

Introduction

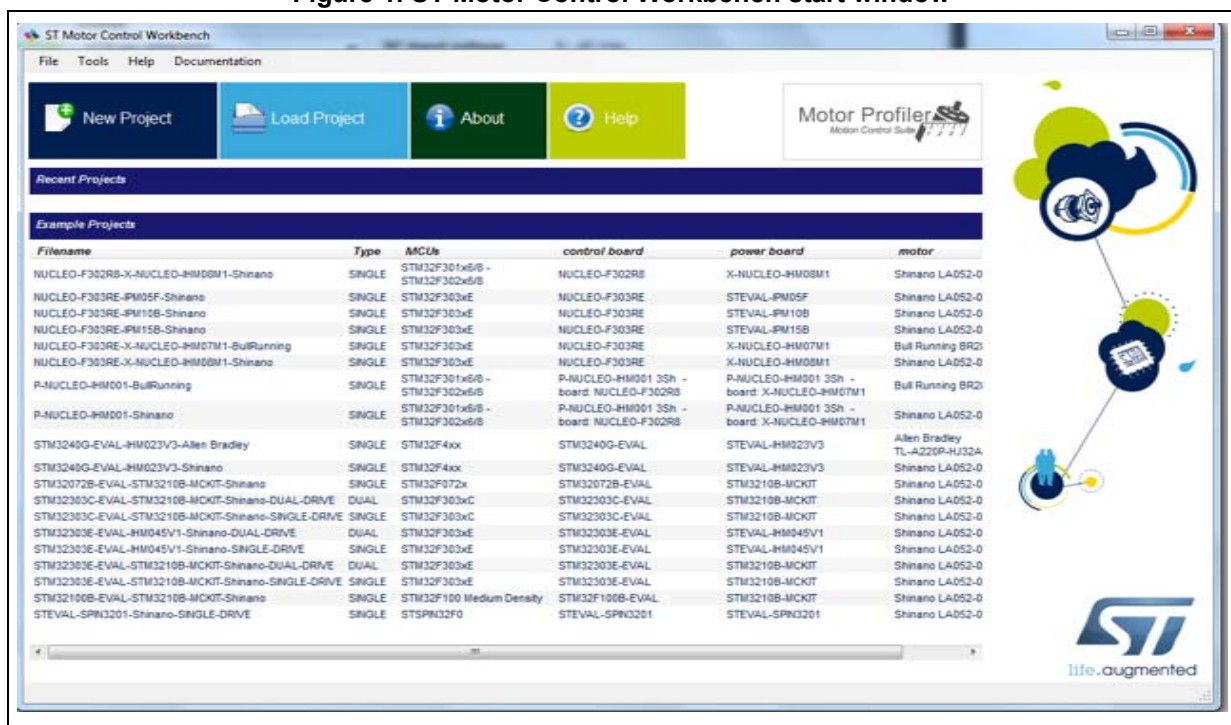
The STSPIN32F0 is a system-in-package providing an integrated solution suitable for driving three-phase BLDC motors using different driving modes. The integrated MCU (STM32F031x6) allows performance of field-oriented control.

This document explains how to drive the STSPIN32F0 with FOC algorithms, using the ST Motor Control Workbench software to generate all the parameter header files, to configure the FOC FW library according to your application needs.

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

1. Set up the hardware.
2. Use the ST Motor Control Workbench to configure the library.

Figure 1. ST Motor Control Workbench start window



3. Compile and download the firmware.

Contents

- 1 Set up hardware 3**

- 2 Use ST Motor Control Workbench to configure library 3**
 - 2.1 Create new project for ST STEVAL-SPIN3201 board 3
 - 2.2 Create new project to configure library for custom STSPIN32F0 board .. 5
 - 2.3 Motor parameters 7
 - 2.4 Power Stage parameters 8
 - 2.5 Drive Management parameters 10
 - 2.6 Control Stage parameters 12

- 3 Compile and download firmware 16**

- 4 Revision history 18**

1 Set up hardware

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

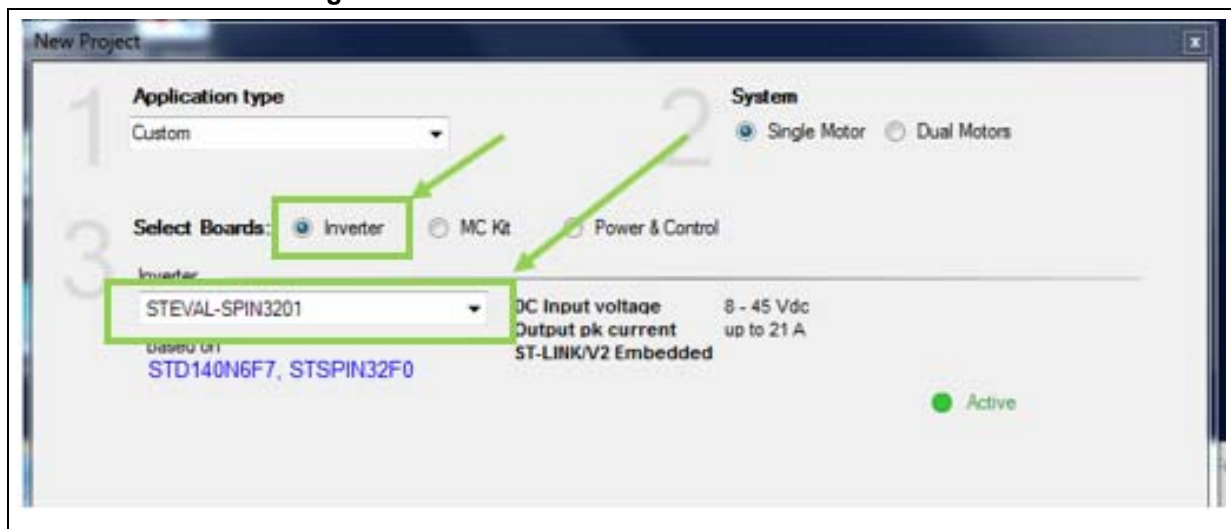
2 Use ST Motor Control Workbench to configure library

The ST Motor Control Workbench can be used to configure the FW FOC library to use in your application. You can use the ST **STEVAL-SPIN3201** board or you can use a custom board.

2.1 Create new project for ST STEVAL-SPIN3201 board

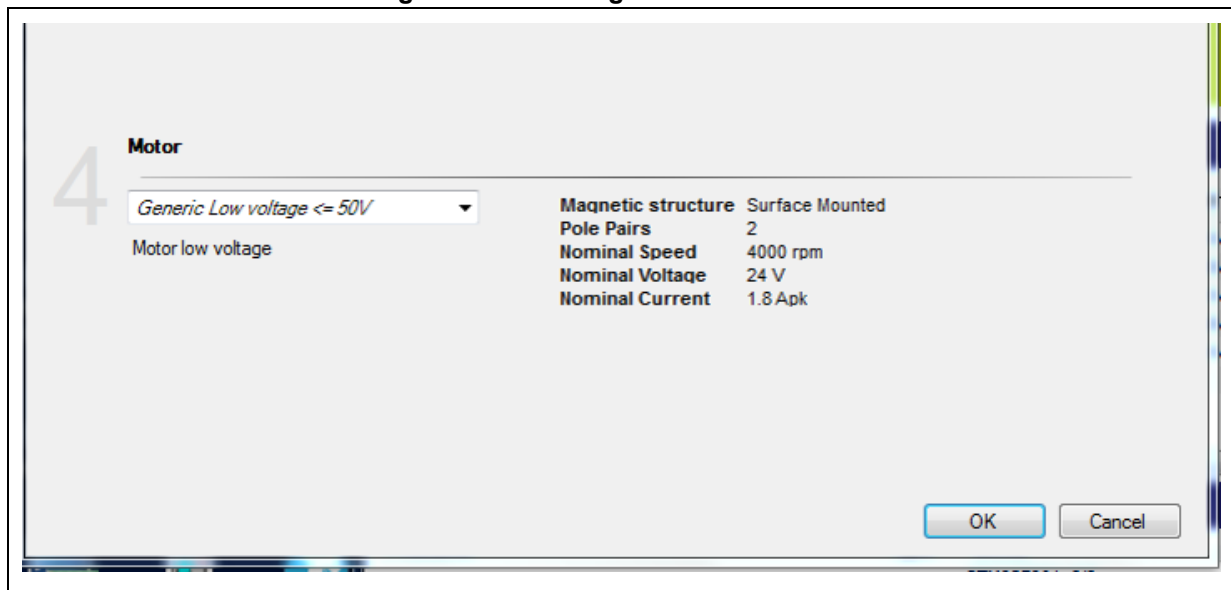
- Open the ST Motor Control Workbench v4.3
- Click on “New Project” and a parameter window will appear
- Choose the “Inverter” board type and select the STEVAL-SPIN3201 from the drop-down list. In this way, the application automatically loads all the hardware-related parameters for the FOC library.

Figure 2. Parameter window for STEVAL-SPIN3201



- From the motor list, you can select one of the pre-configured motors or select a generic starting model.

Figure 3. Pre-configured Motor window



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

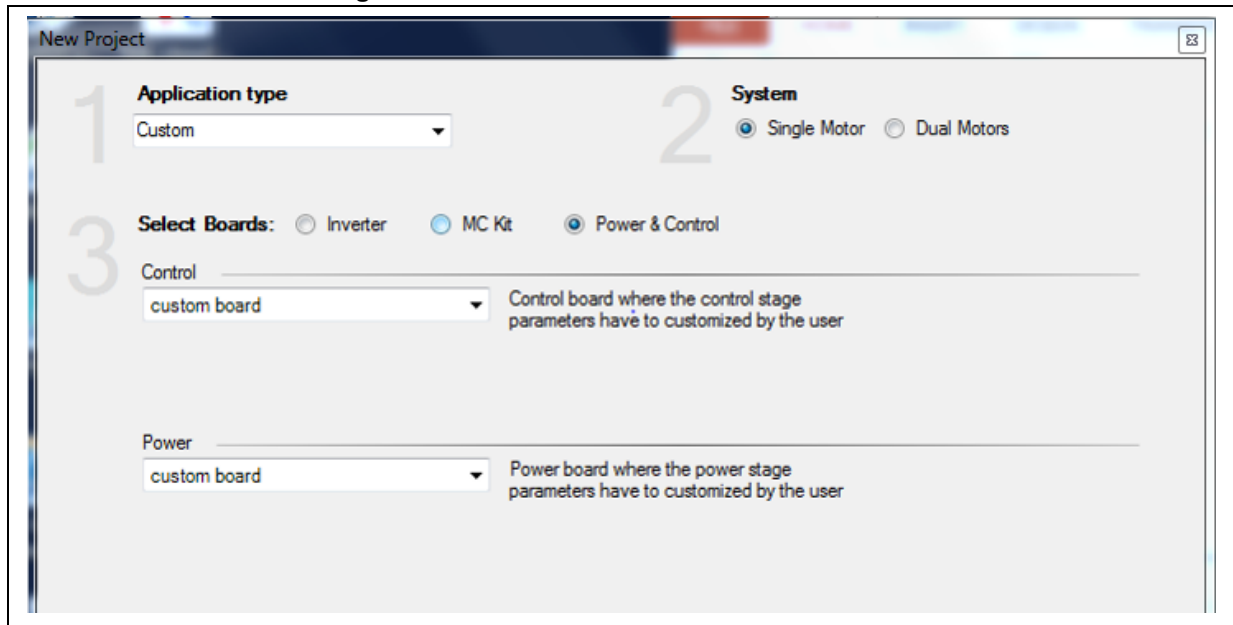
A configuration window will appear, allowing you to set the parameters for:

- “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, Control Stage and Drive Management are already set.

2.2 Create new project to configure library for custom STSPIN32F0 board

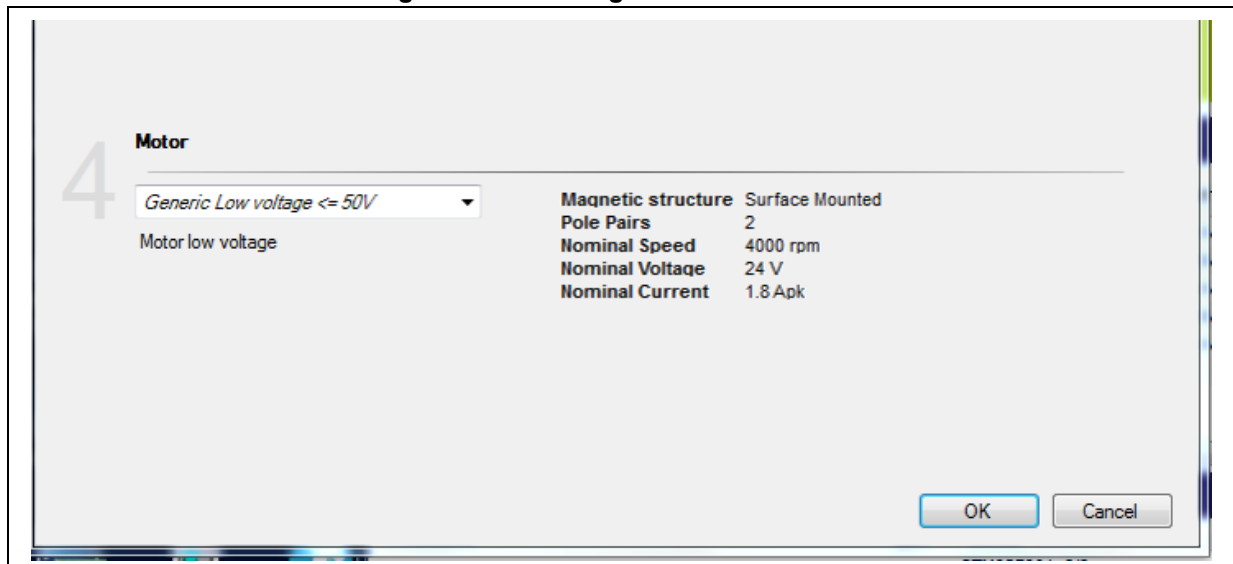
- Open the ST Motor Control Workbench v4.3
- Click on New Project and a parameter window will appear
- Select the options as shown in *Figure 4*:

Figure 4. Parameter window for custom board



- From the motor list, you can select one of the pre-configured motors or select a generic starting model.

Figure 5. Pre-configured Motor window



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

A configuration window will appear, allowing you to set the parameters 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 to your application.
- To use the integrated MCU (STM32F031x6), remember that you can access a limited number of pins as you can see in the STSPIN32F0 datasheet. Here is a list of pins you can use to access the integrated MCU:

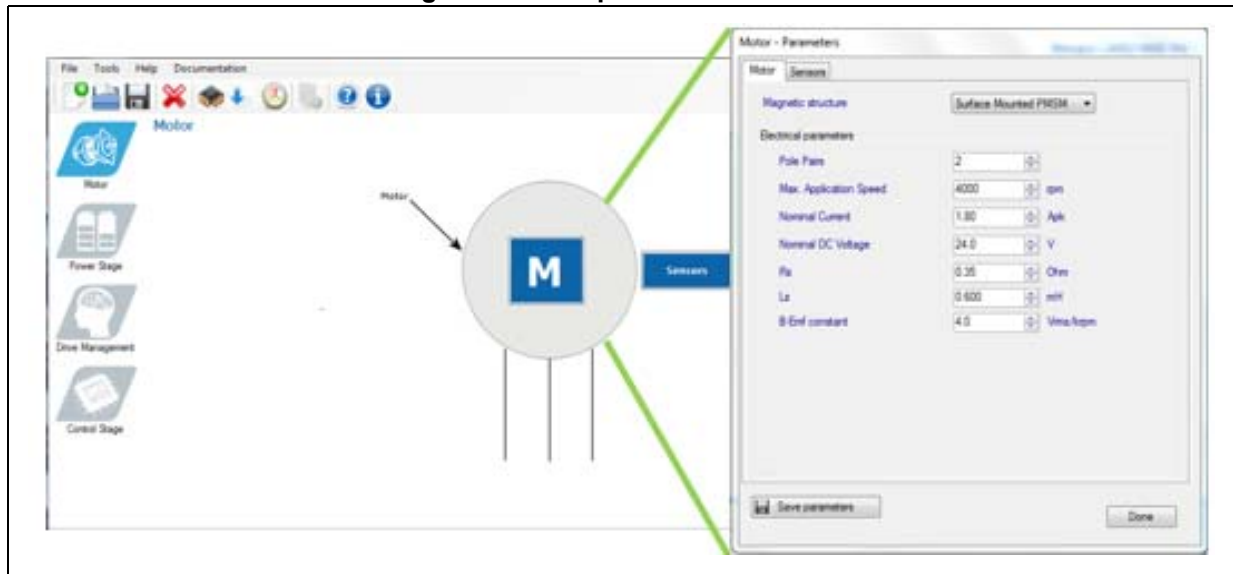
Table 1. Accessible pin of integrated MCU

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

2.3 Motor parameters

- In the configuration window you can manually insert the motor parameters by clicking on the Motor → M and filling the fields. If you click on “save parameters”, you can add your motor to the preset list of the motors.

Figure 6. Motor parameters window

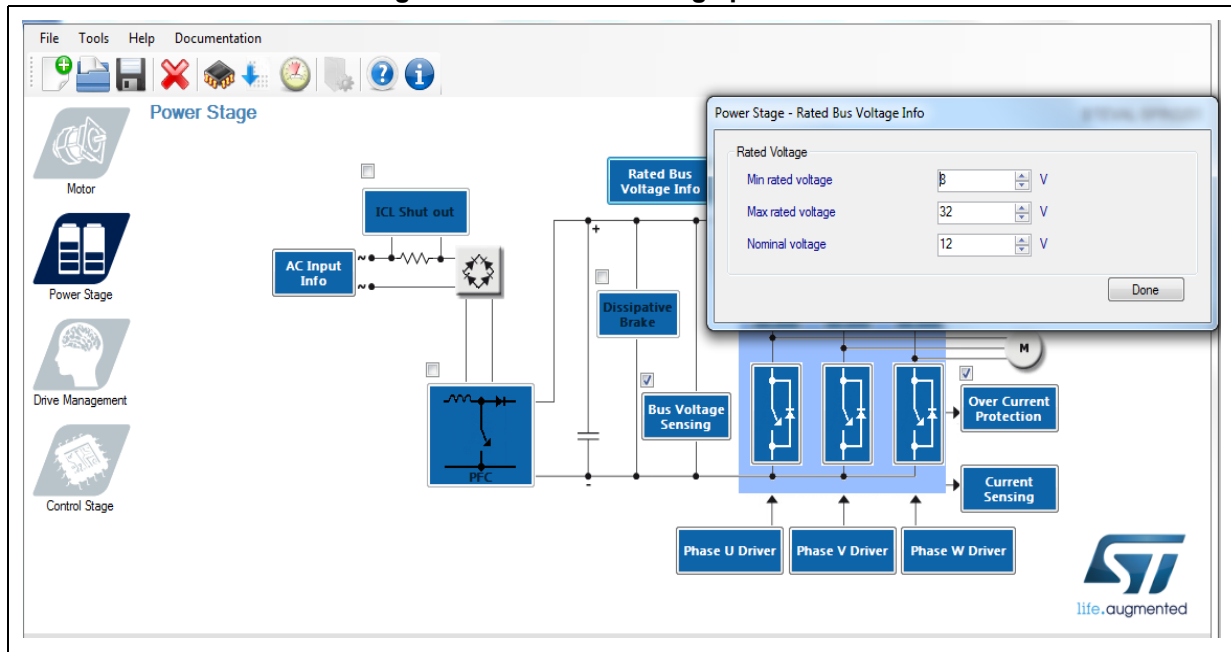


2.4 Power Stage parameters

In the configuration window you can manually insert the Power Stage parameters by clicking on its icon and choosing the area you want to set. Using the **STEVAl-SPIN3201** device, the configuration parameters for the Power Stage are already set. You should set the parameters related to your application (for example the “Rated Bus Voltage”).

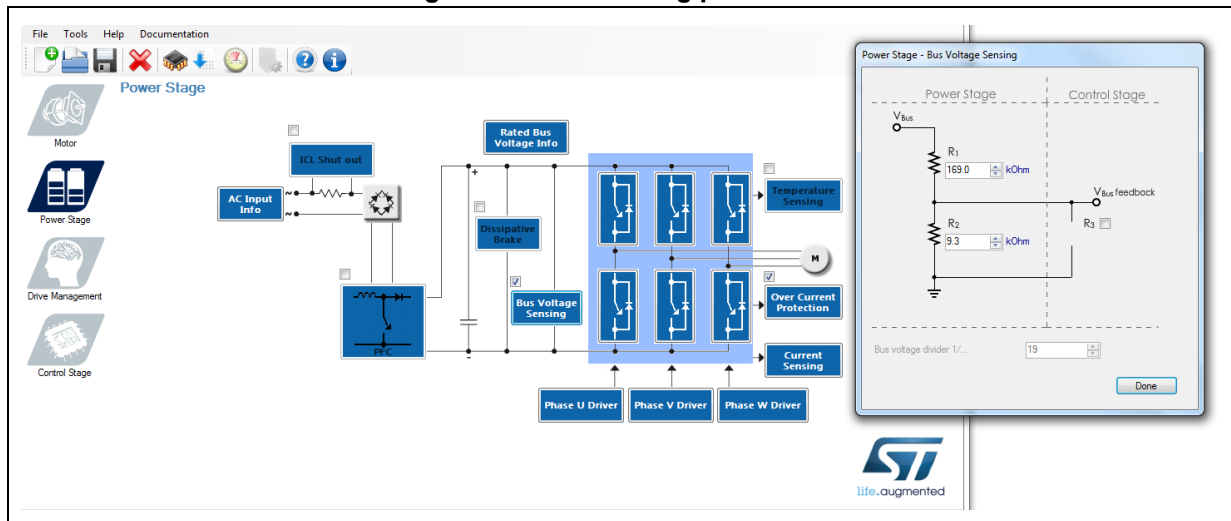
- Select the Power Stage → “Rated Bus Voltage Info” and set the voltage range related to your application.

Figure 7. Rated Bus Voltage parameters



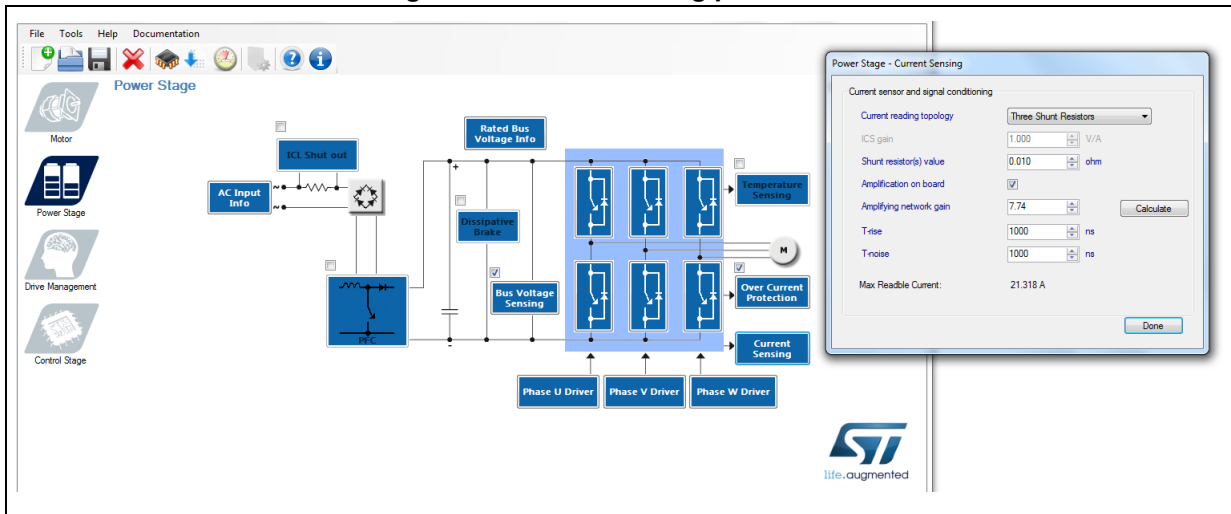
- Select the Power Stage → “Bus Voltage Sensing” and set the parameters for the sensing of the Vbus.

Figure 8. Vbus sensing parameters



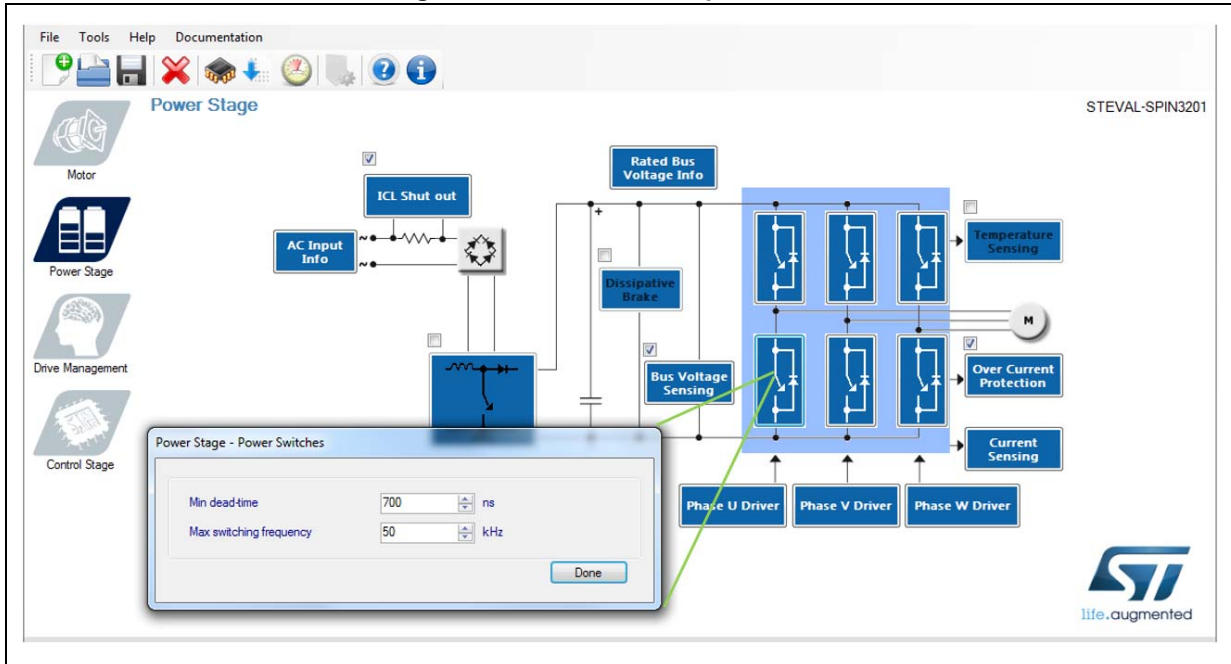
- In the Power Stage → “Current Sensing” choose the sensing network.

Figure 9. Current Sensing parameters



- In the Power Stage → select the parameters of the “Power Switches”.

Figure 10. Power Switch parameters

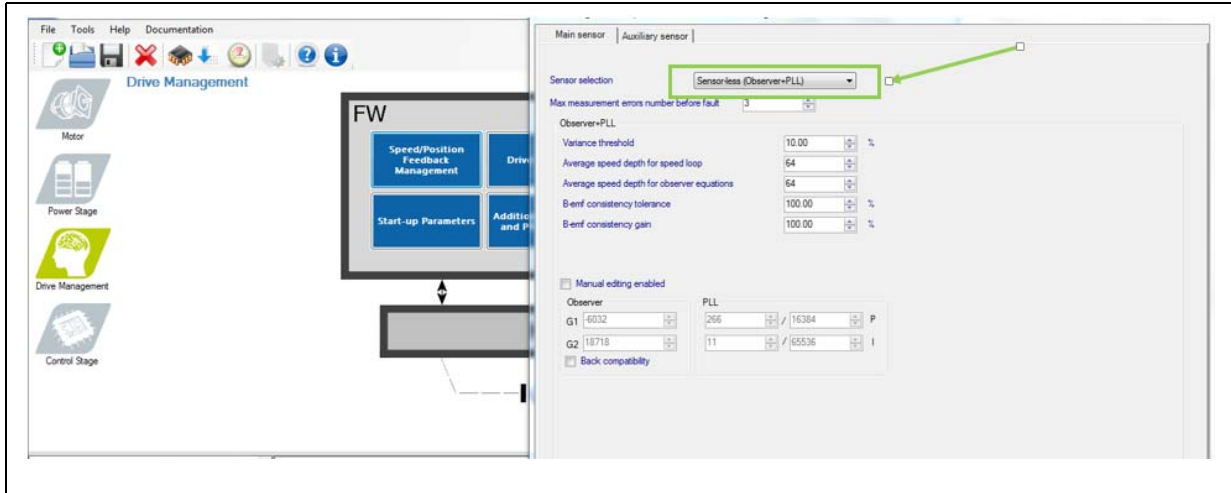


2.5 Drive Management parameters

In the configuration window you can manually insert the Drive Management parameters by clicking on its icon and choosing the area you want to set.

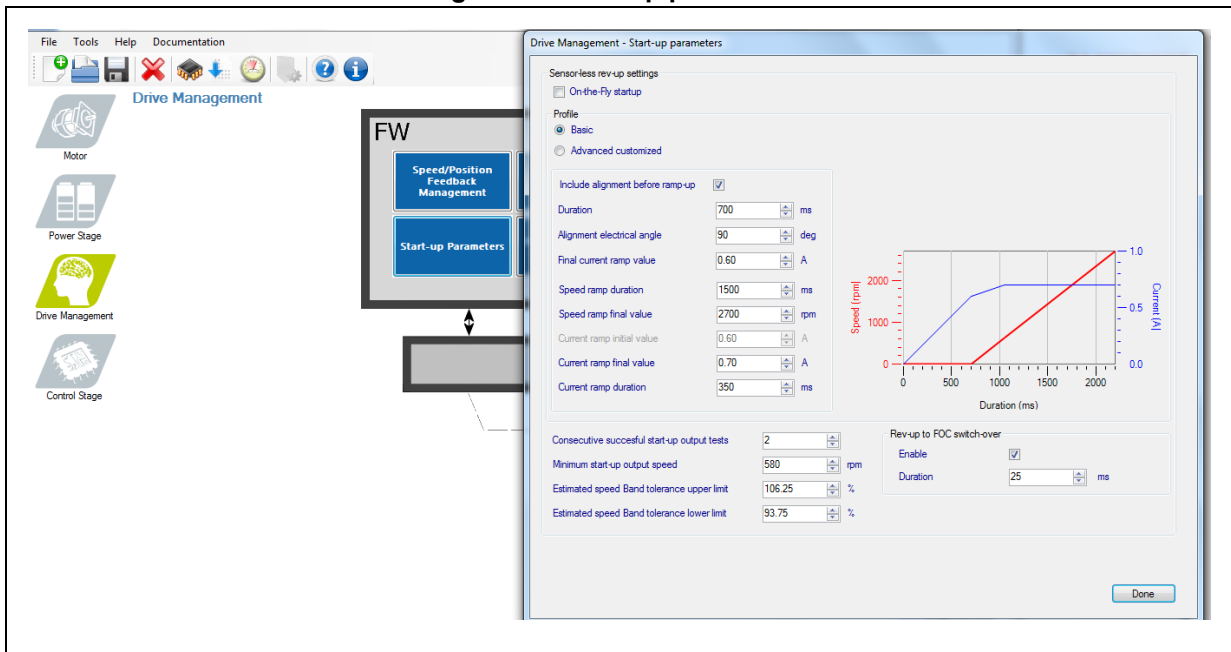
- In the Drive Management → "Speed/Position" feedback management in the "Sensor selection" you can select the sensing algorithm you want to use.

Figure 11. Drive Management Sensor selection



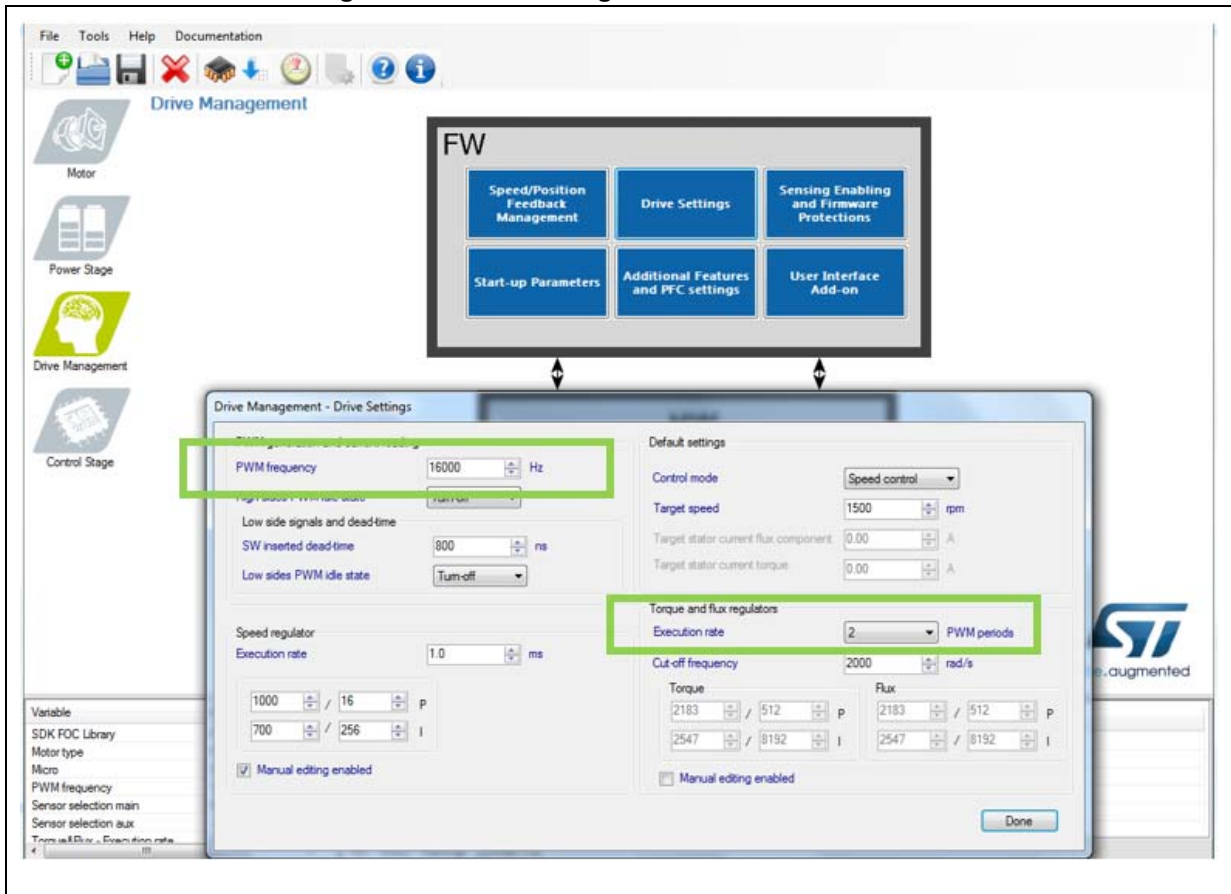
- In the Drive Management → "Start-up parameters" you can set the starting speed and current profile.

Figure 12. Start-up parameters



- In the Drive Management → "Drive Settings": remember that the **PWM frequency/ Execution rate** must be below 15 KHz, so adjust those two parameters.

Figure 13. Drive Settings window Execution rate

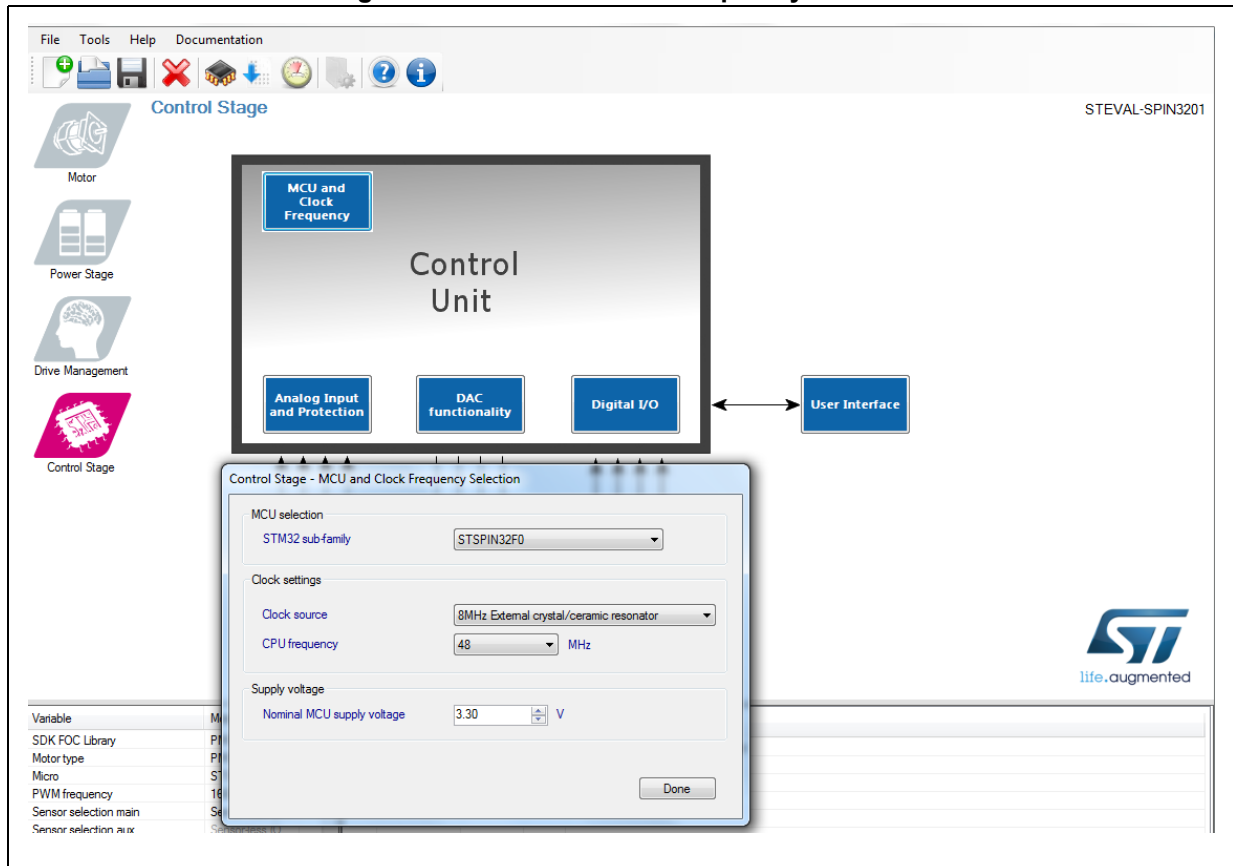


2.6 Control Stage parameters

In the configuration window you can manually insert the Drive Management parameters by clicking on its icon and choosing the area you want to set. Using the **STEVAL-SPIN3201** device, the general configuration parameters for the Control Stage are already set.

- If you use custom HW remember to select the **STSPIN32F0** as a microcontroller in the Control Stage → "MCU and Clock Frequency" → **STM32 sub-family**.

Figure 14. MCU and Clock Frequency window

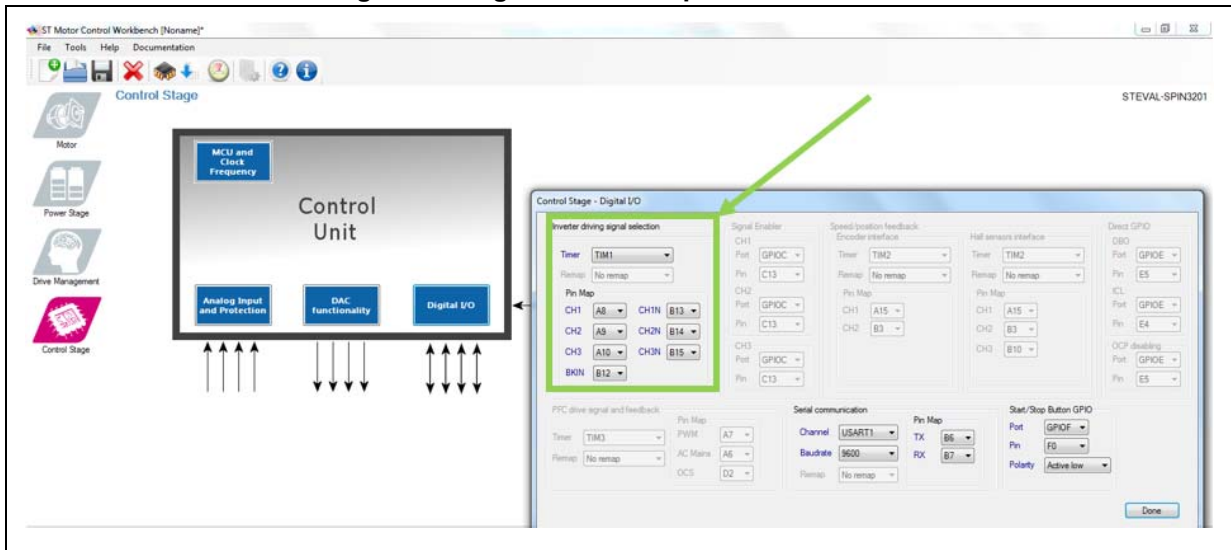


- Never change the Control Stage → "Digital I/O" → "Pin Map", as the internal mapping of the device is shown in [Table 2](#):

Table 2. Pin Map for STSPIN32F0

TIM1	
CH1	A8
CH2	A9
CH3	A10
CH1N	B13
CH2N	B14
CH3N	B15
BKIN	B12

Figure 15. Digital I/O Pin Map for STSPIN32F0



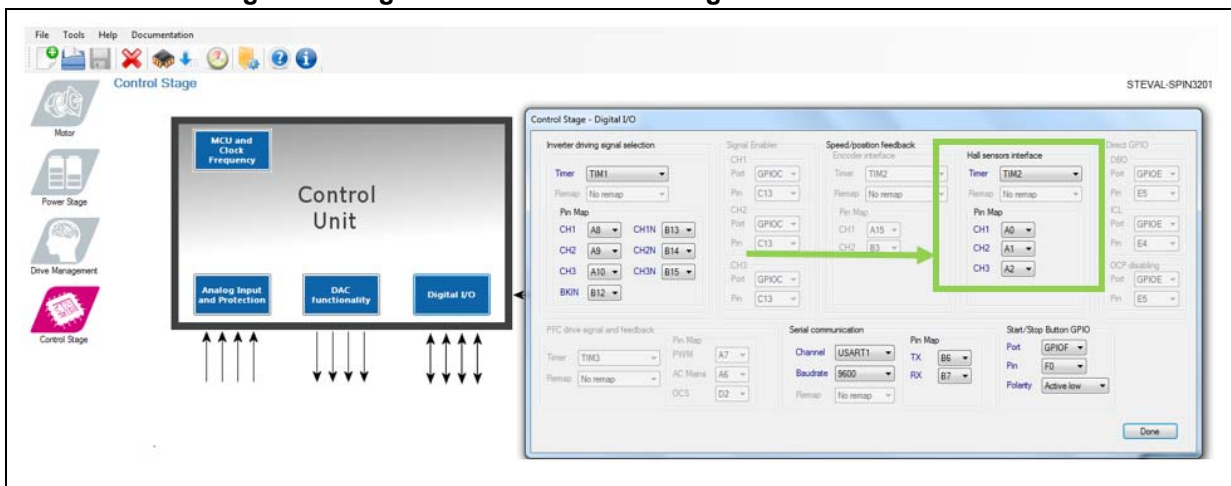
- If the “Hall” sensor position feedback is used, in the Control Stage → Digital I/O → Hall sensor interface, the Pin Map has to be set as shown in [Table 3](#):

Table 3. Hall sensor interface for STSPIN32F0

TIM2	
CH1	A0 or A5 ⁽¹⁾
CH2	A1
CH3	A2

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

Figure 16. Digital I/O Hall sensor settings for STEVAL-SPIN3201



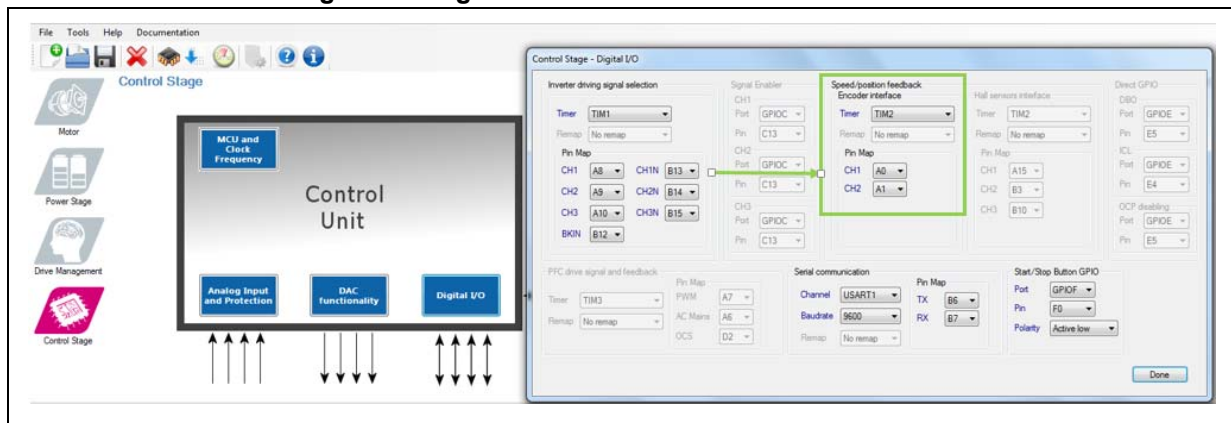
- If the “Encoder” position feedback is used, in the Control Stage → Digital I/O → Hall sensor interface, the Pin Map has to be set as shown in [Table 4](#):

Table 4. Encoder interface for STSPIN32F0

TIM2 ⁽¹⁾		TIM3	
CH1	A0 or A5	CH1	A6
CH2	A1	CH2	A7

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

Figure 17. Digital I/O encoder for STEVAL-SPIN3201



- To define the “Serial Communication” select the pin used for the UART communication in the Control Stage → Digital I/O → Serial Communication.

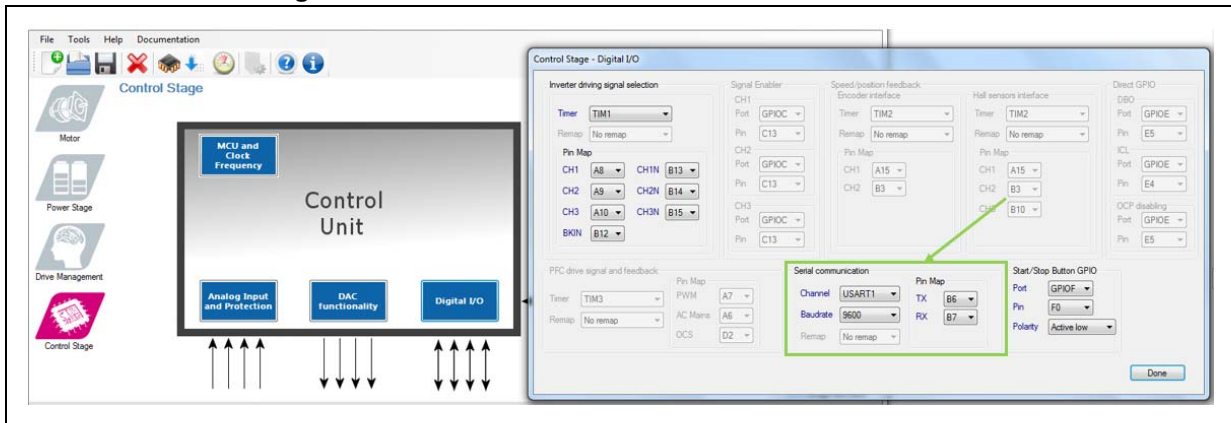
Table 5. Serial Communication parameters for STSPIN32F0

Serial Communication	
Channel	USART1
Baudrate	9600
TX ⁽¹⁾	B6 or A2 or A14
RX	B7 or A3

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

- Remember to use the minimum baudrate for the communication.

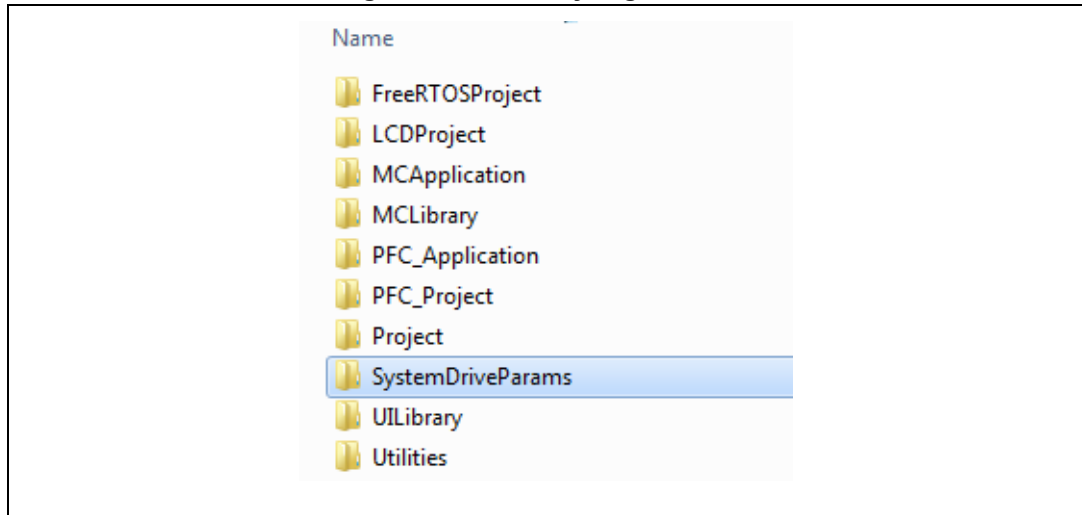
Figure 18. Serial Communication for STEVAL-SPIN3201



3 Compile and download firmware

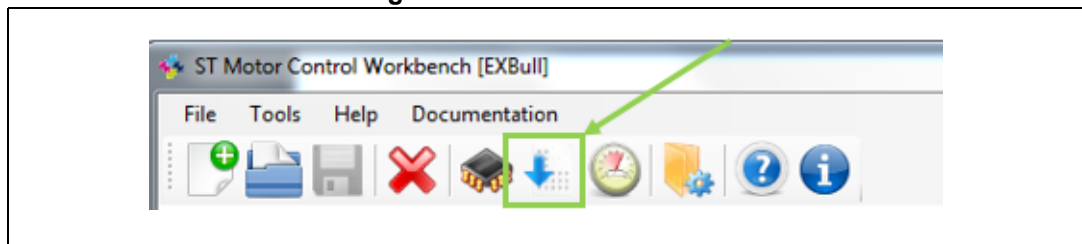
- Before proceeding with creating the configuration files save the project: a *.stmcx file will be saved in the FOC library. This file will be loaded any time you need to use the ST MC Workbench.
- Select the output path in the option form and choose the “SystemDriveParams” present in the FW working folder **STM32 PMSM FOC LIB**.

Figure 19. Directory organization



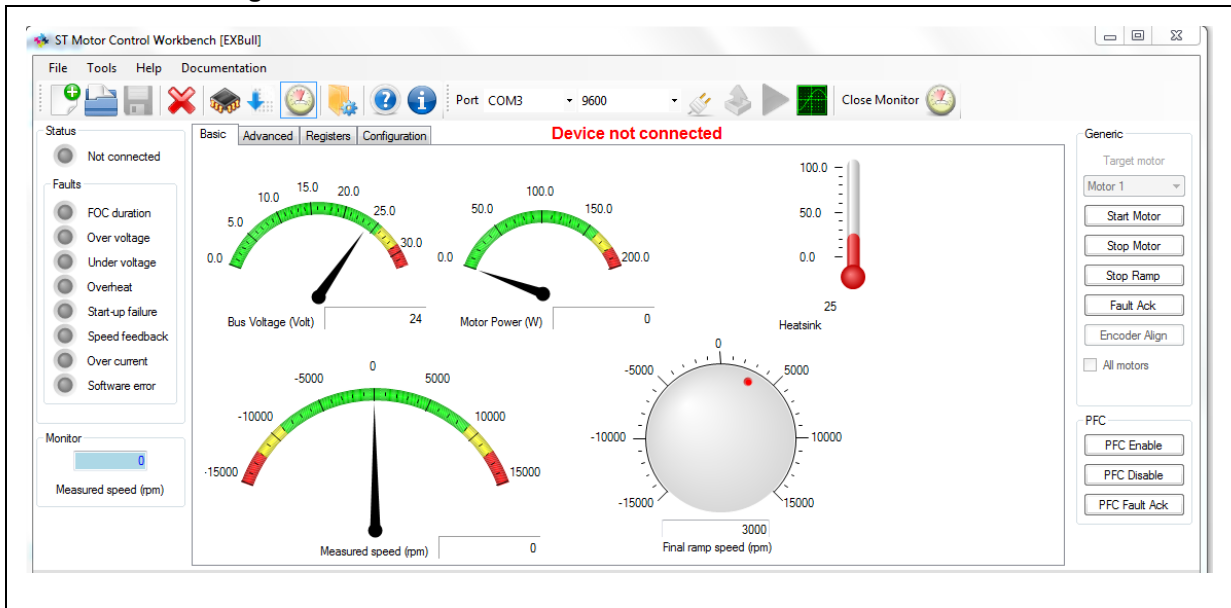
- Click on the “Generation” button to generate the configuration (*.h) file for the firmware library. You must generate a new configuration file any time you change parameters in the ST MC Workbench.

Figure 20. Generation button



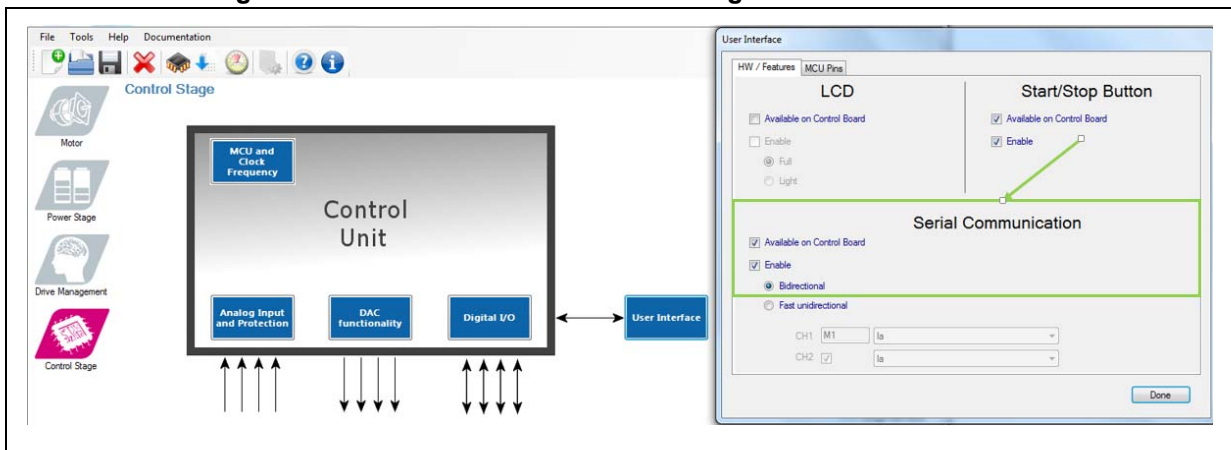
- Open your FW using your favorite IDE (IAR, KEIL and AC6)
- Open v4.3.0\STM32 PMSM FOC LIB\Web\Project\EWARM\STM32F0xx_Workspace.eww and choose the project “STM32SPIN”
- Compile the firmware
- Flash the executable into the microcontroller using the ST-LINK
- Establish real time communication with the firmware using the monitor feature of the ST MC Workbench to start the motor, set the speed and get the feedback.

Figure 21. ST Motor Control Workbench Serial Communication



- The Serial Communication is enabled in the workbench in the Control Stage section. Select the Control Stage → "User Interface" and enable it as shown in Figure 22.

Figure 22. Serial Communication enabling for STEVAL-SPIN3201



For more details refer to the STSPIN32F0 datasheet and the STM32 PMSM FOC Software Development Kit - MC library User manual (UM1052), which you can find at: www.st.com.

4 Revision history

Table 6. Document revision history

Date	Revision	Changes
14-Feb-2017	1	Initial release.
09-Mar-2017	2	Updated note 1. below Table 5 on page 14 (replaced "A3" by "B7").

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.

© 2017 STMicroelectronics – All rights reserved