

UM2168 User manual

Using STM32 motor control workbench with STSPIN32F0 and STSPIN32F0A

Introduction

The STSPIN32F0 and STSPIN32F0A are systems-in-package providing an integrated solution suitable for driving 3-phase BLDC motors using different driving modes. The integrated MCU (STM32F031x6) allows the performance of field-oriented control.

This document explains how to drive the STSPIN32F0 or STSPIN32F0A with FOC algorithms, using the STM32 motor control workbench software to generate all the parameter header files, to configure the STM32 PMSM FOC library according to application needs.

To drive a motor with FOC algorithms using the STSPIN32F0 or STSPIN32F0A device, follow this simple workflow:

- 1. Set up the hardware.
- 2. Use STM32 motor control workbench to configure the library and generate the code.

New Project		👔 About	Help	Motor Pr Motion Com	ofiler State	
Recent Projects						
Example Projects						
Filename	Туре	MCUs	control board	power board	motor	
NUCLEO-F302R8-X-NUCLEO-HM08M1-Shinano	SINGLE	STM32F301x6/8 - STM32F302x6/8	NUCLEO-F302R8	X-NUCLEO-IHM08M1	Shinano LA052-0	
NUCLEO-F303RE-IPM05F-Shinano	SINGLE	STM32F303xE	NUCLEO-F303RE	STEVAL-IPM05F	Shinano LA052-0	\. <u></u>
NUCLEO-F303RE-IPM108-Shinano	SINGLE	STM32F303xE	NUCLEO-F303RE	STEVAL-PM10B	Shinano LA052-0	
NUCLEO-F303RE-IPM158-Shinano	SINGLE	STM32F303xE	NUCLEO-F303RE	STEVAL-PM158	Shinano LA052-0	
NUCLEO-F303RE-X-NUCLEO-HM07M1-BulRunning	SINGLE	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM07M1	Bull Running BR2I	
NUCLEO-F303RE-X-NUCLEO-IHM08M1-Shinano	SINGLE	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM08M1	Shinano LA052-0	
P-NUCLEO-HM001-BullRunning	SINGLE	STM32F301x6/8 - STM32F302x6/8	P-NUCLEO-HM001 3Sh - board: NUCLEO-F302R8	P-NUCLEO-HM001 35h - board: X-NUCLEO-HM07M1	Bull Running BR21	
P-NUCLEO-HM001-Shinano	SINGLE	STM32F301x6/8 - STM32F302x6/8	P-NUCLEO-HM001 3Sh - board: NUCLEO-F302R8	P-NUCLEO-HM001 3Sh - board: X-NUCLEO-HM07M1	Shinano LA052-0	
STM3240G-EVAL-HM023V3-Allen Bradley	SINGLE	STM32F4xx	STM3240G-EVAL	STEVAL-HM023V3	Allen Bradley TL-A220P-HJ32A	<u> </u>
STM3240G-EVAL-IHM023V3-Shinano	SINGLE	STM32F4xx	STM3240G-EVAL	STEVAL-HM023V3	Shinano LA052-0	
STM320728-EVAL-STM32108-MCKIT-Shinano	SINGLE	STM32F072x	STM32072B-EVAL	STM3210B-MCKIT	Shinano LA052-0	
STM32303C-EVAL-STM32108-MCKIT-Shinano-DUAL-DRIVE	DUAL	STM32F303xC	STM32303C-EVAL	STM3210B-MCKIT	Shinano LA052-0	
STM32303C-EVAL-STM3210B-MCKIT-Shinano-SNGLE-DRIVE	SINGLE	STM32F303xC	STM32303C-EVAL	STM3210B-MCK/T	Shinano LA052-0	
STM32303E-EVAL-HM045V1-Shinano-DUAL-DRIVE	DUAL	STM32F303xE	STM32303E-EVAL	STEVAL-HM045V1	Shinano LA052-0	
STM32303E-EVAL-HM045V1-Shinano-SINGLE-DRIVE	SINGLE	STM32F303xE	STM32303E-EVAL	STEVAL-HM045V1	Shinano LA052-0	
STM32303E-EVAL-STM3210B-MCKIT-Shinano-DUAL-DRIVE	DUAL	STM32F303xE	STM32303E-EVAL	STM3210B-MCK/T	Shinano LA052-0	
STM32303E-EVAL-STM3210B-MCK/T-Shinano-SINGLE-DRIVE	SNGLE	STM32F303xE	STM32303E-EVAL	STM3210B-MCK/T	Shinano LA052-0	
STM321008-EVAL-STM32108-MCKIT-Shinano	SINGLE	STM32F100 Medium Density	STM32F100B-EVAL	STM3210B-MCKIT	Shinano LA052-0	
STEVAL-SPIN3201-Shinano-SINGLE-DRIVE	SINGLE	STSPN32F0	STEVAL-SPN3201	STEVAL-SPIN3201	Shinano LA052-0	

Figure 1. STM32 motor control workbench start window

- 3. Create the library and download the firmware.
- 4. Control the motor.

Contents

1	Set	hardware	3
2	Use gene	TM32 motor control workbench to configure the library and ate the code	3
	2.1	Create new project for ST STEVAL-SPIN3201 board	3
	2.2	Create new project for ST STEVAL-SPIN3202 board	4
	2.3	Create a new project for STSPIN32F0/A mounted on a custom board	6
	2.4	Customize parameters for application needs	9
		2.4.1 Motor parameters	. 9
		2.4.2 Power stage parameters	10
		2.4.3 Drive management parameters	13
		2.4.4 Control stage parameters	17
3	Crea	e the library and download the firmware	23
	3.1	Generation of the source code 2	23
	3.2	Using STSW-SPIN3201 2	25
	3.3	Compile and download the firmware	26
4	Con	ol the motor	27
5	Rev	on history	<u>29</u>



1 Set up hardware

- Choose the board according to the target: you can use the ST **STEVAL-SPIN3201** or **STEVAL-SPIN3202** boards or you can use a custom board;
- Connect the board, power supply and plug in your motor.

2 Use STM32 motor control workbench to configure the library and generate the code

The STM32 motor control workbench can be used to configure the FOC firmware library to use in your application. The user can use the **STEVAL-SPIN3201** or **STEVAL-SPIN3202** boards or a custom board can be used.

2.1 Create new project for ST STEVAL-SPIN3201 board

The STEVAL-SPIN3201 board is a three-phase brushless DC motor driver board based on the STSPIN32F0, a 3-phase controller with an integrated STM32 MCU.

The device provides an affordable and easy-to-use solution for the evaluation of the device in low voltage motor driving applications such as fans, drones and power tools.

The board is designed for sensored or sensorless FOC algorithms with 3-shunt sensing. To create a new project for the STM32 motor control workbench based on STEVAL-SPIN3201, follow the procedure:

- Open the STM32 motor control workbench v5.2;
- Click on "New Project" and a parameter window appears;
- Choose the "Inverter" board type and select the STEVAL-SPIN3201 from the dropdown list (*Figure 2*). In this way, the application automatically loads all the hardware-related parameters for the FOC library.

	Application type		System	
C	Custom 🔻	•	Single Motor O Dual Motors	
	Select Boards: (a) Inverter	MC Kit	Power & Control	
	Inverter	9 MO N		
	InverterSTEVAL-SPIN3201		DC Input voltage 8 - 45 Vdc	
	Inverter STEVAL-SPIN3201 based on STD140N6F7, STSPIN32F0		DC Input voltage 8 - 45 Vdc Output pk current up to 21 Apk ST-LINK/V2 Embedded	

Figure 2. Parameter window for STEVAL-SPIN3201

 From the motor list, one of the pre-configured motors or a generic starting model can be selected (*Figure 3*);



Figure 3. Pre-configured motor window

Motor			
Generic Low voltage <= 50V	-	Magnetic structure	Surface Mounte
Motor low voltage		Pole Pairs	2
Notor low Voltage		Nominal Speed	4000 rpm 24 V
		Nominal Current	1.8 Apk

• Click OK. A new project is now created according to the starting parameters selected.

A configuration window appears, allowing the parameters to be set for:

- "Motor"
- "Power Stage"
- "Drive Management" (i.e. FOC algorithm configuration)
- "Control Stage" (i.e. MCU configuration)

Using the **STEVAL-SPIN3201** device, the configuration parameters for the Power Stage, Drive Management, and Control Stage are already set.

2.2 Create new project for ST STEVAL-SPIN3202 board

The STEVAL-SPIN3202 board is a three-phase brushless DC motor driver board based on the STSPIN32F0A, a 3-phase controller with integrated STM32 MCU.

The device provides an affordable and easy-to-use solution for the evaluation of the device in low voltage motor driving applications such as fans, drones and power tools.

The board is designed for the sensored or sensorless FOC, with single shunt current sensing.

To create a new project for the STM32 motor control workbench based on STEVAL-SPIN3202 follow the procedure:

- Open the STM32 motor control workbench v5.2;
- Click on "New Project" and a parameter window appears;
- Choose the "Inverter" board type and select the STEVAL-SPIN3202 from the dropdown list (*Figure 4*). In this way, the application automatically loads all the hardware-related parameters for the FOC library.
- From the motor list, one of the pre-configured motors or a generic starting model can be selected (*Figure 5*);
- Click OK. A new project is now created according to the starting parameters selected.

A configuration window appears, allowing the parameters to be set for:

- "Motor"
- "Power Stage"
- "Drive Management" (i.e. FOC algorithm configuration)
- "Control Stage" (i.e. MCU configuration)



Using the **STEVAL-SPIN3202** device, the configuration parameters for the Power Stage, Drive Management and Control Stage are already set.

Application type		System
Custom	•	Single Motor O Dual Motors
Select Boards: Invert 	ter 🔘 MC Kit	Power & Control
Select Boards: Inverter STEVAL-SPIN3202	ter 🔘 MC Kit	Power & Control DC Input voltage 8 - 45 Vdc

Figure 4. Parameter window for STEVAL-SPIN3202

Figure 5. Pre-configured motor window

Generic Low voltage <= 50V	-	Magnetic structure	Surface Mounte
		Pole Pairs	2
Motor low voltage		Nominal Speed	4000 rpm
		Nominal Voltage	24 V
		Nominal Current	1.8 Apk



2.3 Create a new project for STSPIN32F0/A mounted on a custom board

To create a new project for STM32 motor control workbench using a custom board, follow the procedure:

- Open the STM32 motor control workbench v5.2;
- Click on New Project and a parameter window appears;
- Select the options as shown in Figure 6:

	Application type		System
	Custom	•	Single Motor Dual Motors
2	Select Boards: Inverter 	MC Kit	Power & Control
5	Control		
	custom board	-	Control board where the control stage
			parameters have to customized by the user
	Power		
	custom board	•	Power board where the power stage
			parameters have to customized by the user

• From the motor list, one of the pre-configured motors or a generic starting model can be selected (*Figure 7*);

Figure 7. Pre-configured motor window

Generic Low voltage <= 50V	•	Magnetic structure	Surface Mounte
2		Pole Pairs	2
Motor low voltage		Nominal Speed	4000 rpm
		Nominal Voltage	24 V
		Nominal Current	1.8 Apk

Click OK. A new project is now created according to the starting parameters selected.



A configuration window appears, allowing the parameters to be set for:

- "Motor"
- "Power Stage"
- "Drive Management" (i.e. FOC algorithm configuration)
- "Control Stage" (i.e. MCU configuration)
- Using a custom board, choose the configuration parameters for the Power Stage and Control Stage that best fit your application;
- To use the integrated MCU (STM32F031x6), remember that a limited number of pins can be accessed, as can be seen in the STSPIN32F0 or in the STSPIN32F0A datasheet. Here is a list of pins that can be used to access the integrated MCU for both devices:

No.	Name	Function
4	PF0	MCU PF0
5	PF1	MCU PF1
7	NRST	MCU reset pin
11	PA0	MCU PA0
12	PA1	MCU PA1
13	PA2	MCU PA2
14	PA3	MCU PA3
15	PA4	MCU PA4
16	PA5	MCU PA5
17	PA6	MCU PA6
18	3FG_PA7	3FG open-drain output or MCU PA7
19	PB1	MCU PB1
37	PA13_SWD_IO	MCU PA13/SWDIO (system debug data via ASIC)
38	PA14_SWD_CLK	MCU PA14/SWDCLK (system debug clock)
39	PB6	MCU PB6
40	PB7	MCU PB7

Table 1. STSPIN32F0: Accessible pins for integrated MCU



No.	Name	Function
4	PF0	MCU PF0
5	PF1	MCU PF1
7	NRST	MCU reset pin
11	PA0	MCU PA0
12	PA1	MCU PA1
13	PA2	MCU PA2
14	PA3	MCU PA3
15	PA4	MCU PA4
16	PA5	MCU PA5
17	PA6	MCU PA6
18	PA7	MCU PA7
19	PB1	MCU PB1
37	PA13_SWD_IO	MCU PA13/SWDIO (system debug data via ASIC)
38	PA14_SWD_CLK	MCU PA14/SWDCLK (system debug clock)
39	PA15	MCU PA15
40	PB6	MCU PB6
41	PB7	MCU PB7
42	BOOT0	MCU BOOT0

Table 2. STSPIN32F0A: Accessible pins for integrated MCU



2.4 Customize parameters for application needs

When a project is opened by the STM32 motor control workbench, a configuration window appears allowing the user to easily manage parameters for the FOC firmware library. There are 4 families of parameters that should be changed to best fit the characteristics of the application.





2.4.1 Motor parameters

In the configuration window the motor parameters can be manually inserted by clicking on the motor symbol and filling the fields (*Figure 9*). If "save parameters" is clicked on, the user can add their motor to the preset list of motors.



rigure 5. Motor parameters window
Motor - Parameters
Motor Sensors
Magnetic structure Surface Mounted PMSM
Electrical parameters
Pole Pairs 7
Max. Application Speed 15000 mm
Nominal Current 5.00 Apk
Nominal DC Voltage 12.0 A
Rs 0.18 Am
Ls 0.012 mH
B-Emf constant 0.9 Vms/krpm
Inertia 0.365 ▲ uN*m*s2
Friction 0.557 uN*m*s
Save parameters

Figure 9. Motor parameters window

2.4.2 Power stage parameters

There is a family of parameters which are not covered in *Figure 10* that are related to the hardware of the board.



Figure 10. Power stage setting



Using the **STEVAL-SPIN3201** or **STEVAL-SPIN3202** device, the Power Stage parameters are already set. If the supply voltage is changed or if the hardware of the board is modified (changing MOSFETs, adjusting the gain of the sensing circuitry, etc.) or if a custom board is used, the user should set the parameters related to their application. In the configuration window the Power Stage parameters can be manually inserted by choosing the area you want to set.

Select the link for "Rated Bus Voltage" and set the voltage range related to your application (*Figure 11*).

Figure 11.	Rated bus	voltage	parameter
------------	-----------	---------	-----------

Power Stage - Rated Bus Voltag	e Info	
Rated Voltage		
Min rated voltage	8 🔹 V	
Max rated voltage	45 🔶 V	
Nominal voltage	24 👻 V	
		Done
		Doug

• Select "Bus Voltage Sensing" and set the parameters for the sensing of the Vbus (*Figure 12*).



Figure 12. Bus voltage sensing parameters



DocID030267 Rev 4

• In "Current Sensing" choose the sensing network. If the user wants to change the sensing circuit, they should also change the model used by the algorithm by changing the "Current reading topology" or the "Shunt resistor value" in the Current Sensing menu (*Figure 13*).



Figure 13. Current sensing menu

• The user can calculate the Amplifying network gain through the STM32 motor control workbench by setting the resistor in the Amplifying network Gain Calculator: in the current sensing menu click on Calculate and then set your amplification network (*Figure 14*).





Figure 14. Amplifying network gain calculator

• Click on "Power Switches" and set their characteristics.

Figure 15. Power switch parameters

Power Stage - Power Switches		
Min dead-time	700 🍧 ns	
Max switching frequency	50 🚖 kHz	
		Done

2.4.3 Drive management parameters

There is a family of parameters, shown in *Figure 16*, that are related to the configuration of the algorithm, for example, the start-up configuration of the algorithm, the control mode chosen (Speed or Torque) and also gain parameters if needed.

In the configuration window the parameters related to the algorithm usage can be manually inserted by clicking on the area you want to set.





Figure 16. Drive management setting

• In the Speed Sensing window choose "Sensor selection" to select the sensing algorithm you want to use (*Figure 17*).



Drive Management - Speed Position Feedback Management	
Main sensor Auxiliary sensor	
Sensor selection Sensor-less (Observer+PLL) Max measurement errors number before fault 3 Observer+PLL 3 Variance threshold 10.00 % Average speed depth for speed loop 64 • Average speed depth for observer equations 64 • B-enf consistency tolerance 100.00 % B-enf consistency gain 100.00 %	
Manual editing enabled Observer G1 1300 G2 1877 Back compatibility 234 P 234 V 95536 I 1	
	1

• To select the starting speed and the open loop current profile, right click on "Firmware Drive Management" and choose "Start-up Parameters" in the dropdown menu.





Figure 18. Start-up parameters

This is an example of a basic control of speed and current in open loop. The red line is the speed profile while the blue line is the current profile chosen by editing the parameters on the left of the graph. At first, the algorithm aligns the motor, if the "Include alignment before ramp-up" is enabled. After the alignment phase the current value is "Final current ramp value". Speed and current ramp is now applied and the "Minimum start-up output speed" is the minimum speed accepted by the algorithm to close the loop. When the algorithm converges, if the Rev-up FOC switchover is enabled, the passage to the closed loop is more gradual.

Choosing Advanced customized profile the user can set a more elaborate profile for the open loop ramp, as shown in *Figure 19*.





Figure 19. : Advanced start-up parameters

Figure 20. Drive settings window

Drive Management - Drive Settings		
PWM generation and current reading	Default settings	
PWM frequency 15000 Hz	Control mode	Speed control
High sides PWM idle state Tum-off	Target speed	1500 mm
SW inserted dead-time 800 - Ins	Target stator current flux component	0.00 A
Low sides PWM idle state Tum-off	l arget stator current torque	0.00 A
	Torque and flux regulators	
Speed regulator	Execution rate	1 PWM periods
Execution rate 1.0 ms	Cut-off frequency	2000 🚔 rad/s
1000 / 16 p	Torque 2194 v 1024	P 2194 / 1024 / P
Manual editing enabled	1280 🔶 / 16384 🐳	
	Manual editing enabled	
		Done

 To select the PWM frequency, right click on "Firmware Drive Management" and choose "Drive Settings": note that the PWM frequency / Execution rate must be below 14 KHz, so adjust the Execution rate if you want to increase PWM frequency. In the Drive Settings window, the user can also select the control mode (Speed or Torque control) and the

DocID030267 Rev 4



UM2168 Use STM32 motor control workbench to configure the library and generate the code

Target speed for the application. The user can also set the Cut-off frequency for the stability of closed loop (*Figure 20*).

2.4.4 Control stage parameters

There is a family of parameters, shown in *Figure 21*, that are related to the mapping of the STM32 peripherals which should not be changed as long as the STEVAL-SPIN3201 or the STEVAL-SPIN3202 board is used.



Figure 21. Control stage setting

Using the **STEVAL-SPIN3201** or the **STEVAL-SPIN3202** device, the general configuration parameters for the Control Stage are already set. In the configuration window the Control Stage parameters can be manually inserted by clicking on the area you want to set.

• If custom HW is used remember to select the STSPIN32F0 or STSPIN32F0A as a microcontroller in the "MCU and Clock Frequency" → MCU TYPE (*Figure 22*).



MCUTTE	
MCU	STSPIN32F0 -
package	VFQFPN48
Clock settings	
Clock source	Internal RC oscillator 🔹
CPU frequency	MHz
Supply voltage	
Nominal MCU supply voltage	3.30 🚖 V

The "Digital I/O" \rightarrow "Pin Map" (*Figure* 23), should follow the internal mapping of the ٠ device, shown in Table 3. If you have selected the STSPIN32F0 or STSPIN32F0A as a microcontroller, the "Digital I/O" \rightarrow "Pin Map" is automatically configured and shouldn't be changed.

Table 3. Pin map for STSPIN32F0 and STSPIN32F0A

TIM1		
CH1	A8	
CH2	A9	
СНЗ	A10	
CH1N	B13	
CH2N	B14	
CH3N	B15	
BKIN	B12	

Figure 22 MCII and clock frequency window



Inverter driving signal selection Timer TIM1 • Remap No remap • Pin Map CH1 A8 • CH1N B13 • CH2 A9 • CH2N B14 • CH3 A10 • CH3N B15 • BKIN B12 •	Signal Enabler CH1 Port GPIOC * Pin C13 * CH2 Port GPIOC * Pin C13 * CH3 Port GPIOC * Pin C13 *	Speed/position feedback Encoder interface Timer TIM2 Remap No remap Pin Map CH1 A0 - CH2 A1 -	Hall sensors interface Timer Timer Remap No remap Pin Map CH1 A6 CH2 A7 CH3 B0	Direct GPIO DBO Port GPIOE • Pin E5 • ICL Port GPIOE • Pin E4 • OCP disabiling Port GPIOE • Pin E5 •
PFC drive signal and feedback Timer TIM3 Pin Map PWM PWM AC Mains OCS	A7 v Cha A6 v Bau D2 v Ren	communication nnel USART1 TX drate 19200 RX hap No remap	Start/Stop Button GPI Port GPIOF ▼ B6 ▼ Pin F0 ▼ Polarity Active low	0]]

Figure 23 Digital I/O nin man for STSDIN32E0 and STSDIN32E0A

If the "Hall" sensor position feedback is used, set the correct Sensor selection in the • "Speed Sensing" window (*Figure 17*) and then in the Digital I/O \rightarrow Hall sensor interface (Figure 24); the Pin Map has to be set as shown in Table 4:

Table 4. Hall sensor interface for STSPIN32F0 and for STSPIN32F0A

TIM2			
CH1	A0 ⁽¹⁾ , A15 ⁽²⁾		
CH2	A1		
СНЗ	A2		

1. If you use the ST STEVAL-SPIN3201 or STEVAL-SPIN3202 board, choose CH1 = A0.

2. A15 available only for STSPIN32F0A.

	Signal Enabler	Speed/position feedback		Direct GPIO
	CH1	Encoder interface	Hall sensors interface	DBO
Timer TIM1 -	Port GPIOC -	Timer TIM2 -	Timer TIM2 -	Port GPIOE 👻
Remap No remap -	Pin C13 👻	Remap No remap 👻	Remap No remap 👻	Pin E5 👻
Pin Map	CH2	Pin Map	Pin Map	-ICL
CH1 A8 V CH1N B13 V	Port GPIOC -	CH1 A0 -	CH1 A0 V	Port GPIOE 🔻
	Pin C13 -	CH2 A1 V	CH2 A1 -	Pin E4 👻
CH2 A9 V CH2N BI4 V	-CH2	Unit Million		- OCP disabling
CH3 A10 - CH3N B15 -	Port GPIOC -		CH3 A2 -	Port GPIOE -
BKIN B12 -	Pin C12 -			Pin E5
	Share signal enable			
PFC drive signal and feedback	Serial	communication	Start/Stop Button GPI0)
Pin Map	Char	Pin Map	Port GPIOF -	
fimer TIM3		TX B6	▼ Pin F0 ▼	
Remap No remap	A6 - Bauc	drate 19200 • RX B7	Polarity Active law	_
	D2 -	N	Polality Active low	•

_. 24 Divital I/O Hall a ... -

• If the "Encoder" position feedback is used, set the correct Sensor selection in the Speed Sensing window (*Figure 17*) and in the Digital I/O \rightarrow Encoder interface (*Figure 25*); the Pin Map has to be set as shown in *Table 5* for STSPIN32F0 or in *Table 6* for STSPIN32F0A.

Table 5. Encoder interface for STSPIN32F0

TIM2 ⁽¹⁾		TII	M3
CH1	A0 or A5	CH1	A6
CH2	A1	CH2	A7

1. If you use the ST **STEVAL-SPIN3201** board, choose TIM2 and CH1 = A0.

Table 6. Encoder interface for STSPIN32F0A

TIM2			
CH1	A0 ⁽¹⁾ , A5, A15		
CH2	A1		

1. If you use the **STEVAL-SPIN3202** board, choose CH1 = A0.



Timer TIM1	Signal Enabler CH1 Port GPIOC -	Speed/position feedback Encoder interface Timer TIM2	Hall sensors interface Timer TIM2	Direct GPIO DBO Port GPIOE V
Pin Map CH1 A8 CH1N B13 • CH2 A9 CH2N B14 • CH3 A10 CH3N B15 • BKIN B12 • • •	CH2 Port GPIOC + Pin C13 + CH3 Port GPIOC + Pin C13 + Pin C13 + Share signal enable	Pin Map CH1 A0 V CH2 A1 V	Pin Map • CH1 A0 • CH2 A1 • CH3 A2 •	ICL Port GPI0E • Pin E4 • OCP disabiling Port GPI0E • Pin E5 •
PFC drive signal and feedback Timer TIM3 PWM Remap No remap CCS	A7 v a A6 D2 v	pommunication hel USART1 tate 19200 p No remap Pin Map TX B6 RX B7 Pin Map TX B6 RX B7 Pin Map TX	Start/Stop Button GPIO Port GPIOF • Pin F0 • Polarity Active low	•

Figure 25 Digital I/O encoder for STEVAL SPIN3201 or STEVAL SPIN3202 boards

To define the "Serial Communication" select the pin used for the UART communication ٠ in the Digital I/O →Serial Communication (Figure 26). For STSPIN32F0 or STSPIN32F0A you should use the mapping shown in Table 7.

Table 7. Serial communication parameters for STSPIN32F0 and STSPIN32F0A

Serial Communication			
Channel	USART1		
Baud rate	9600		
TX ⁽¹⁾	B6 or A2 or A14		
RX	B7, A3, A15 ⁽²⁾		

1. If you use the ST STEVAL-SPIN3201 or STEVAL-SPIN3202 board, choose TX = B6 and RX = B7.

2. A15 available only for STSPIN32F0A.



nverter driving signal selection	Signal Enabler	Speed/position feedback		Direct GPIO
	CH1	Encoder interface	Hall sensors interface	DBO
Timer TIM1 -	Port GPIOC -	Timer TIM2 -	Timer TIM2 -	Port GPIOE -
Remap No remap 👻	Pin C13 🔻	Remap No remap 👻	Remap No remap 👻	Pin E5 💌
Pin Map	CH2	Pin Map	Pin Map	-ICL
CH1 A8 - CH1N B13 -	Port GPIOC -	CH1 A0 -	CH1 A0 -	Port GPIOE 🔻
CH2 A9 - CH2N B14 -	Pin C13 👻	CH2 A1 -	CH2 A1 -	Pin E4 💌
	CH3		CH3 A2 -	OCP disabling
CH3 A10 - CH3N B15 -	Port GPIOC -			Port GPIOE -
BKIN B12 -	Pin C13 👻			Pin E5 💌
	Share signal enable			
FC drive signal and feedback	Serial	communication	Start/Stop Button GP	10
- Pin Map -	(ha	Pin Map	Port GPIOF -	
imer PWM		TX BE	Pin F0 v	
AC Mains	Bau	drate 9600 🔻 RX B7		
OCS	Ren	nap No remap 💌	Polanty Active low	

Figure 26. Serial communication for STEVAL-SPIN3201 or STEVAL-SPIN3202 boards

• It is recommended to use the minimum Baud rate for the communication because a higher value could reflect on the functionality of the environment. Remember to match the Baud rate in the monitor window of the STM32 motor control workbench, when using UART connection.



3 Create the library and download the firmware

In this section the user can understand how to use the STM32 motor control workbench to create the code and control the motor. It is possible to customize the firmware via one of the supported different IDEs available on the STM32 motor control workbench.

3.1 Generation of the source code

Once the user has fixed the parameters, the STM32 motor control workbench is ready to generate the library to use the FOC algorithm in the application. To generate the new code, follow these steps:

• Save the project by clicking on the save button:



In the Save window, choose the output path of the user folder and the name of the project file, for example 'Application.stmcx'.

This is the configuration file of parameters used in the STM32 motor control workbench. When the user changes the parameters of the application, this file changes accordingly and a new generation of the library is needed.

• Generate the code by clicking on the button:



A generation window appears as shown in Figure 27.

4.26.0	•
Target Toolchain	
IAR EWARM	★
HAL/LL Drivers Selection	
HAL/LL Drivers Selection HAL - Hardware Abstraction Li	ayer 🗸 🗸
HAL/LL Drivers Selection HAL - Hardware Abstraction La	ayer

Figure 27. Generation window



In the generation window:

- STM32CubeMx should be the latest version;
- Choose your preferred Target Toolchain;
- Choose HAL-Hardware Abstraction Layer in Driver Selection;
- Click on Generate.

Γ

The STM32 motor control workbench generates, in the user folder, the directory 'Application' (*Figure 28*).

Figure 28.	User folder	structure

Name
Application Application.stmcx

With the following subfolders:

Figure	29. A	Applica	tion	folder

	Drivers
	IDE WORKING FOLDER
	Inc
	MCSDK_v5.2.0
	Src
	.extSettings
	.mxproject
۲	Application.ioc
	Application.ioc.bak
	Application.log
	Application.settings
	Application.wb_def

DocID030267 Rev 4



Those folders contain:

- Drivers: the HAL driver library and the CMSIS files from ARM[®];
- IDE WORKING FOLDER: this is the working folder of the IDE chosen in the Target Toolchain menu of the generation window (*Figure 30*);

ettings Consertion	
Generation	
STM32CubeMx	
4.26.0	
·	
Target Toolchain	
ST TrueSTUDIO	
ST TrueSTUDIO IAR EWARM	
ST TrueSTUDIO IAR EWARM Keil MDK-ARM V4	
ST TrueSTUDIO IAR EWARM Keil MDK-ARM V4 Keil MDK-ARM V5	
ST TrueSTUDIO IAR EWARM Keil MDK-ARM V4 Keil MDK-ARM V5 ST SW4 STM32	
ST TrueSTUDIO IAR EWARM Keil MDK-ARM V4 Keil MDK-ARM V5 ST SW4 STM32 ST TrueSTUDIO THAL - Hardware Adstraction Laver	
ST TrueSTUDIO IAR EWARM Keil MDK-ARM V4 Keil MDK-ARM V5 ST SW4 STM32 ST TrueSTUDIO HAL - Hardware Abstraction Layer	
ST TrueSTUDIO IAR EWARM Keil MDK-ARM V4 Keil MDK-ARM V5 ST SW4 STM32 ST TrueSTUDIO HAL - Hardware Abstraction Layer	
ST TrueSTUDIO IAR EWARM Keil MDK-ARM V4 Keil MDK-ARM V5 ST SW4 STM32 ST SW4 STM32 ST TrueSTUDIO HAL - Hardware Abstraction Layer	

Figure 30. Target toolchain menu

- Inc: application header files;
- MCSDK_v5.2.0: the files for FOC library (revision 5.2);
- Src: application source files;
- Application.ioc is a project file used by STM32CubeMX to generate the code.

Note: Important : Do not use the STM32CubeMX project file to change configurations related to the STM32 PMSM FOC library (timers, DMA, interrupts, etc.). All the changes must be done through the STM32 motor control workbench only.

• When the user changes the parameters of the project they should restart the steps of generating a new code.

The new 'Application' library is ready to be used by your preferred IDE.

3.2 Using STSW-SPIN3201

In association with the STEVAL-SPIN3201 evaluation board, the STSW-SPIN3201 firmware example allows to control a 3-phase permanent magnet motor with field-oriented control algorithms in sensorless operations. The STSW-SPIN3201 firmware is a customization of the STM32 PMSM FOC library, where the target speed is imposed through potentiometer and the motor is started/stopped using the USER1 button of the board. It is also possible to use the STM32 motor control workbench (GUI) to monitor and change in real time some of the variables of the algorithm and to initialize a new project according to the application needs.



DocID030267 Rev 4

To use STSW-SPIN3201 on the STEVAL-SPIN3201 board, refer to UM2152 available on <u>www.st.com</u>.

3.3 Compile and download the firmware

After the generation of the application code, the library is ready to be compiled and downloaded. To build and load a customized firmware, follow these steps:

- Supply the board correctly and connect it to the PC through the USB cable;
- Connect the motor;
- Run your preferred IDE;
- Load the project with your preferred IDE from the releted directory created by STM32 motor control workbench (for example "EWARM\Project.eww" if you are using IAR embedded workbench for the ARM toolchain);
- Compile and download the code;
- Start the execution of the code.



4 Control the motor

The user can now control the motor through the STM32 motor control workbench:

- Open STM32 motor control workbench
- Click on the "Open Monitor" icon:



to open the 'Monitor and spin control GUI' as shown in Figure 31.



Figure 31. Monitor and spin control GUI

• Connect the board by clicking the connection button:



To make this operation work, remember to use the correct Port number and the Baud rate configured during the setting of parameters (see *Figure 26*).

• Once the board is connected, use the control panel on the right of the control GUI:





Figure 32. Control panel

Using the STM32 motor control workbench it is also possible to monitor the speed and • change the variables of the algorithm in real time.

For details of the use of the STM32 motor control workbench v5, see UM2374 and UM2380 available on www.st.com.



5 Revision history

Date	Revision	Changes	
14-Feb-2017	1	Initial release.	
09-Mar-2017	2	Updated note <i>1.</i> below <i>Table 7 on page 21</i> (replaced "A3" by "B7").	
11-Apr-2018	3	Updated Section 3 on page 23.	
17-Oct-2018	4	Updated to Revision 5.2.0 of STM32 Motor Control SDK. Added STSPIN32F0A.	

Table 8. Document revision history



IMPORTANT NOTICE - PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2018 STMicroelectronics – All rights reserved

DocID030267 Rev 4

