6.3.0 or later)
  - STM32CubeMX
  - One among the supported software development toolchains:
    - STM32CubeIDE
    - IAR Embedded Workbench for Arm
    - ARM-Keil µVision
- A USB Type-C® cable to connect the evaluation board to the PC
- A 3-phase brushless motor with voltage and current ratings compatible with the board
- An external DC power supply fitting the motor's characteristics

3.2 Step by step guide

Using the STM32 Motor Control SDK, the creation of a new motor control project based on the evaluation board is simplified.

For more information about the STM32 Motor Control SDK, refer to the related documentation.

1. Launch the Motor Control Workbench tool
2. Select the target control algorithm from Field Oriented Control (FOC) or 6STEP
3. Select the target motor or create a new motor
4. Select the target evaluation board in the inverter section
5. Configure the solution according to application requirements

Warning: *Please consider that to enable some features, the solder bridges on the board may be modified. See Section 4.3 for more details.*

6. Generate the project and compile the code
7. Connect the board to the PC through the USB cable
8. Wire the motor to the board
9. Supply the board
10. Download and debug the code using the embedded ST-LINK/V2-1 and control the motor through the Motor Pilot (included in the STM32 Motor Control SDK)

4 Hardware description

Figure 2, Figure 3, Figure 4, and Figure 5 show the position of the connectors, LEDs, buttons, and test points of the evaluation boards.

Figure 2. EVLSPIN32G0A1 hardware description

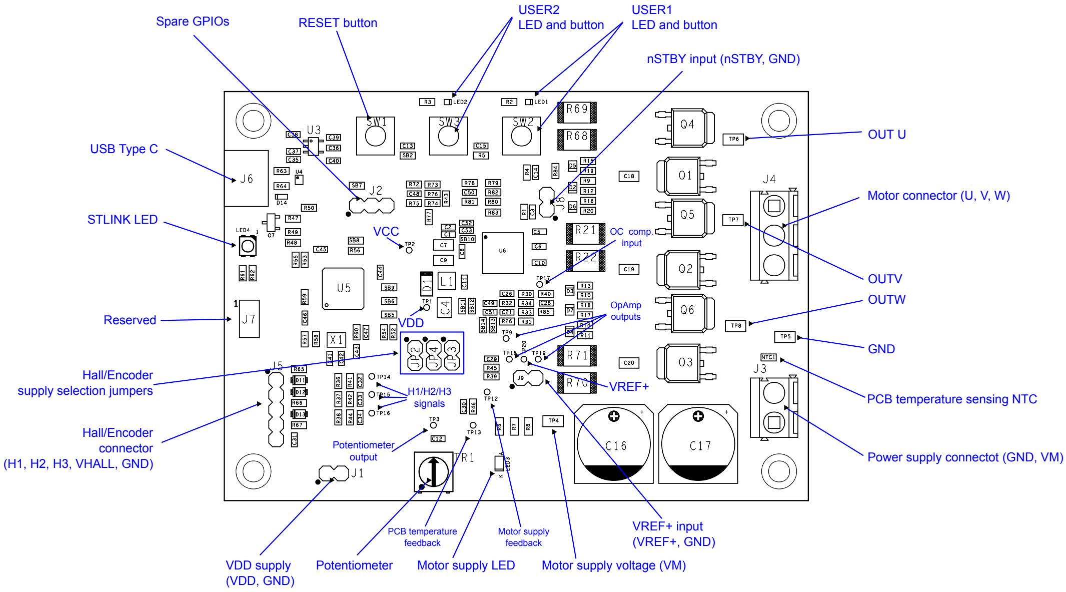


Figure 3. EVLSPIN32G0A2 hardware description

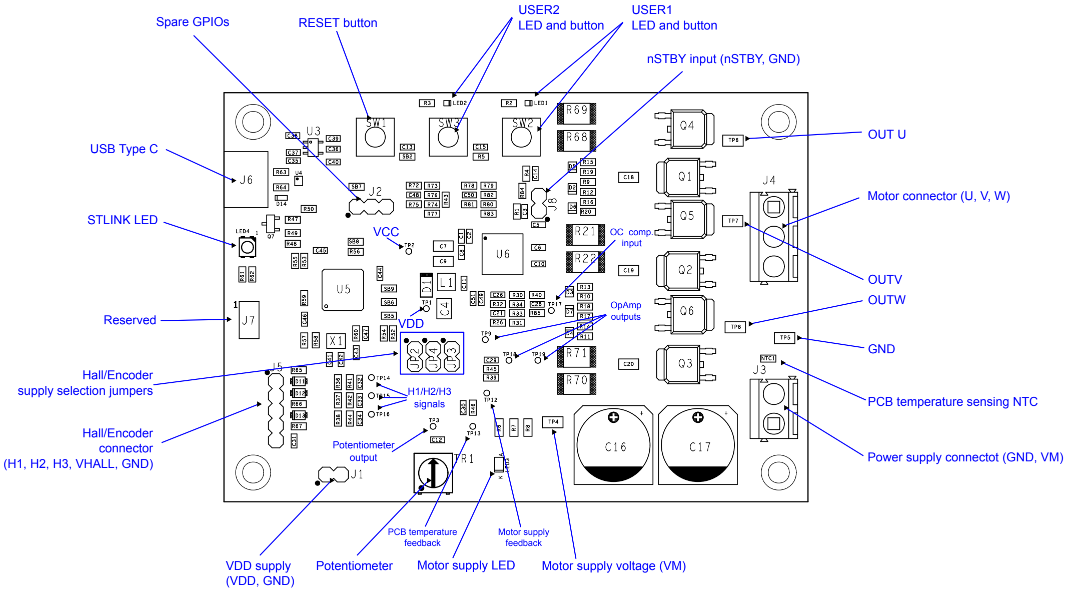


Figure 4. EVLSPIN32G0B1 hardware description

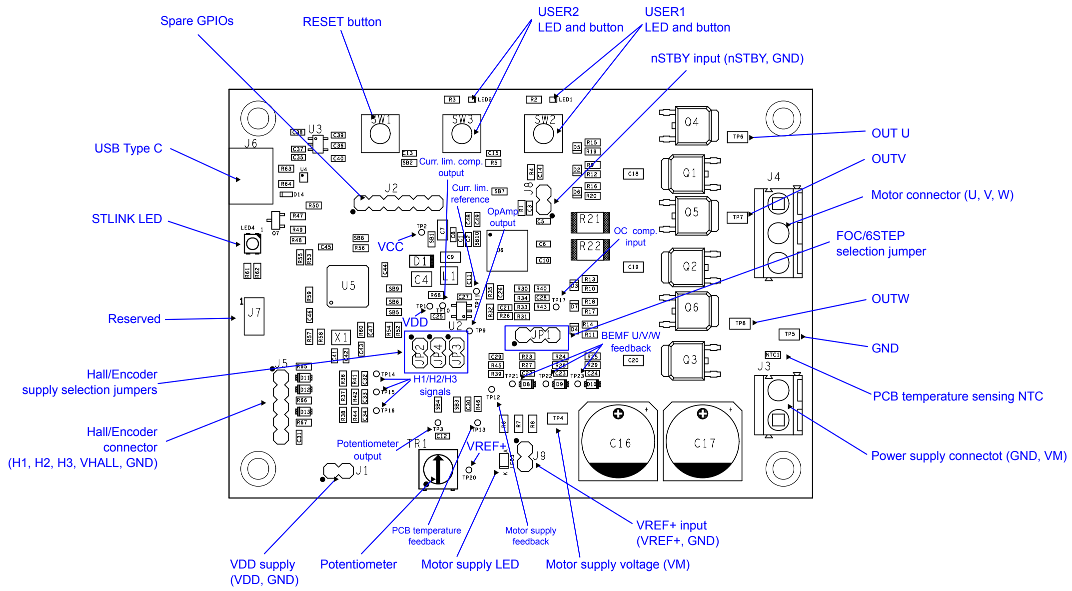


Figure 5. EVLSPIN32G0B2 hardware description

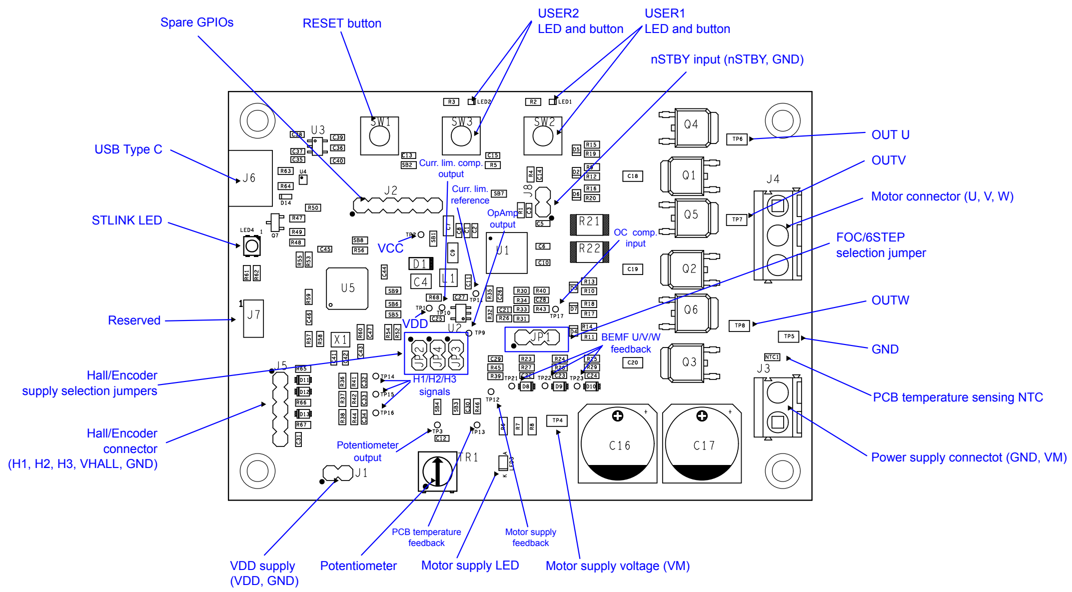


Table 1. Connectors, LEDs, buttons, and test points list

A1	A2	B1	B2	Reference	Description	UM section
X	X	X	X	J1	VDD supply connector (3.3 V generated by STSPIN32G0 buck regulator)	Section 4.1
X	X	X	X	J2	Spare GPIOs	Section 4.3
X	X	X	X	J3	Motor supply voltage input connector (45 V max.)	Section 4.1
X	X	X	X	J4	Inverter outputs connector (connect to motor leads)	Section 4.2
X	X	X	X	J5	Hall/Encoder connector	Section 4.10
X	X	X	X	J6	USB Type C connector	Section 4.11
X	X	X	X	J7	Reserved	-
X	X	X	X	J8	nSTBY input connector	Section 4.3
X	-	X	-	J9	VREF+ input connector	Section 4.4.3
X	X	X	X	LED1	User LED 1 (yellow)	Section 4.3
X	X	X	X	LED2	User LED 2 (yellow)	Section 4.3
X	X	X	X	LED3	Motor supply LED (Red)	Section 4.1
X	X	X	X	LED4	ST-LINK/V2-1 communication LED (red-green)	Section 4.11
X	X	X	X	SW1	Reset button	Section 4.3
X	X	X	X	SW2	User button 1	Section 4.3
X	X	X	X	SW3	User button 2	Section 4.3
X	X	X	X	TP1	VDD supply and buck regulator output (3.3 V)	Section 4.1
X	X	X	X	TP2	VCC supply and LDO output (12 V)	Section 4.1
X	X	X	X	TP3	Potentiometer output	Section 4.3
X	X	X	X	TP4	Motor supply voltage	Section 4.1
X	X	X	X	TP5	Power ground	Section 4.1
X	X	X	X	TP6	Inverter output U	Section 4.2
X	X	X	X	TP7	Inverter output V	Section 4.2
X	X	X	X	TP8	Inverter output W	Section 4.2
X	X	X	X	TP9	Op amp 1 output	Section 4.4
-	-	X	X	TP10	Current limiter comparator output	Section 4.6
-	-	X	X	TP11	Current limiter comparator reference input	Section 4.6
X	X	X	X	TP12	Motor supply monitoring feedback	Section 4.7
X	X	X	X	TP13	PCB temperature monitoring feedback	Section 4.8
X	X	X	X	TP14	Hall1/EncoderA signal	Section 4.10
X	X	X	X	TP15	Hall2/EncoderB signal	Section 4.10
X	X	X	X	TP16	Hall3/EncoderZ signal	Section 4.10
X	X	X	X	TP17	Overcurrent comparator input	Section 4.5
X	X	-	-	TP18	Op amp 2 output	Section 4.4
X	X	-	-	TP19	Op amp 3 output	Section 4.4
X	-	X	-	TP20	VREF+ voltage	Section 4.4.3
-	-	X	X	TP21	BEMF U feedback	Section 4.9
-	-	X	X	TP22	BEMF V feedback	Section 4.9
-	-	X	X	TP23	BEMF W feedback	Section 4.9
X	X	X	X	TR1	Potentiometer	Section 4.3

4.1 Supply management

The main supply of the evaluation board is from the J3 screw terminal block (motor supply voltage) and it is used by the STSPIN32G0 SiP to generate the gate driver (VCC) and control circuitry (VDD) supplies.

When the motor supply voltage is present, LED3 turns on. In any case, this does not ensure that its voltage level is within the operative range of the device.

It is possible to directly supply the gate driving circuitry (VCC) through the motor supply (VM) closing the SB1 solder bridge (see Section 4.12); in this case, the maximum supply voltage is limited to 15 V.

The ST-LINK/V2-1 is supplied directly by the USB Type-C® connector.

4.2 Power stage

The inverter consists of six STD140N6F7, 60 V 3 mΩ power MOSFETs in STripFET F7 technology, and it is designed to deliver up to 15 A_{rms}.

The power stage's outputs (U, V, W) are connected to the J4 screw terminal.

Warning: *According to several environmental conditions, such as ambient temperature, airflows, and board positioning, the power stage could overheat when loaded at high current levels for long periods.*

It is recommended to always keep the board temperature monitored and to stop any operation when MOSFETs' case temperature reaches 150 °C.

4.3 Input interface, reset, and spare GPIOs

The evaluation boards are equipped with a pair of user buttons, one potentiometer, and LEDs that can be used to control the application (for example, start/stop the motor, set the target speed, etc.) or provide feedback (for example, fault indication).

Table 2 lists the mapping between UI items and GPIOs.

Table 2. User interface mapping

Function	EVLSPIN32G0A1	EVLSPIN32G0A2	EVLSPIN32G0B1	EVLSPIN32G0B2
SW1/LED1	PC14-OSC32_IN	PC14-OSC32_IN	PC14-OSC32_IN	PC14-OSC32_IN
SW2/LED2	PA12 [PA10]	PA12 [PA10]	PC15-OSC32_OUT	PC15-OSC32_OUT
Potentiometer	PA5 (1)	PA3	PA3 (2)	PA3 (2)

1. *Close SB14 and open SB13 to enable this feature (see Section 4.12).*
2. *Close SB4 and open SB3 to enable this feature (see Section 4.12).*

A dedicated button is connected to the reset input of the MCU (PF2-nRST).

Shorting the J8 strip, the nSTBY input is shorted to ground, forcing the gate driver in standby mode (see device datasheet for further details).

Some spare GPIOs are made available according to the specific board version as listed in Table 3.

Table 3. Spare GPIOs list (J2 connector)

Pin	EVLSPIN32G0A1	EVLSPIN32G0A2	EVLSPIN32G0B1	EVLSPIN32G0B2
1	PB6	PA15	PA15	PA15
2	PF0-OSC_IN	PF0-OSC_IN	Unconnected	PB5
3	GND	GND	PB9	PB9
4	N/A	N/A	Unconnected	PC13
5	N/A	N/A	PF0-OSC_IN	PF0-OSC_IN
6	N/A	N/A	GND	GND

4.4 Current sensing

The evaluation boards provide current sensing circuitry based on shunt resistors and take advantage of the embedded op amps in the STSPIN32G0 SiP for the signal conditioning.

4.4.1 Three-shunt current sensing (EVLSPIN32G0A1 and EVLSPIN32G0A2)

In three-shunt board versions, based on the STSPIN32G0A1 and STSPIN32G0A2, the three embedded op amps are used for bipolar current sensing:

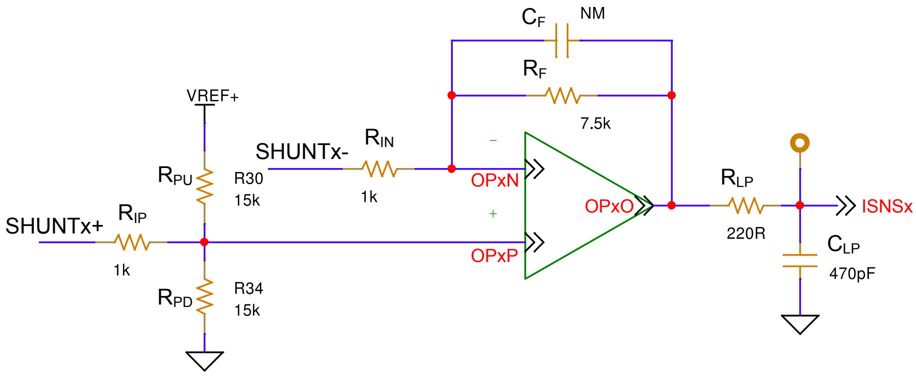
- Op amp 1 is used for phase W current monitoring
- Op amp 2 is used for phase V current monitoring
- Op amp 3 is used for phase U current monitoring

The MCU can acquire the output of the current sensing circuits through ADC:

- Phase U current monitoring: PA6 (ADC1, Channel 6)
- Phase V current monitoring: PA7 (ADC1, Channel 7)
- Phase W current monitoring: PB1 (ADC1, Channel 9)

All the op amps are in differential amplifier configuration with low pass filtered output (see Figure 6). This configuration allows better common-mode rejection performance and effective filtering of commutation noise.

Figure 6. Three-shunt current sensing op amp configuration



In the default configuration the circuit is sized as follows:

- Op amp gain = 7.5 V/V
- Current sensing gain = 75 mV/A (shunt resistance of 10 mΩ)
- Current sensing range = +/- 22 A (rail-to-rail at VDD = 3.3 V)
- Output offset (that is, output voltage at 0 A) = VREF+/2 = 1.65 V (see Section 4.4.3)
- Low pass cut frequency = 1.54 MHz

The current sensing can be customized to better fit the target motor: for example, driving a 1 A rated motor uses only 4.5 % of the dynamics resulting in an under-performing control.

For better performance, the differential configuration of the op amp must be ensured:

- $R_{IN} = R_{IP} = R_I$
- $R_{PU} = R_{PD} = 2 \times R_F$

In the above conditions, the offset voltage is always VREF+/2, allowing a matched positive and negative current sensing range.

Eq. (1), Eq. (2), and Eq. (3) are used to set the sensing range according to R_I, R_F, and shunt resistor (R_{SHUNT}) values.

$$G_{V/V} = \frac{R_F}{R_I} \quad (1)$$

$$G_{V/A} = R_{SHUNT} \times G_{V/V} \quad (2)$$

$$I_{RANGE} = \frac{V_{REF+}}{2 \times G_{V/A}} \quad (3)$$

4.4.2 Single-shunt current sensing (EVLSPIN32G0B1 and EVLSPIN32G0B2)

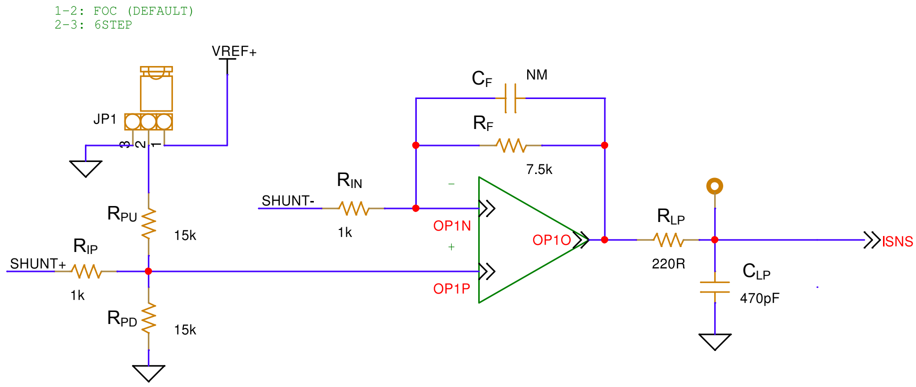
In single-shunt board versions, based on the STSPIN32G0B1 and STSPIN32G0B2, the embedded op amp is used for current sensing in two possible configurations (see Section 4.12):

- Bipolar current sensing: JP1 closed in FOC (1-2) position (default)
- Unipolar current sensing: JP1 closed in 6STEP (2-3) position

The MCU can acquire the output of the current sensing circuit through ADC: PB1 (ADC1, Channel 9).

The op amp is in differential amplifier configuration with low pass filtered output (see Figure 7). This configuration allows better common-mode rejection performance and effective filtering of commutation noise.

Figure 7. Single-shunt current sensing op amp configuration



In the default configuration the circuit is sized as follows:

- Op amp gain = 7.5 V/V
- Current sensing gain = 75 mV/A (shunt resistance of 10 mΩ)
- Current sensing range:
  - +/- 22 A (rail-to-rail at VDD = 3.3 V) in bipolar current sensing
  - + 44 A (rail-to-rail at VDD = 3.3 V) in unipolar current sensing
- Output offset (that is, output voltage at 0 A):
  - VREF+/2 = 1.65 V (see Section 4.4.3) in bipolar current sensing
  - 0 V in unipolar current sensing
- Low pass cut frequency = 1.54 MHz

The current sensing can be customized to better fit the target motor: for example, driving a 1 A rated motor uses only 4.5 % of the bipolar sensing dynamics resulting in an under-performing control.

In any case, the differential configuration of the op amp must be ensured:

- $R_{IN} = R_{IP} = R_I$
- $R_{PU} = R_{PD} = 2 \times R_F$

In the above conditions, the bipolar sensing offset voltage is always VREF+/2, allowing a matched positive and negative current sensing range. Eq. (1), Eq. (2), and Eq. (3) are used to set the sensing range according to R_I, R_F, and shunt resistor (R_{SHUNT}) values.

$$G_{V/V} = \frac{R_F}{R_I} \tag{4}$$

$$G_{V/A} = R_{SHUNT} \times G_{V/V} \tag{5}$$

$$I_{RANGE} = \begin{cases} bipolarsensing: \dfrac{V_{REF+}}{2 \times G_{V/A}} \\ unipolarsensing: \dfrac{V_{REF+}}{G_{V/A}} \end{cases} \tag{6}$$

4.4.3 Analog circuitry reference voltage (VREF+)

The EVLSPIN32G0A1 and EVLSPIN32G0B1 evaluation boards provide a dedicated reference voltage (VREF+) for the analog circuitry, in particular for the ADC converter embedded in the MCU.

There are three ways to provide VREF+ voltage to the board:

1. Shorting the SB10 (default). In this case VREF+ is equal to VDD.
2. Providing a reference voltage on the J9 connector. SB10 must be open (see Section 4.12).
3. Enabling the VREFBUF feature of the embedded STM32G031 MCU. SB10 must be open (see Section 4.12).

In the EVLSPIN32G0A2 and EVLSPIN32G0B2 schematics, every reference to VREF+ is equivalent to VDD.

4.5 Overcurrent protection

All boards implement shunt-based overcurrent protection taking advantage of the comparator embedded in the STSPIN32G0 SiP.

In the default configuration the circuits are sized as follows:

- Three-shunt overcurrent protection (see Figure 8)
  - OC threshold = 25.75 A (VREF+ = VDD = 3.3 V, see Section 4.4.3)
  - Low pass cut frequency = 159 kHz
- Single-shunt overcurrent protection (see Figure 9)
  - OC threshold = 24.4 A (VREF+ = VDD = 3.3 V, see Section 4.4.3)
  - Low pass cut frequency = 132 kHz

Figure 8. **Three-shunt overcurrent protection**

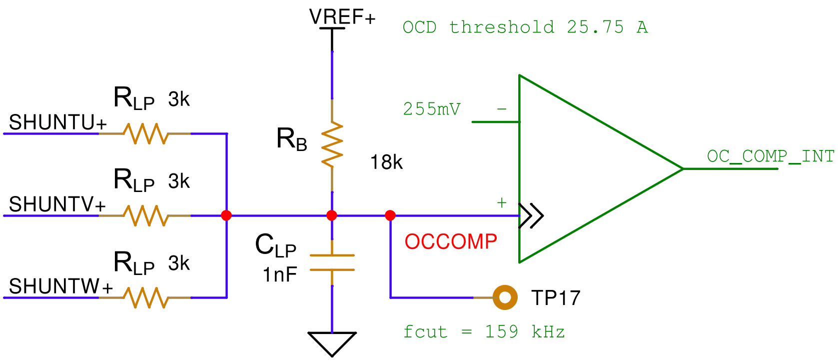
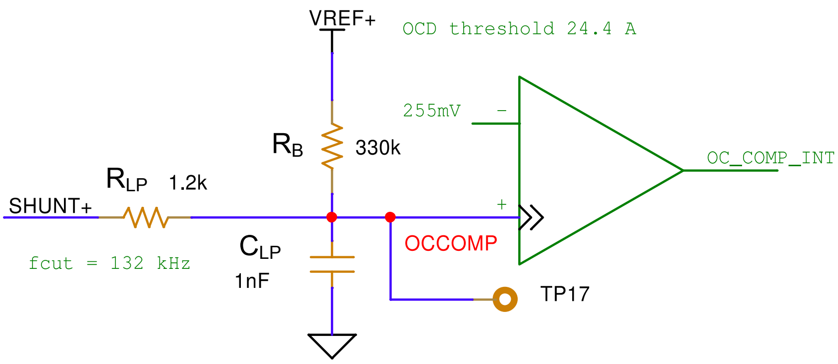


Figure 9. **Single-shunt overcurrent protection**



Eq. (7) and Eq. (8) show how to adjust the threshold and the cut frequency of the filter.

A good trade-off between noise reduction and response time is to set the low pass frequency about 5 times the PWM frequency.

$$I_{OC} = \tag{7}$$

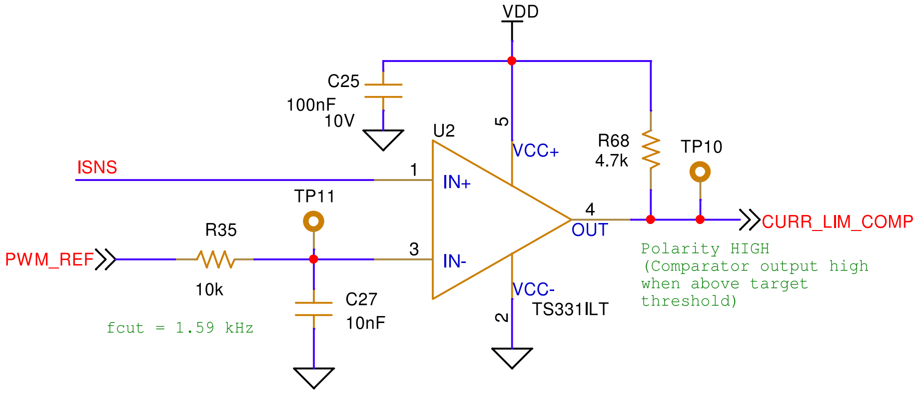
$$\begin{cases} singleshunt: \left(255mV - V_{REF+} \times \frac{R_{LP}}{R_{LP} + R_B}\right) / \left(R_{SHUNT} \times \frac{R_B}{R_{LP} + R_B}\right) \\ threeshunt: \left(255mV - V_{REF+} \times \frac{R_{LP}}{R_{LP} + 3 \times R_B}\right) / \left(R_{SHUNT} \times \frac{R_B}{R_{LP} + 3 \times R_B}\right) \end{cases}$$

$$f_{CUT} = \begin{cases} singleshunt: \frac{1}{2\pi \times R_{LP} \times C_{LP}} \\ threeshunt: \frac{3}{2\pi \times R_{LP} \times C_{LP}} \end{cases} \tag{8}$$

4.6 Current limiter (EVLSPIN32G0B1 and EVLSPIN32G0B2)

The single-shunt version boards provide a current limiter circuit comparing the current sensing output (see Section 4.4.2) with a reference value.

Figure 10. **Current limiter circuit**



The reference value is adjusted through a low pass filtered (cut frequency of 1.59 kHz) PWM generated by the CH1 of TIM16 mapped on the PB8 GPIO. The recommended PWM frequency is 100 kHz.

When the current sensing output is higher than the reference voltage, the comparator output is forced high. This signal is provided to the PA12 [PA10] GPIO providing the ETR function of TIM1, that is, the Advanced-control Timer used to control the inverter.

This function allows stopping the TIM1 PWM generation limiting the current inside the motor.

For further details, see the Advanced-control Timer documentation.

4.7 Supply voltage monitoring

The motor supply voltage is monitored through a voltage divider with a scaling factor of 0.0552.

The motor voltage feedback is mapped to the PA4 GPIO (ADC1, Channel 4).

Warning: *There is no overvoltage protection on the supply monitoring voltage divider output; for this reason it is not recommended to change the scaling factor.*

4.8 PCB temperature monitoring

The evaluation boards mount an NTC (see Table 4) to monitor the PCB temperature.

Table 4. NTC characteristics

Parameter	Value	Unit
Beta	3434	K
T0	25	°C
T1	85	°C
RT0	10000	Ω

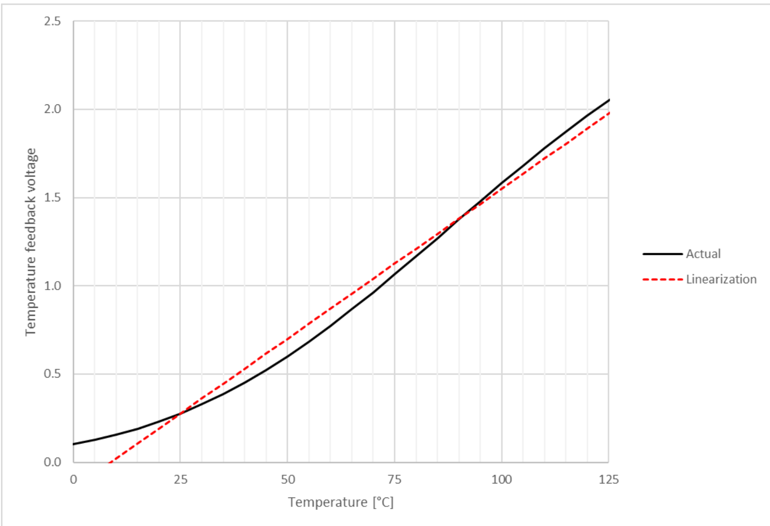
This feature is enabled by default in all the boards, but it can be excluded to enable alternate features (see Section 4.12).

The motor voltage feedback is mapped to:

- EVLSPIN32G0A1 and EVLSPAIN32G0A2: PA3 GPIO (ADC1, Channel 3)
- EVLSPIN32G0B1 and EVLSPAIN32G0B2: PA5 GPIO (ADC1, Channel 5)

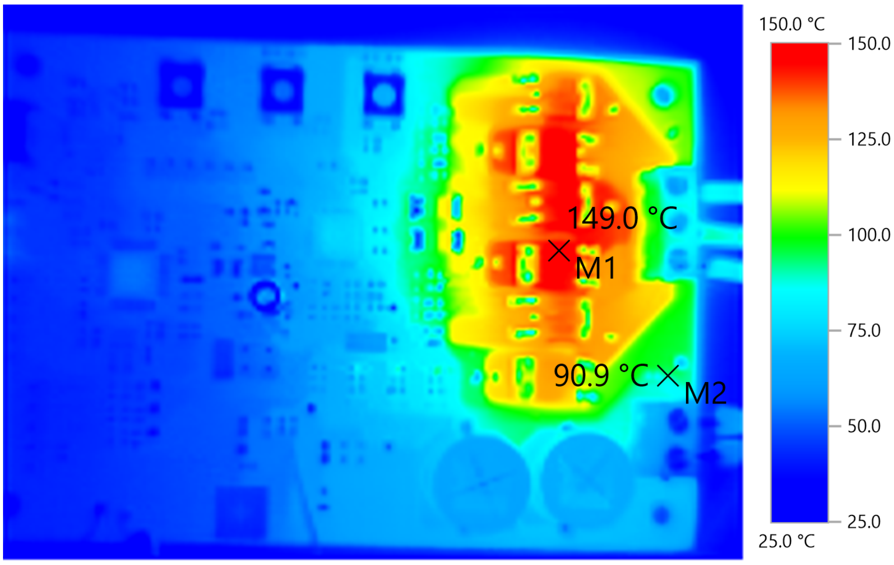
Figure 11 shows the expected temperature monitor output according to NTC temperature at VREF+ = 3.3 V (see Section 4.4.3). The “linearization” curve is obtained considering an output voltage of 275 mV at 25 °C and a gain of 17 mV/°C.

Figure 11. Temperature feedback curve



At room temperature, when the MOSFETs’ case temperature reaches 150 °C, the expected NTC temperature is 90 °C (see Figure 12), so this can be considered the typical overtemperature threshold.

Figure 12. **PCB thermal map (M1 = Q2, M2 = NTC)**



4.9 Back EMF sensing (EVLSPIN32G0B1 and EVLSPIN32G0B2)

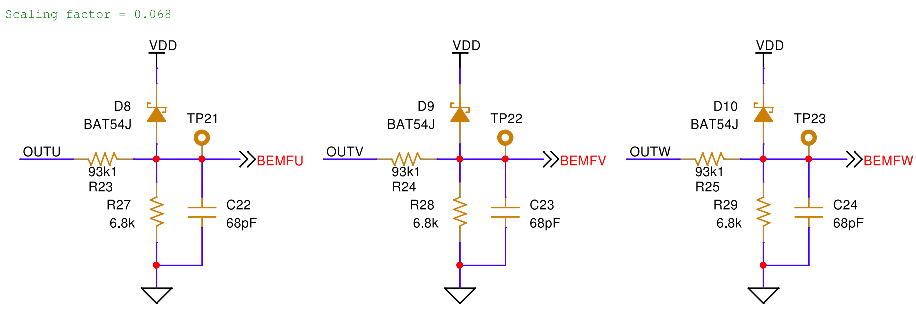
The Back EMF (BEMF) sensing circuitry allows implementing the 6STEP sensorless driving based on BEMF zero-crossing detection through ADC.

The phase voltages are scaled by a factor of 0.068 allowing the mapping of the whole operative voltage range to the ADC full scale (VREF+ = 3.3 V, see Section 4.4.3).

The MCU can acquire the output of the current sensing circuits through ADC:

- Phase U BEMF monitoring: PA5 (ADC1, Channel 5)
- Phase V BEMF monitoring: PA6 (ADC1, Channel 6)
- Phase W BEMF monitoring: PB7 (ADC1, Channel 7)

Figure 13. **BEMF sensing circuit**



The BEMF sensing can be customized to better fit the operative range: for example, driving a 12 V rated motor uses only 27 % of the dynamics resulting in an under-performing zero-crossing detection.

For optimal performance the scaling factor should be tuned to make the supply range fit the 90% of ADC full scale:

$$V_M \times BEMF_{V/V} = 90\% \times V_{REF+} \tag{9}$$

4.10 Hall sensors and encoder

The evaluation boards provide a dedicated connector for digital Hall position sensors or incremental encoder. The supply voltage for the position sensors is selected from 3 possible values (see Section 4.12):

1. JP2 closed (default): 5 V from USB
2. JP3 closed: VDD from buck regulator output
3. JP4 closed: VCC from LDO regulator output

Warning: *Only one supply selection jumper (JP2, JP3, or JP4) closed at a time.*

Figure 14. Hall/Encoder inputs

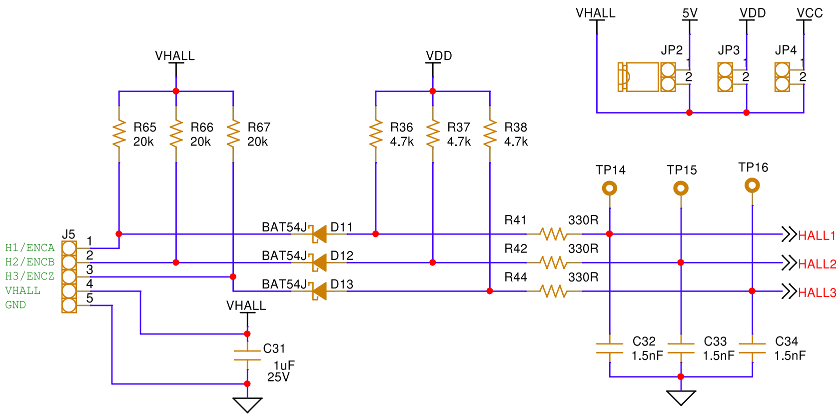


Table 5. Hall/Encoder connector (J5 connector)

Pin	Name	Description	GPIO mapping
1	H1/ENCA	Hall 1 or Encoder A signal	PA0
2	H2/ENCB	Hall 2 or Encoder B signal	PA1
3	H3/ENCZ	Hall 3 or Encoder Z signal	PA2 (1)
4	VHALL	Hall sensor/Encoder supply	-
5	GND	Ground	-

1. *EVLSPIN32G0A1: Close SB12 and open SB11 to enable this feature (see Section 4.12).*

4.11 ST-LINK/V2-1

The evaluation boards embed an ST-LINK/V2-1, directly supplied by the USB, featuring:

- Programming and debugging functions
- Easy programming through mass-storage unit
- Virtual COM port (see Table 6)

Table 6. Virtual COM mapping

Board	USART	Tx GPIO	Rx GPIO
EVLSPIN32G0A1	USART2	PA2 (1)	PA3
EVLSPIN32G0A1	USART1	PB6	PB7
EVLSPIN32G0A1	USART1	PB6	PB7
EVLSPIN32G0A1	USART1	PB6	PB7

1. *EVLSPIN32G0A1: Close SB11 and open SB12 to enable this feature (see Section 4.12).*

4.12 Configuration and solder bridges

Several features require a change of the default configuration of jumpers and solder bridges as listed in Table 7.

Table 7. **Jumpers and solder bridges list**

A1	A2	B1	B2	Ref.	Description	Default	Remarks
		X	X	JP1	Bipolar (FOC)/Unipolar (6STEP) current sensing	1-2 (FOC)	
X	X	X	X	JP2	Hall/Encoder supply selection jumper: 5 V from USB	CLOSED	Only one of jumpers JP2, JP3, and JP4 must be closed. Closing more than one jumper at the same time can cause permanent damage to the board.
X	X	X	X	JP3	Hall/Encoder supply selection jumper: VDD	OPEN	
X	X	X	X	JP4	Hall/Encoder supply selection jumper: VCC	OPEN	
X	X	X	X	SB1	12 V LDO bypass	OPEN	WARNING! When closed, maximum supply voltage is limited at 15 V
X	X	X	X	SB2	PF2-nRESET bypass	CLOSED	
		X	X	SB3	PCB temperature monitoring (NTC) to PA3 connection	CLOSED	If closed, SB4 must be open
		X	X	SB4	Potentiometer to PA3 connection	OPEN	If closed, SB3 must be open
X	X	X	X	SB5	ST-LINK/V2-1 bypass (UART RX)	CLOSED	
X	X	X	X	SB6	ST-LINK/V2-1 bypass (UART TX)	CLOSED	
X	X	X	X	SB7	ST-LINK/V2-1 bypass (SWD CLK)	CLOSED	
X	X	X	X	SB8	ST-LINK/V2-1 bypass (SWD DIO)	CLOSED	
X	X	X	X	SB9	ST-LINK/V2-1 bypass (SWD NRST)	CLOSED	
X		X		SB10	VREF+ to VDD connection	CLOSED	Open for using VREFBUF feature or external reference voltage
X				SB11	UART TX to PA2 connection	CLOSED	If closed, SB12 must be open
X				SB12	HALL3 to PA2 connection	OPEN	If closed, SB11 must be open
X				SB13	PCB temperature monitoring (NTC) to PA5 connection	CLOSED	If closed, SB14 must be open
X				SB14	Potentiometer to PA5 connection	OPEN	If closed, SB13 must be open

Revision history

Table 8. **Document revision history**

Date	Version	Changes
31-Oct-2024	1	Initial release.

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