STM32 PMSM FOC SDK 4.3
Getting Started

Rev 1.6

life.augmented

Objectives

The purpose of this document is to:

- Help developers get started with the STM32 PMSM FOC SDK using the ST MC Workbench with the final purpose of running a Permanent Magnet Synchronous Motor (PMSM) with ST Evaluation boards.
- Show where to find technical documentation, firmware libraries and other related materials.
- How to obtain additional technical support

Systems check

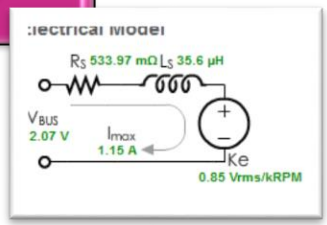
- What is needed:
  - Windows laptop (Win 7)
  - ST-LINK dongle (optional)
  - USB to RS-232 dongle and a null modem cable (optional)
  - A permanent magnet motor
  - Multimeter (optional)
  - An oscilloscope with current probe (optional)
  - An insulated DC and or AC power supply

Motor control – SDK workflow

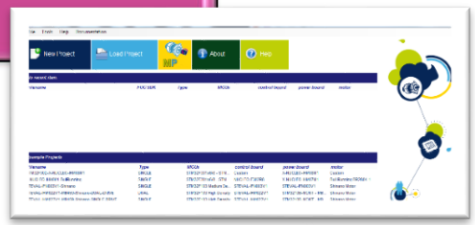
Motor control – SDK – Workflow

Set up the HW

Use motor specs or identify the motor using Motor Profiler



Finalize the project with Workbench



Send commands with serial communication

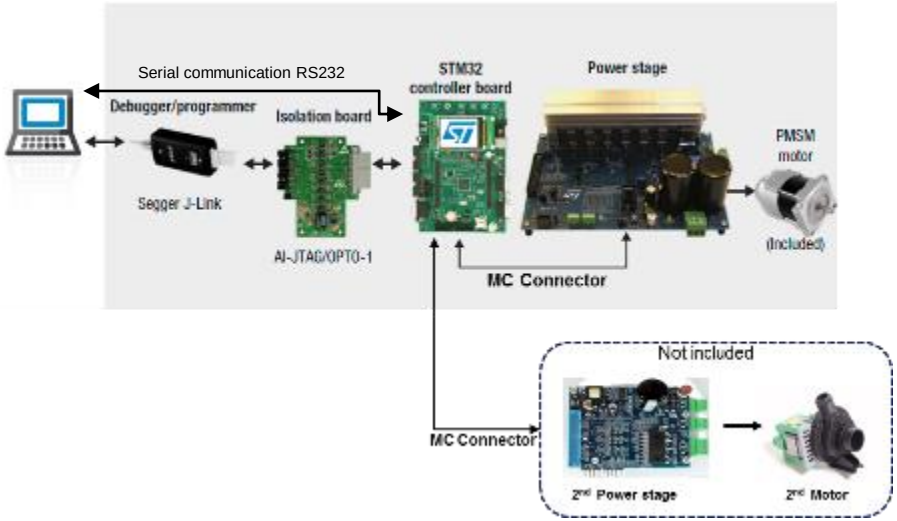
life.augmented

Motor control – SDK – Workflow 1/4

- First step → ***Set up the hardware.*** Depending on the targeted application, it is possible to choose the most suitable hardware configuration from among the different “ready-to-start” ST evaluation boards presented in *Steps 1 to 5*.

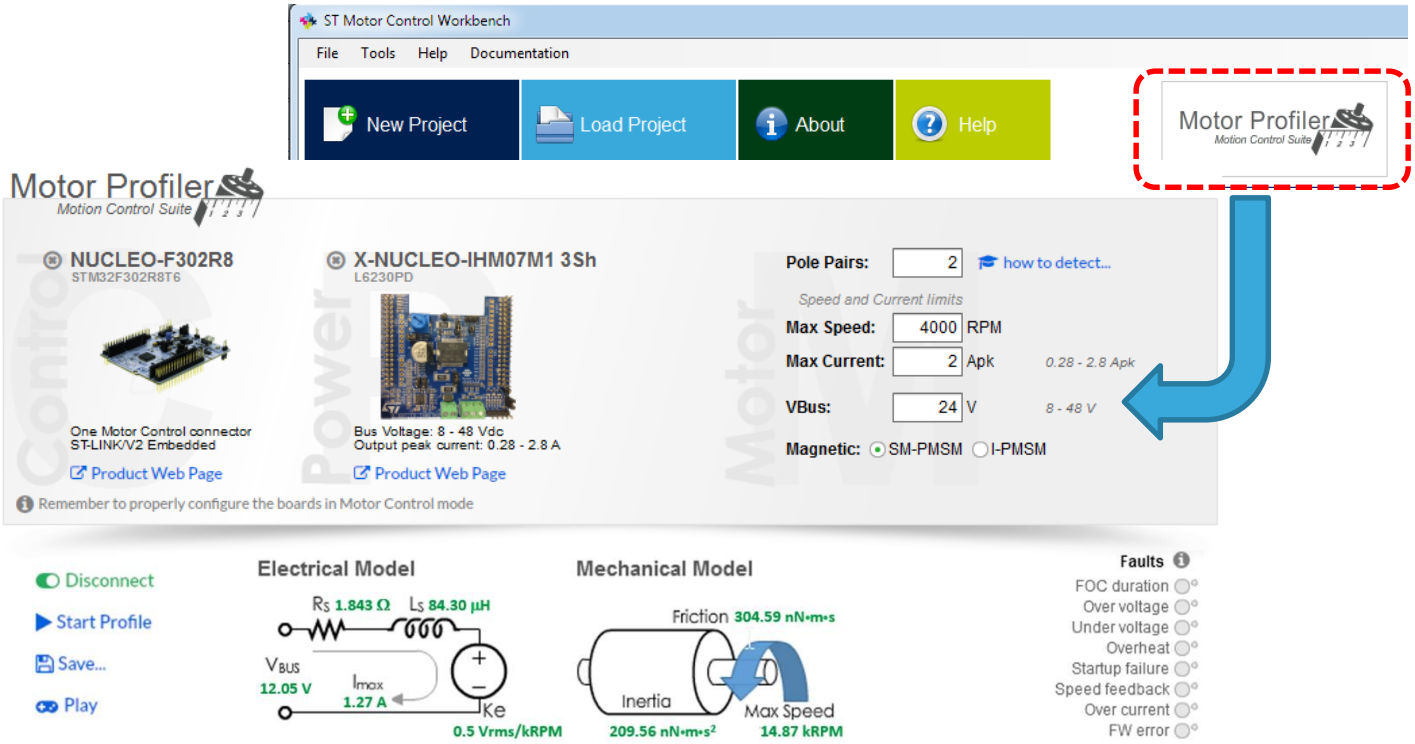
- Set up the selected board according the specification stated in each of the related user manuals.

- Connect the board (if required) to the power supply and your motor.



Motor control – SDK – Workflow 2/4

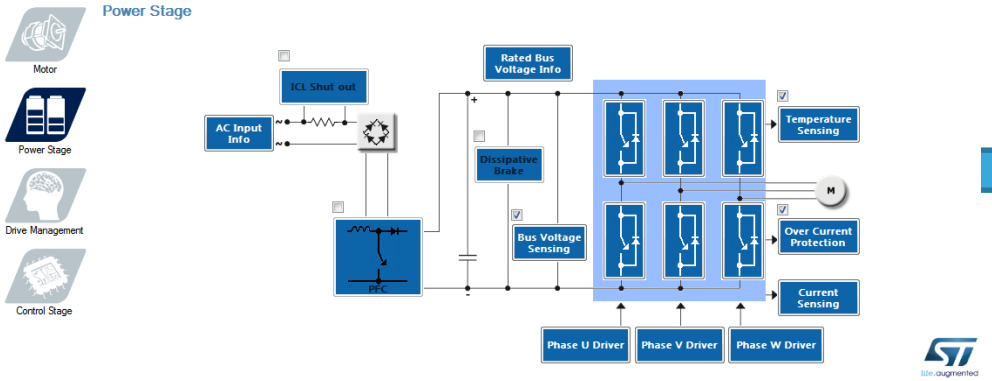
- When the hardware is ready, if the user does not know the motor parameters, he can identify the motor.
- How? Using the ***Motor Profiler***!!
  - Follow the instruction in Step 6.
- If want to measure the Motor parameter in the lab Step 8



Motor control – SDK – Workflow 3/4

- When using the Motor Profiler, the motor is running but the user can develop his own code!
- **Finalize the MC project** using Workbench according to the instructions in Step 7.
- Use your favorite IDE to develop your code.

MC Workbench



IAR SYSTEMS

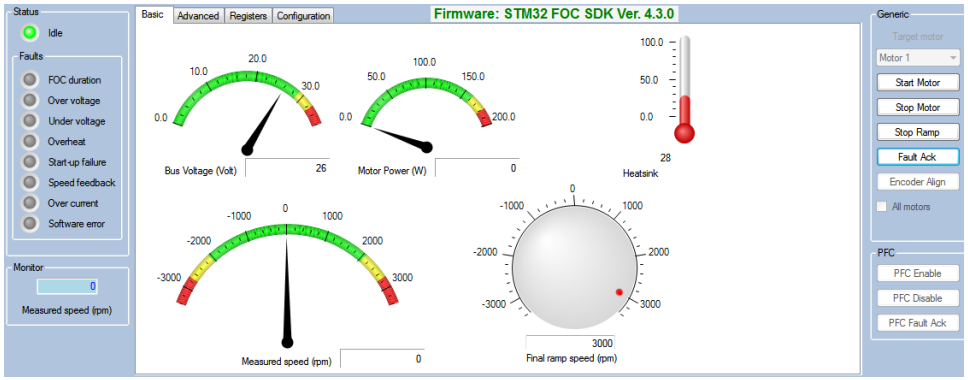
KEIL Tools by ARM

ac6 Assistance Conseil Systemes

Motor control – SDK – Workflow 4/4

- Finally, the user can **send commands** (e.g. start, stop, execRamp, …) via serial communication.

- Use the Workbench as explained in Step 13.



life.augmented

Hardware setup

Step #1 – Hardware setup

- It is possible to choose one of the following offers:
  - Complete Motor Control Kit.
  - One of the complete inverters currently in stock.
  - Any STM32 evaluation board combined with one of the ST evaluation power stages which include the MC connector.
- The following slides cover the boards in the *ST Evaluation Tools Portfolio* that can be used to arrange a motor control system.
  - Follow the instructions in the related user manual to set up each board.

Flexible motor control platforms

STM32 PMSM FOC SDK
(Firmware library)

Flexible Motor Control platform	Complete Motor Control drives	STM32 ODE: Nucleo + X-NUCLEO	Motor Control Kit
based on ST MC connector **Control stages**  **Power stages**			

Board List

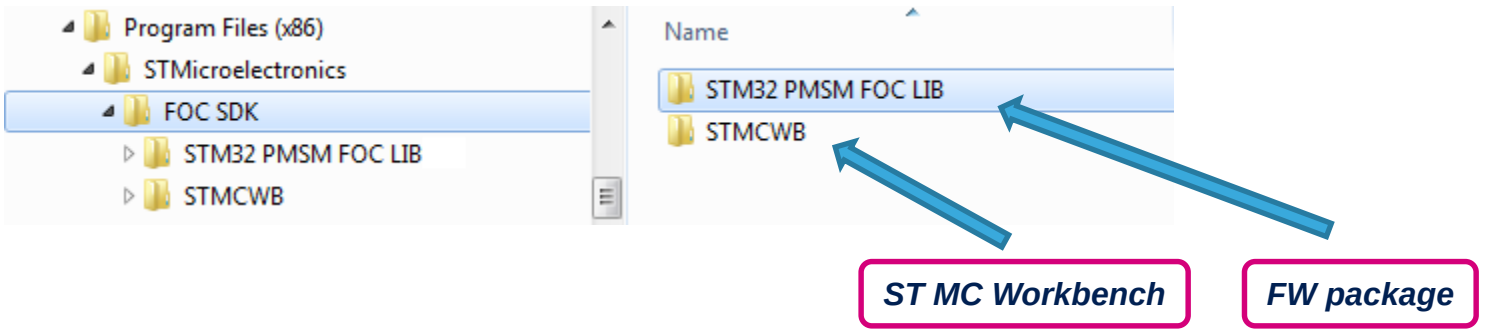
Software setup

Step #2 – Software setup

Download and install the STM32 PMSM FOC SDK from www.st.com.

It contains both the firmware package and the ST MC Workbench (PC GUI).

After installation, you will have the following new folders:



Step #3 – IDE setup

- An IDE (Integrated development environment) is required to compile, flash and debug the application.

- Several IDEs are supported:
  - *IAR* Embedded Workbench for ARM - *IAR* Systems (http://www.iar.com/)
  - *Keil* Embedded Development Tools for ARM, Cortex-M **...** (**http://www.keil.com/**)
  - SW4STM32 : free IDE for STM32 on Windows, Linux and OS X (http://www.st.com/)

Step #4 – ST-LINK installation

- If the control board or the complete system doesn't embed the ST-LINK, a stand-alone dongle is required.
- In any case, you must install the ST-LINK driver that can be found in the ST website searching for part number ST-LINK/V2 or ST-LINK/V2-ISOL

Part Number	Status	Description
ST-LINK/V2	Active	ST-LINK/V2 in-circuit debugger/programmer for STM8 and STM32

- Click on Design Resources, download and install the STSW-LINK009

Related Tools and Software

Related Tools and Software	
Part Number	Description
STSW-LINK004	STM32 ST-LINK utility
STSW-LINK005	ST-LINK/V2 firmware upgrade
STSW-LINK009	ST-Link, ST-Link/V2, ST-Link/V2-1 USB driver signed for XP, Windows7, Windows8

Step #4 – ST-LINK installation

- On the same page, download and install also the STSW-LINK004 – STM32 ST-LINK utility

  (This will be required to flash the LCD FW code into the MCU).

Related Tools and Software

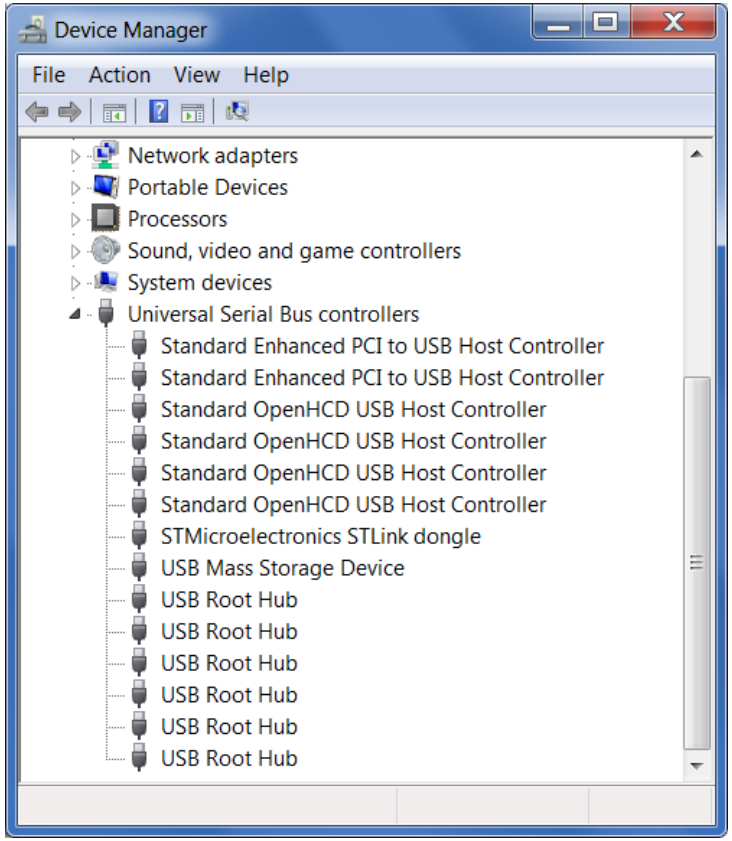
Related Tools and Software	
Part Number	Description
STSW-LINK003	ST-LINK/V2 USB driver for Windows 7, Vista and XP
STSW-LINK004	STM32 ST-LINK utility
STSW-LINK005	ST-LINK/V2 firmware upgrade
STSW-LINK006	ST-LINK/V2 USB driver for Windows 8

Step #5 – Connect ST-LINK (1/6)

- Using the USB cable, connect the control board with ST-LINK embedded (or the ST-LINK dongle) to the A male connector into your laptop.

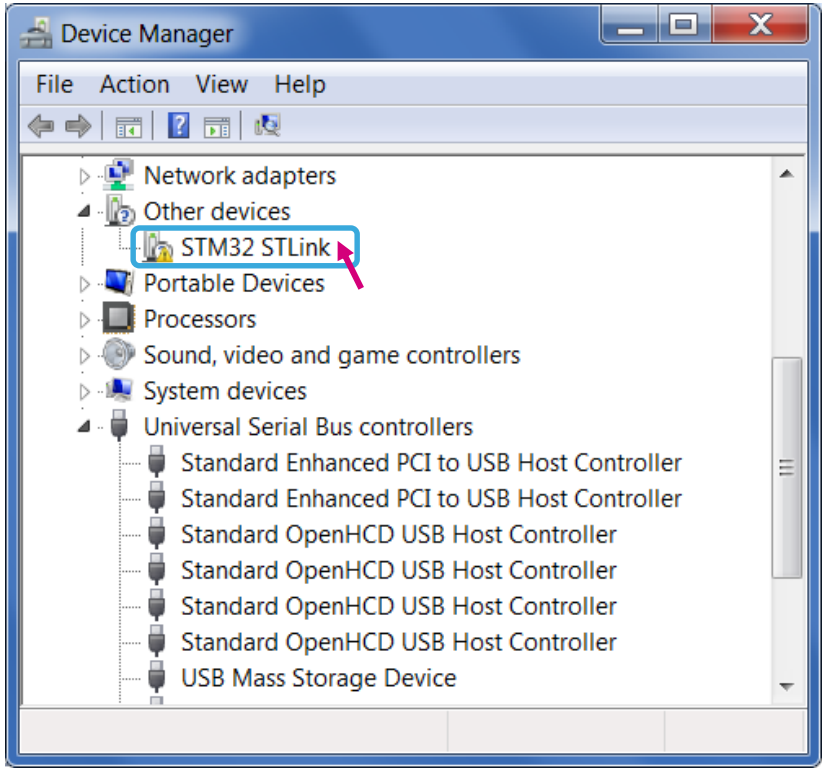
- Wait for Windows to recognize the ST-Link device and follow any steps required to install the driver.

- Upon successful driver recognition, the ST-Link device should be fully enumerated in the Windows Device Manager as shown:



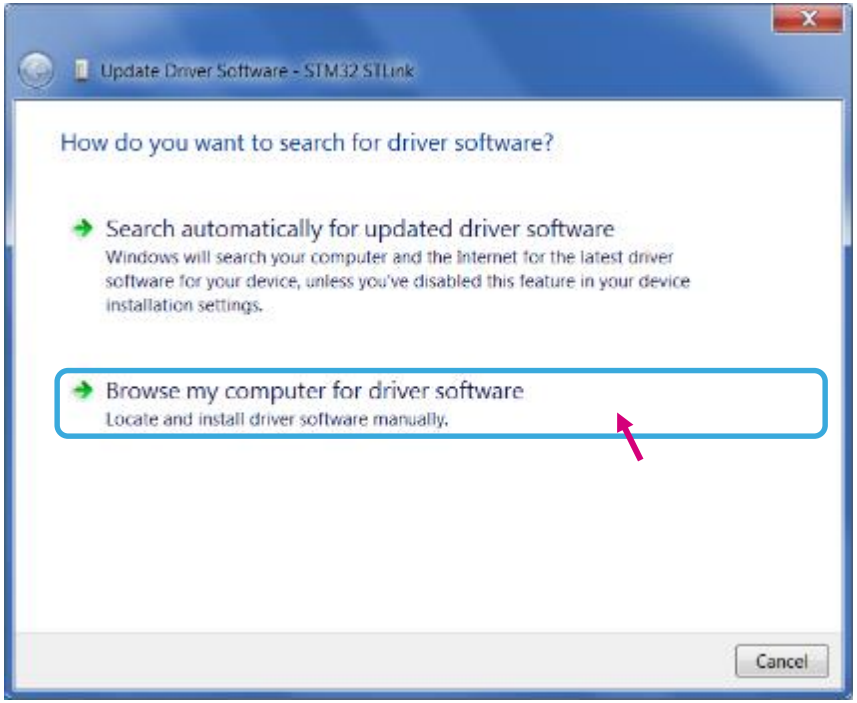
Step #5 – Driver trouble-shooting (2/6)

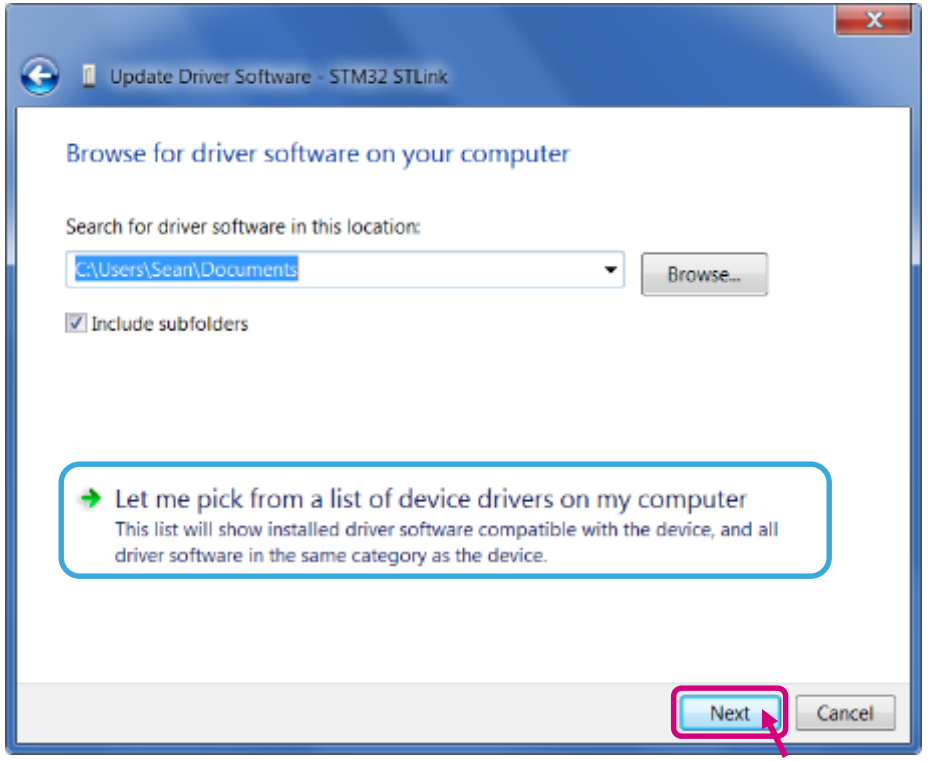
1. Open Device Manager.
2. Right-click on the "**STM32 STLink**" Driver icon.
3. Select "**Update Driver Software**".



Step #5 – Driver trouble-shooting (3/6)

4. Select “**Browse my computer for driver software**”.





5. Select “Let me pick from a list of device drivers of my computer”.

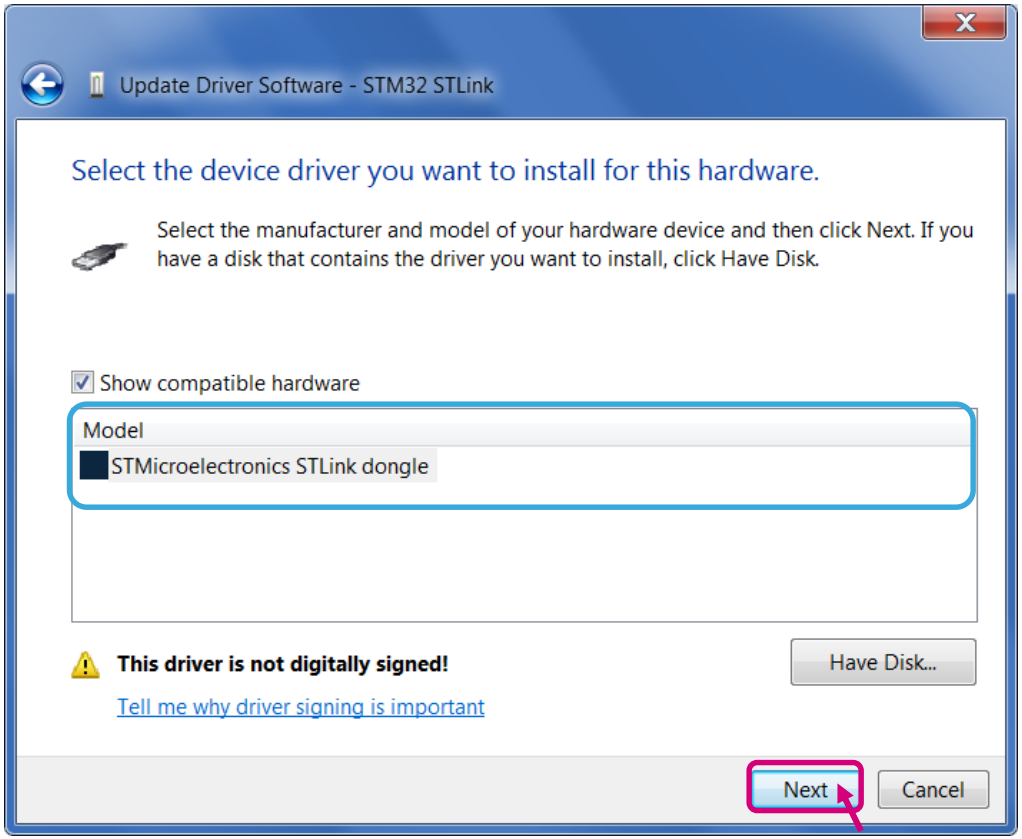
6. Click “Next”.

life.augmented

Step #5 – Driver trouble-shooting (4/6)

- The “**STMicroelectronics ST-Link dongle**” should be listed.

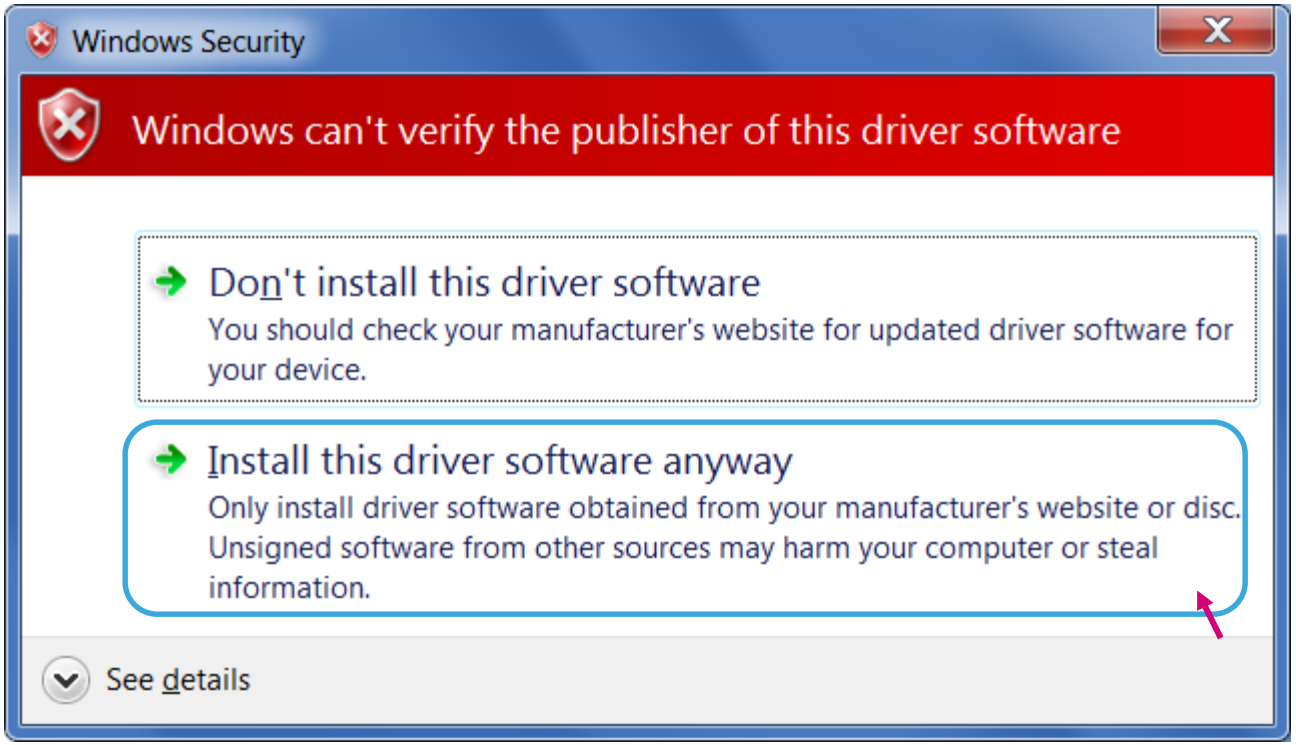
7. Click “Next”.



Step #5 – Driver trouble-shooting (5/6)

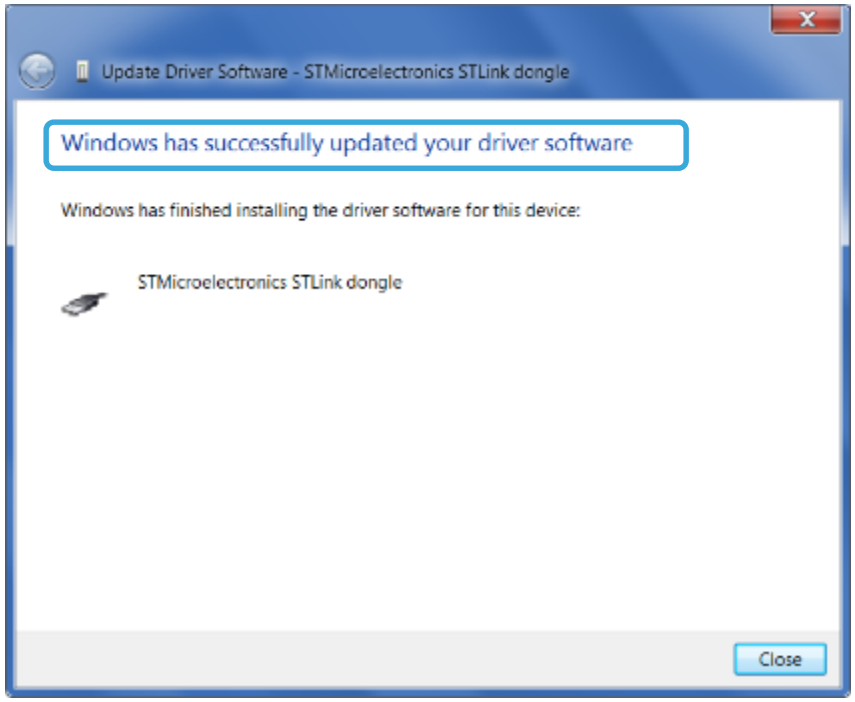
- A warning message may appear.

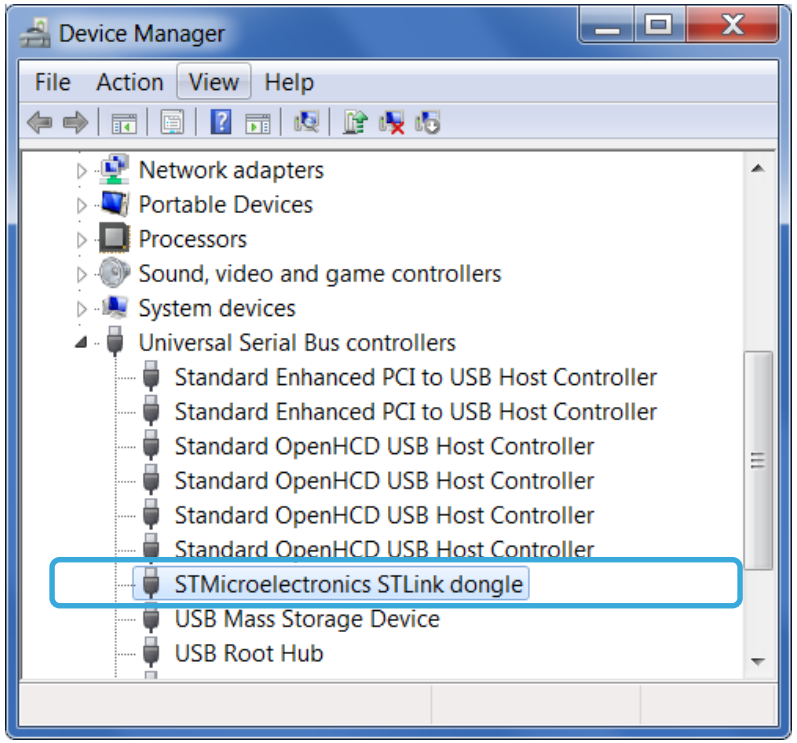
8. Select "**Install this driver software anyway**".



Step #5 – Driver trouble-shooting (6/6)

- You should receive a message: “**Windows has successfully updated your driver software**”.

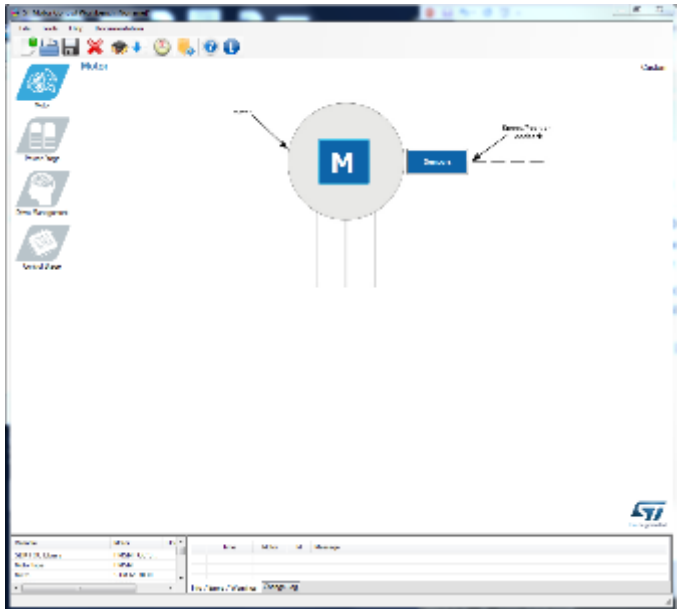


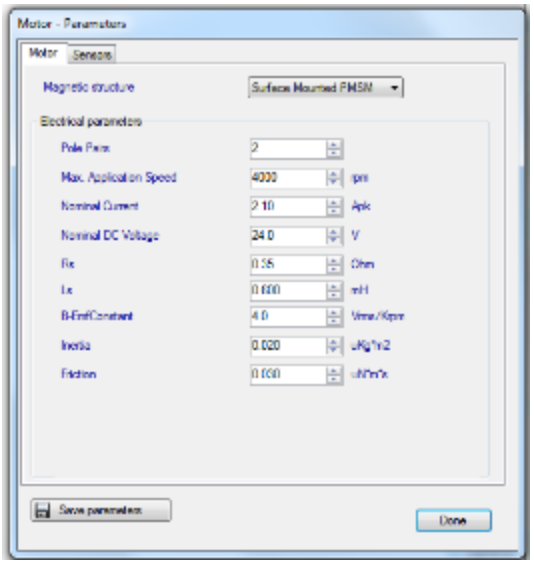


- Re-check Device Manager to ensure “**STMicroelectronics STLink dongle**” is functioning normally.

Step #6 – Set up motor parameters

- ST MC Workbench – Motor section contains:
  - Motor parameters
  - Motor sensor parameters
- In this hands-on session, we will configure the system for sensor-less control using a motor with a surface-mounted magnet.
- For a custom project, the user can set all the parameters individually.

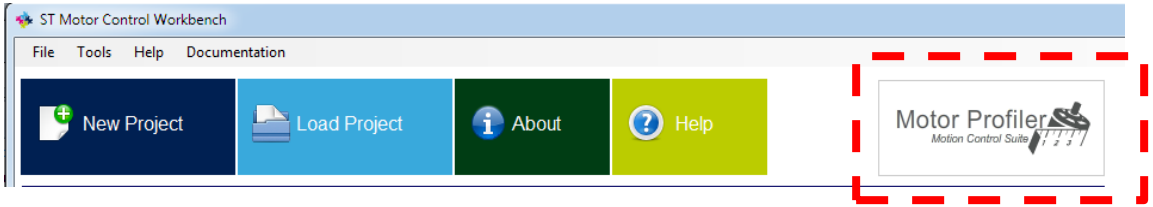




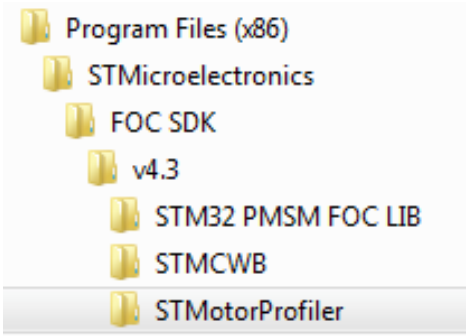
Step #6 – Set up motor parameters

- If motor parameters are unknown (or the instrumentation to measure them is missing), it is possible to use the new ***Motor Profiler*** feature with the supported ST hardware.

- Two ways to open the Motor Profiler:
  - From the Home page of the ST Motor Control Workbench

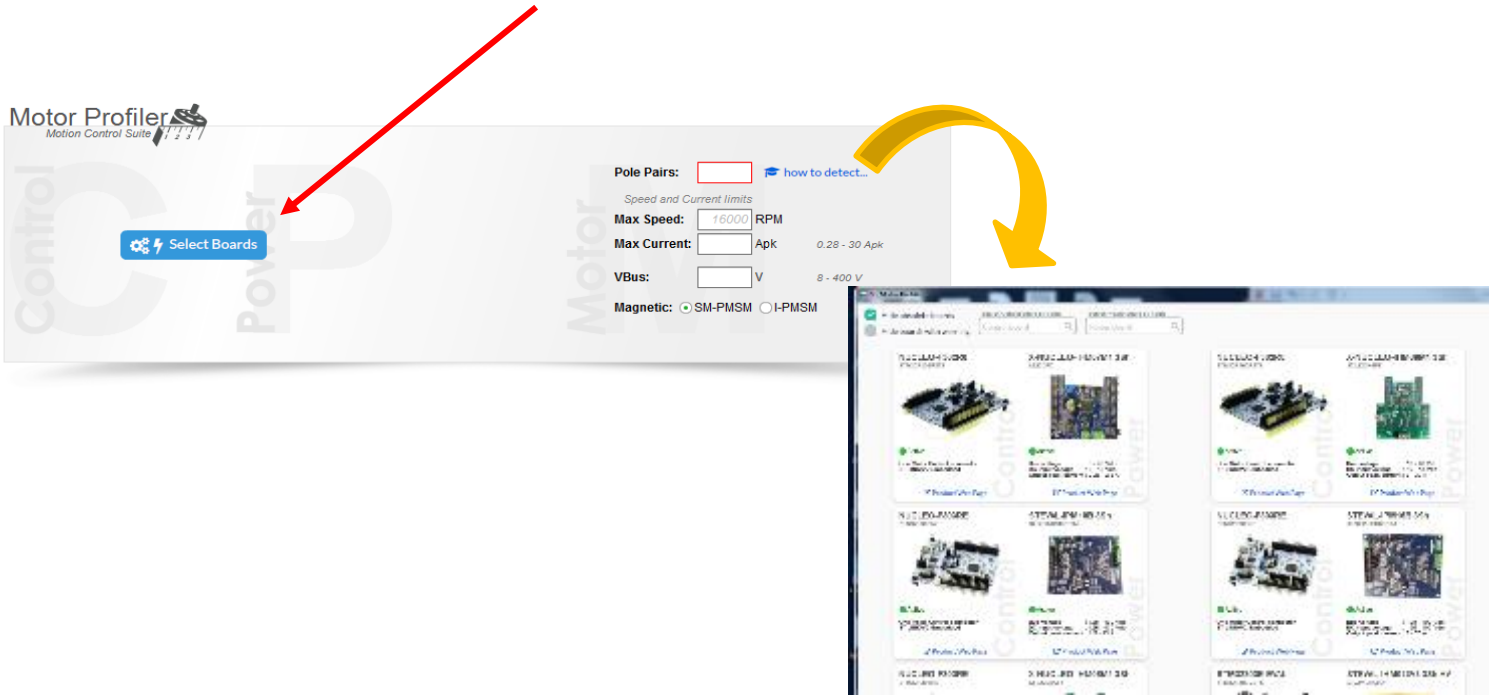


  - From the "STMotorProfiler" installation folder

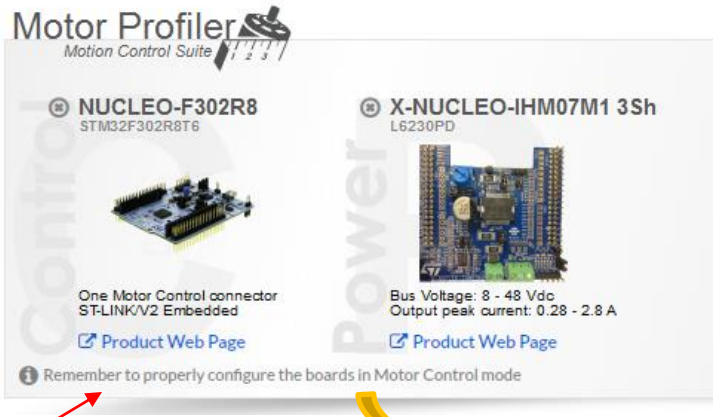


Step #6 – Set up the Motor Profiler

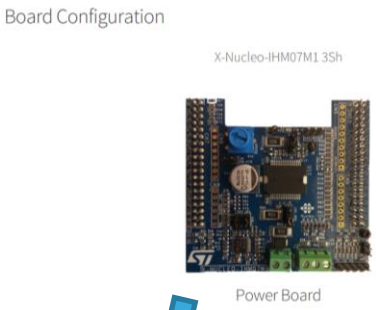
- Click “Select Boards” to display a list of supported boards. The Motor Profiler feature can be used only in the systems listed.

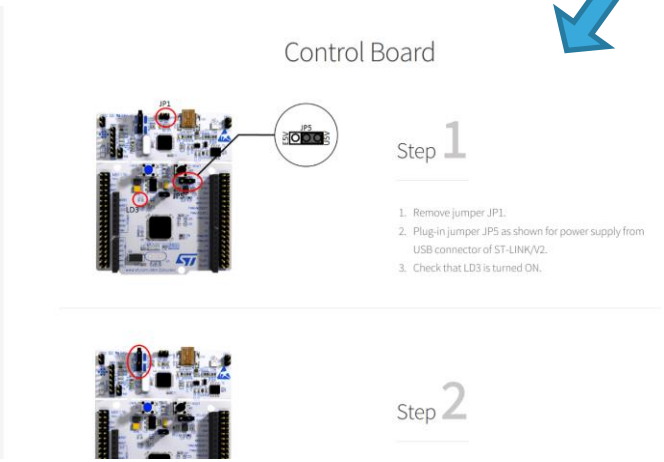


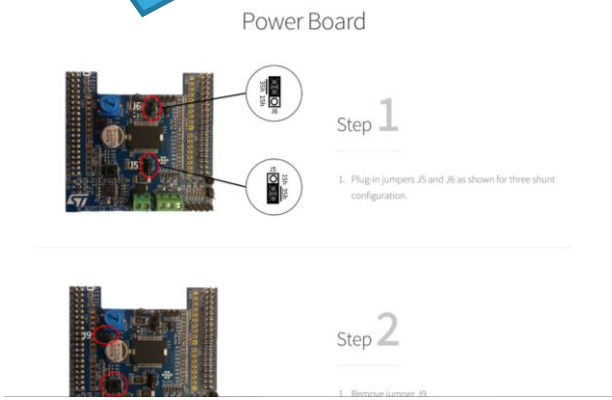
Board Configuration in Motor Control Mode Example



Open Board configuration window







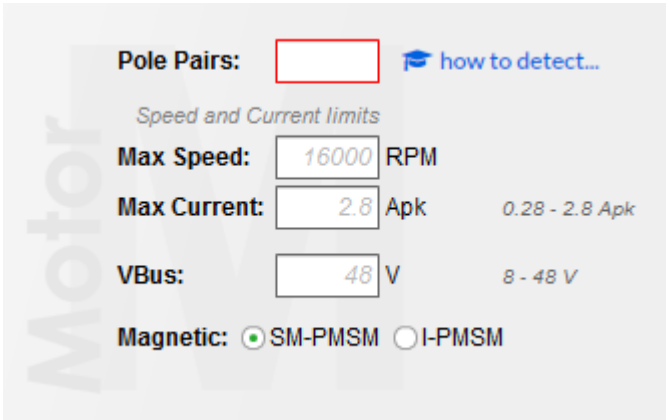
life.augmented

Step #6 – Set up the Motor Profiler

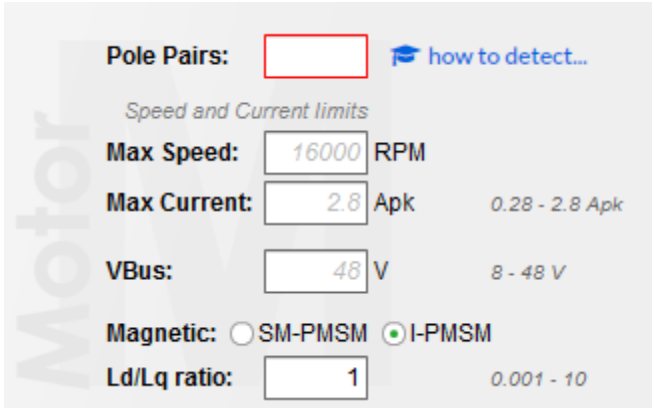
Parameters set by the user:

- Motor pole pairs (mandatory)
- Maximum application speed
- Maximum peak current
  - The maximum peak current delivered to the motor
- Expected bus voltage provided to the system.
- Type of motor
  - Surface-mounted permanent magnet synchronous motor (SM-PMSM)
  - Internal permanent magnet motor (I-PMSM). In this case, the Ld/Lq ratio as input is required.

SM-PMSM



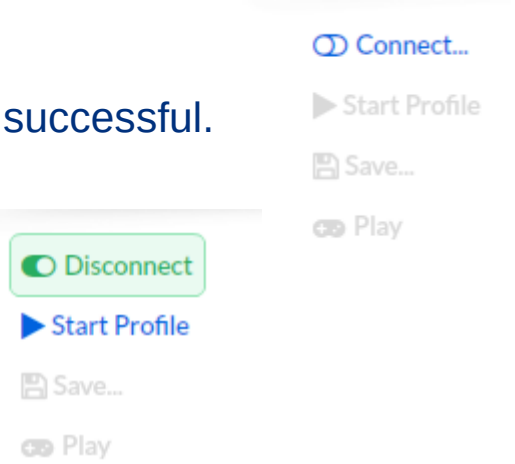
I-PMSM



life.augmented

Step #6 – Set up the Motor Profiler

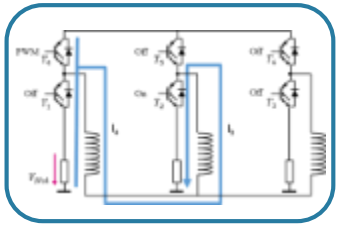
- Connect the selected hardware to the PC.
  - Remember to properly configure the boards in Motor Control mode.
- Click the “Connect” button.
  - If communication with the board is successful.
- Click the “Start Profile” button.



Step #6 – Run the Motor Profiler

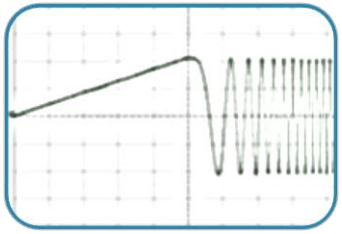
- Procedure will end in about 60 seconds.

Motor stopped
- Rs measurement
- Ls measurement
- Current regulators set-up



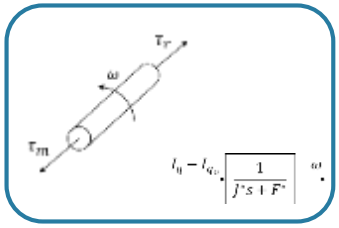
10 sec

Open loop
- Ke measurement
- Sensorless state observer set-up
- Switch over



5 sec

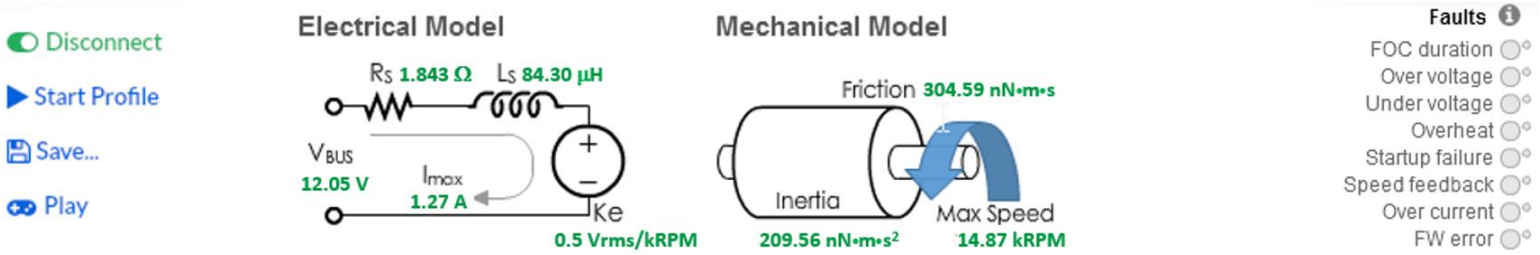
Closed loop
- Friction coefficient measurement
- Moment of inertia measurement
- Speed regulator set-up



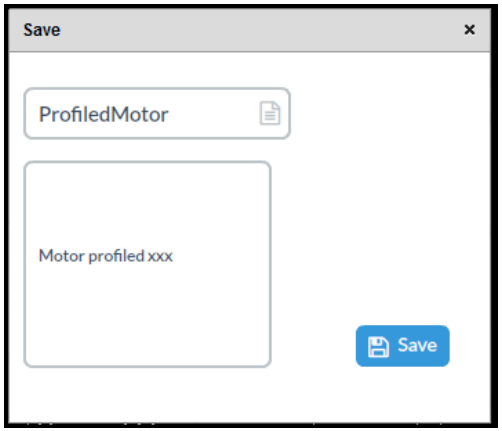
45 sec

Step #6 – Motor Profiler complete

- At the end of the procedure, the measured parameters will be displayed in a dedicated window.



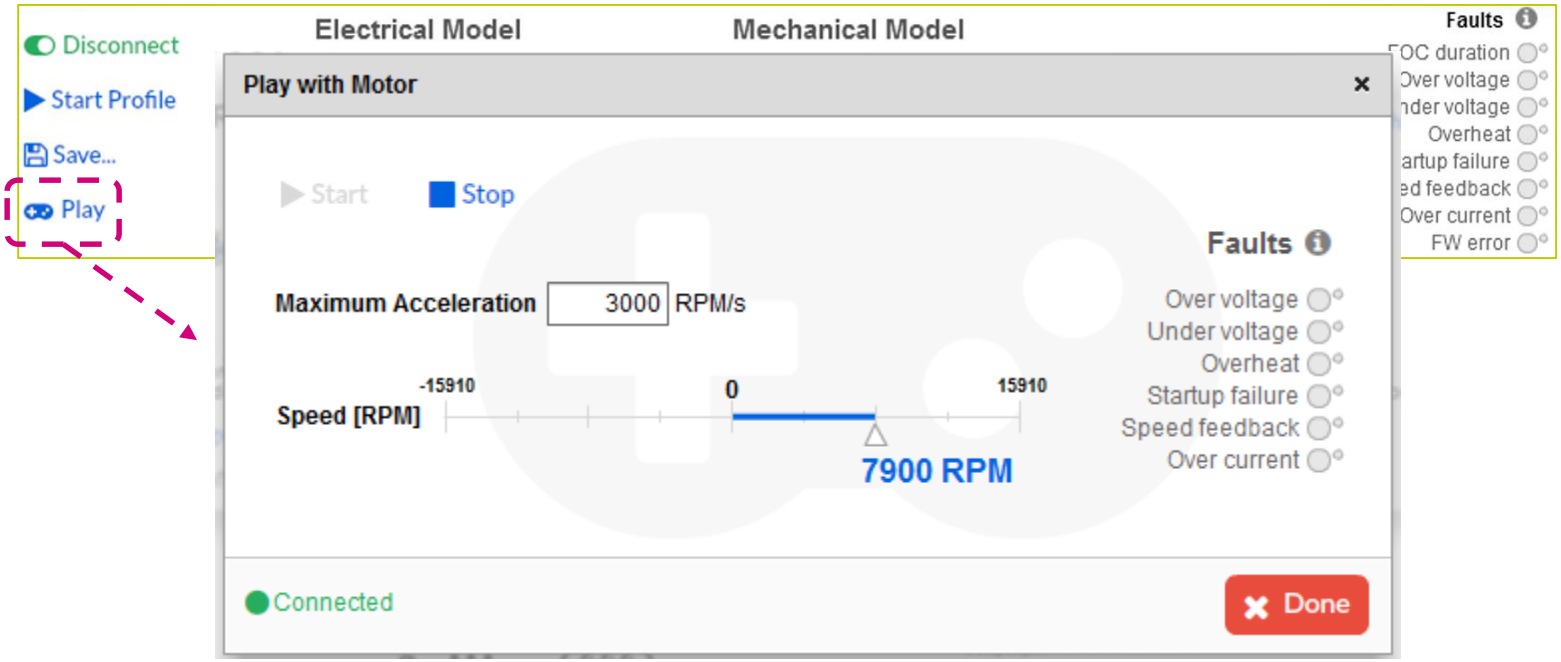
- It is possible to import them into the Workbench project and save them for later use.



Step #6 – Motor Profiler complete

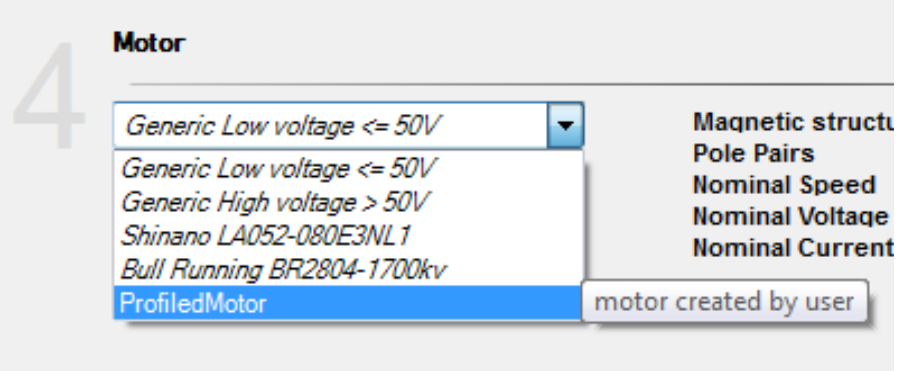
Play Mode

- At the end of the procedure, it is possible to run and control the motor's speed



Step #6 – Motor Identified

- Motor Identified: users can switch the motor on or off using the “Start” and “Stop” buttons.
- It is possible to create a new ST MC Workbench project with the profiled motor by clicking “New Project” in the Motor section.



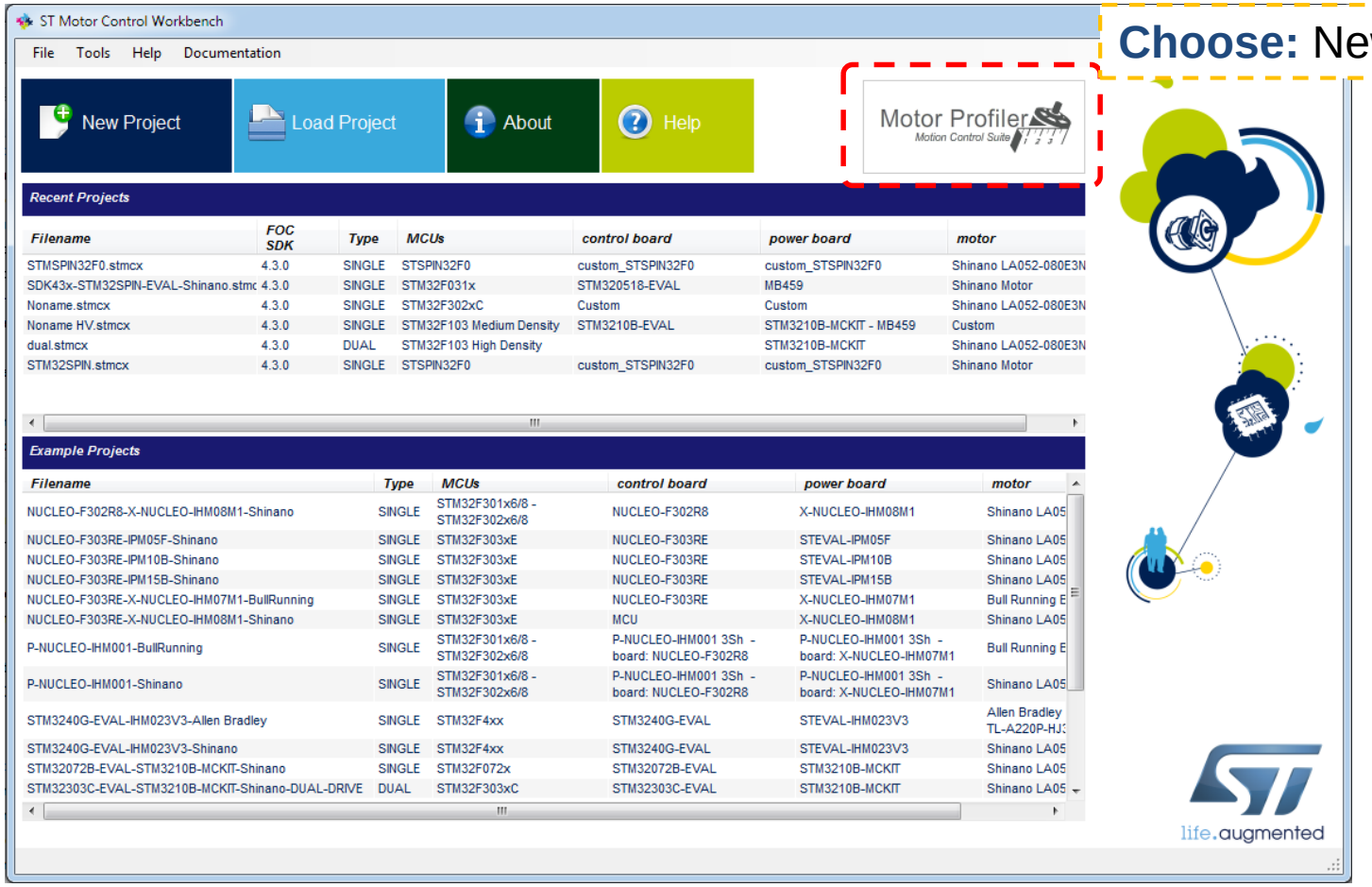
Step #6 – Motor Profiler Disclaimer

- The Motor Profiler algorithm is intended to quickly evaluate the ST 3-phase motor control solution (PMSM)
- The Motor Profiler can be used only when using compatible ST evaluation boards. Choose the best ST hardware according to the motor characteristics.
- The precision of the measurement is not like when using proper instrumentation.
- In certain cases, Motor Profiler measurements may not be reliable. Please see the limits reported in the software tool.

Set up workbench project

Step #7 – Create a new Workbench project based on the ST evaluation board

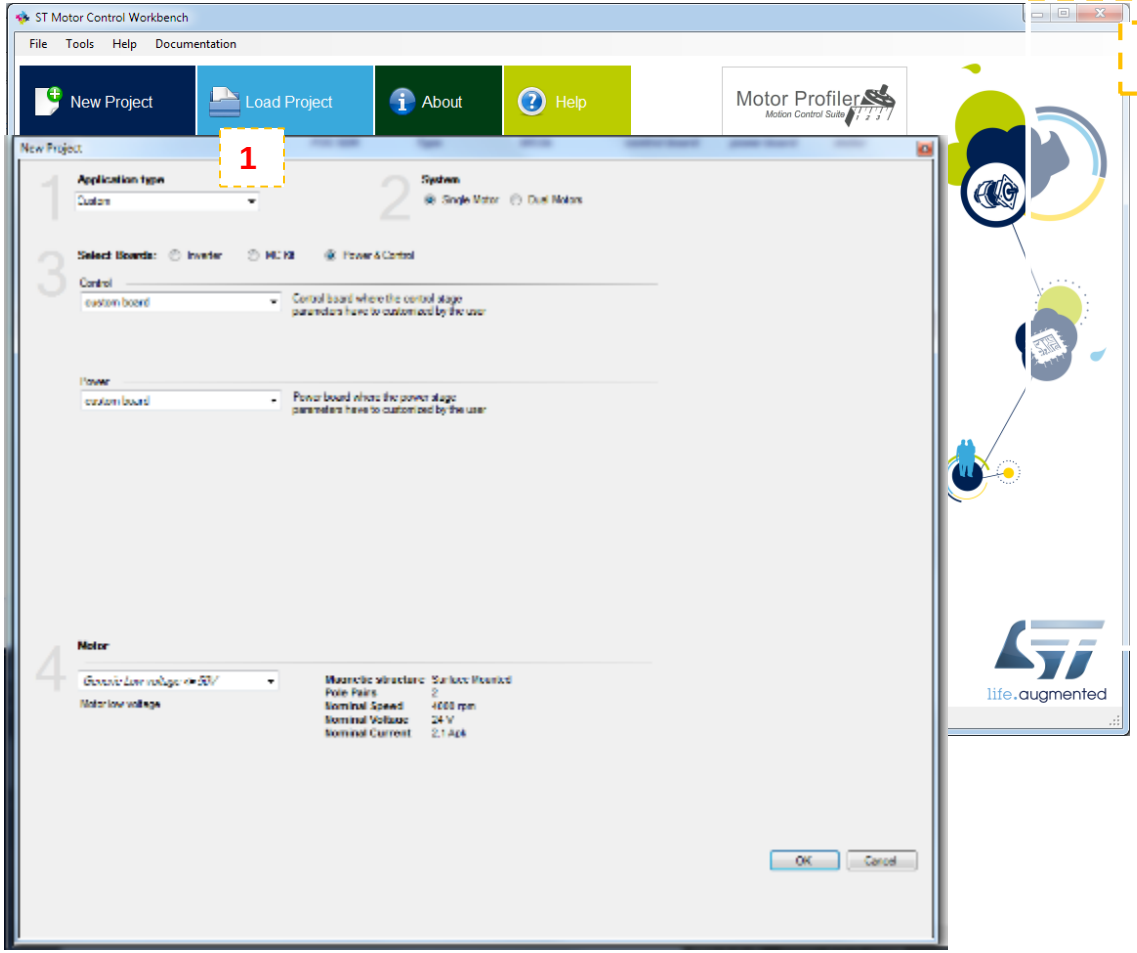
Choose: New Project

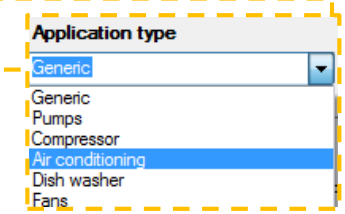


Step #7 – Create a new Workbench project based on the ST evaluation board

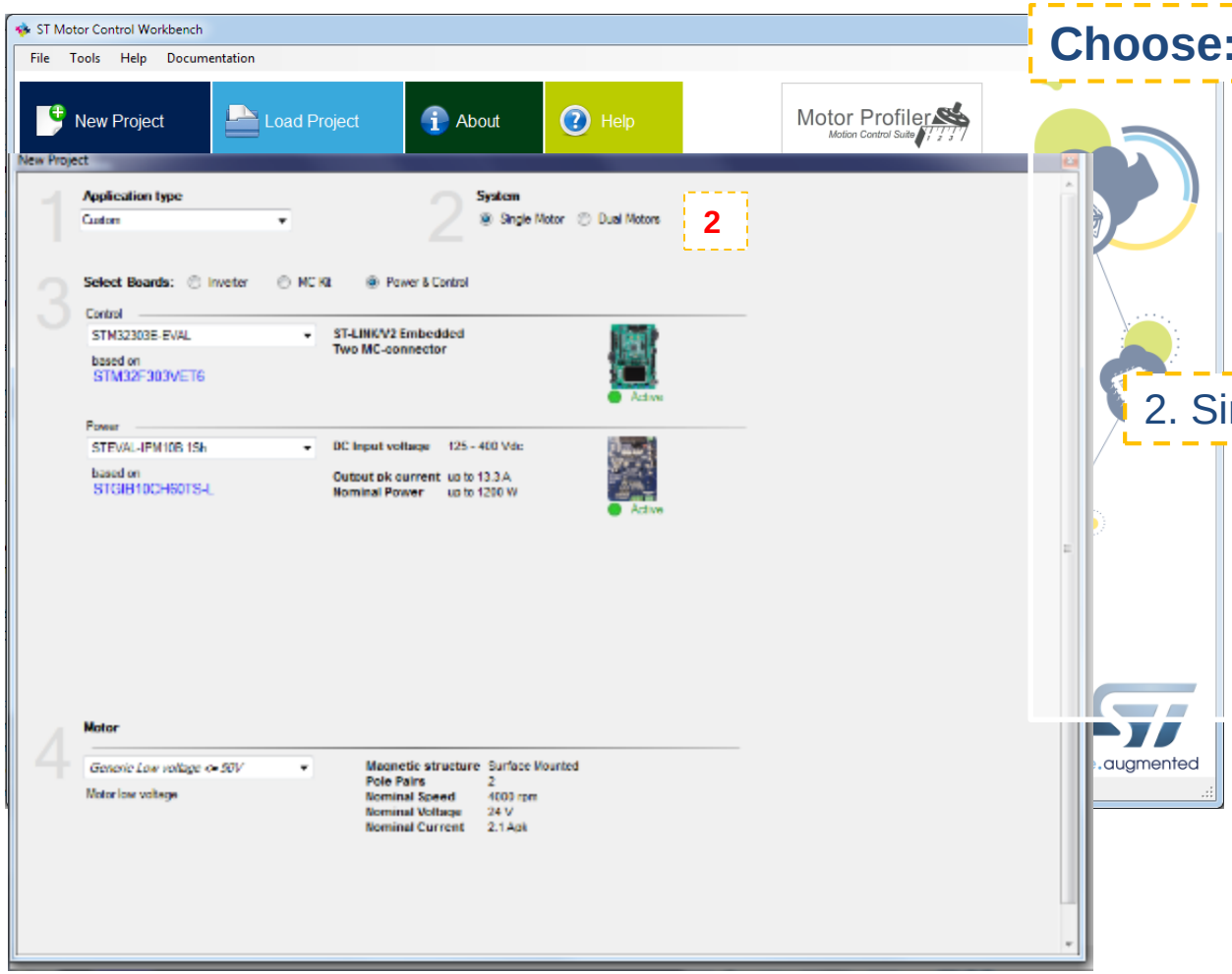
Choose:

1. Applications





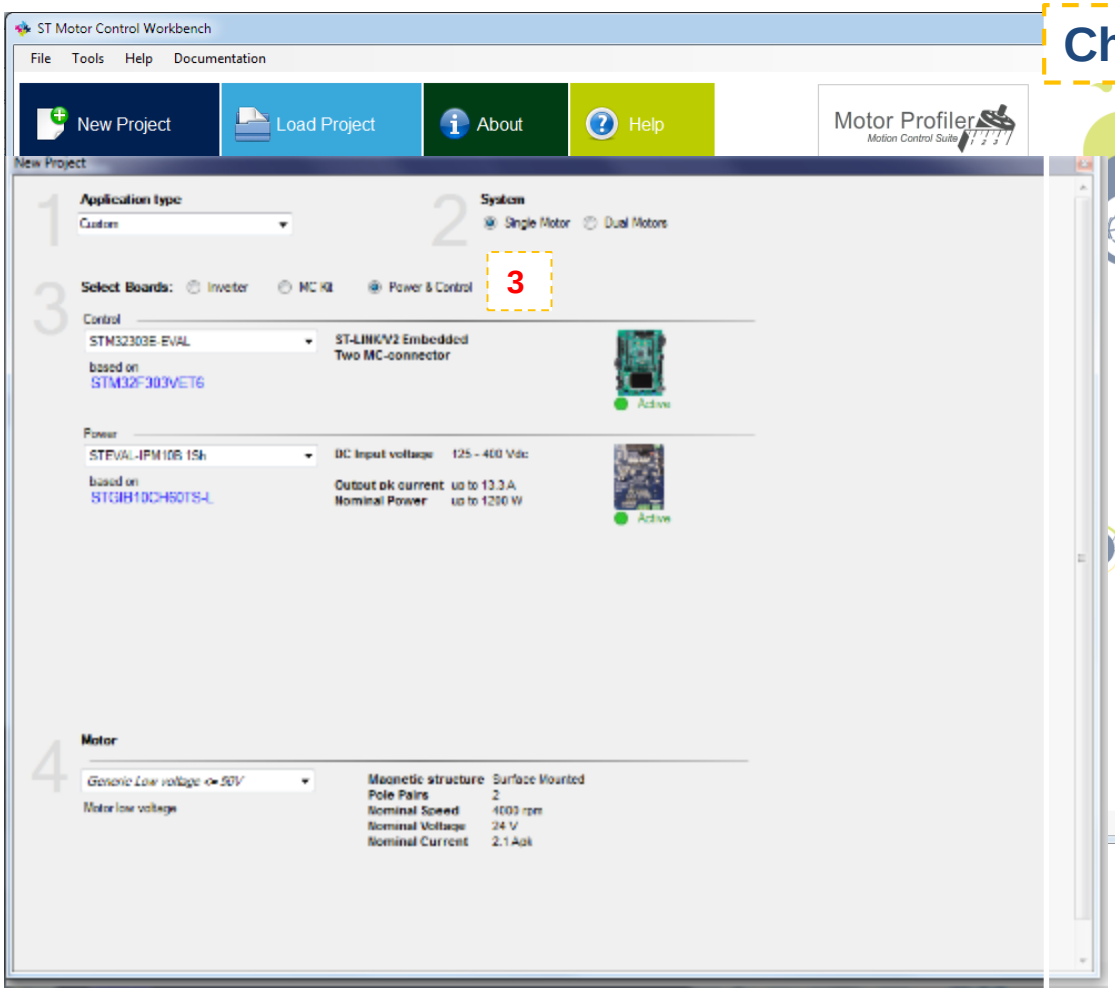
Step #7 – Create a new Workbench project based on the ST evaluation board



Choose:

2. Single or dual motor

Step #7 – Create a new Workbench project based on the ST evaluation board

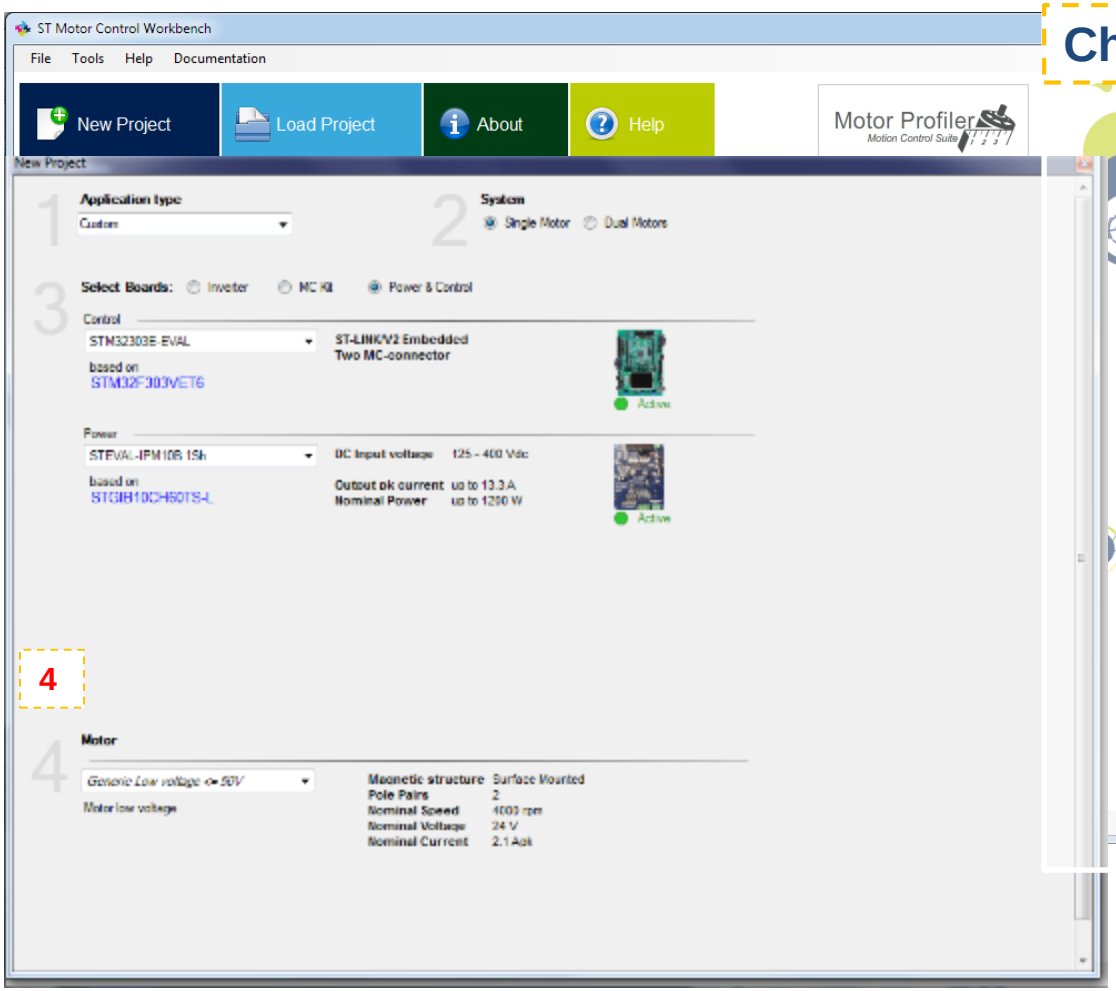


Choose:

3. Board approach:

- Choose if you are using Inverter, MC Kit or Power plus Control boards.
- Select the board used or create your own custom board.

Step #7 – Create a new Workbench project based on the ST evaluation board

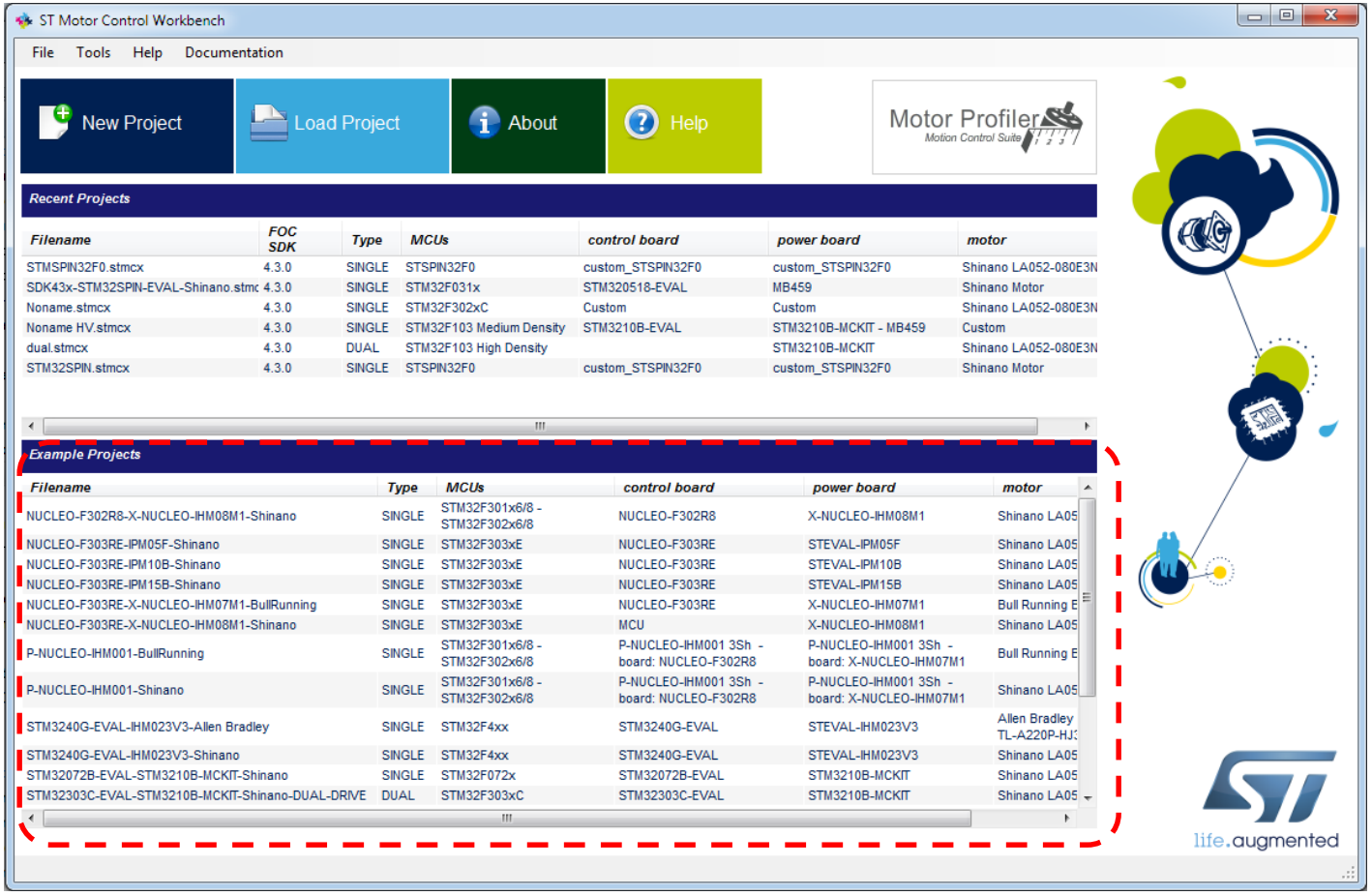


Choose:

4. Motor:
Choose the motor from a motor database. (You can save your motor parameters from your project.)

Step #7 – Create a new Workbench project based on the ST evaluation board

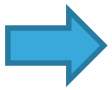
- Choose the example Workbench project that best fits your needs.
  - Choose the one with the same name of the ST evaluation board you are using, or
  - choose the one with the same microcontroller you are using.

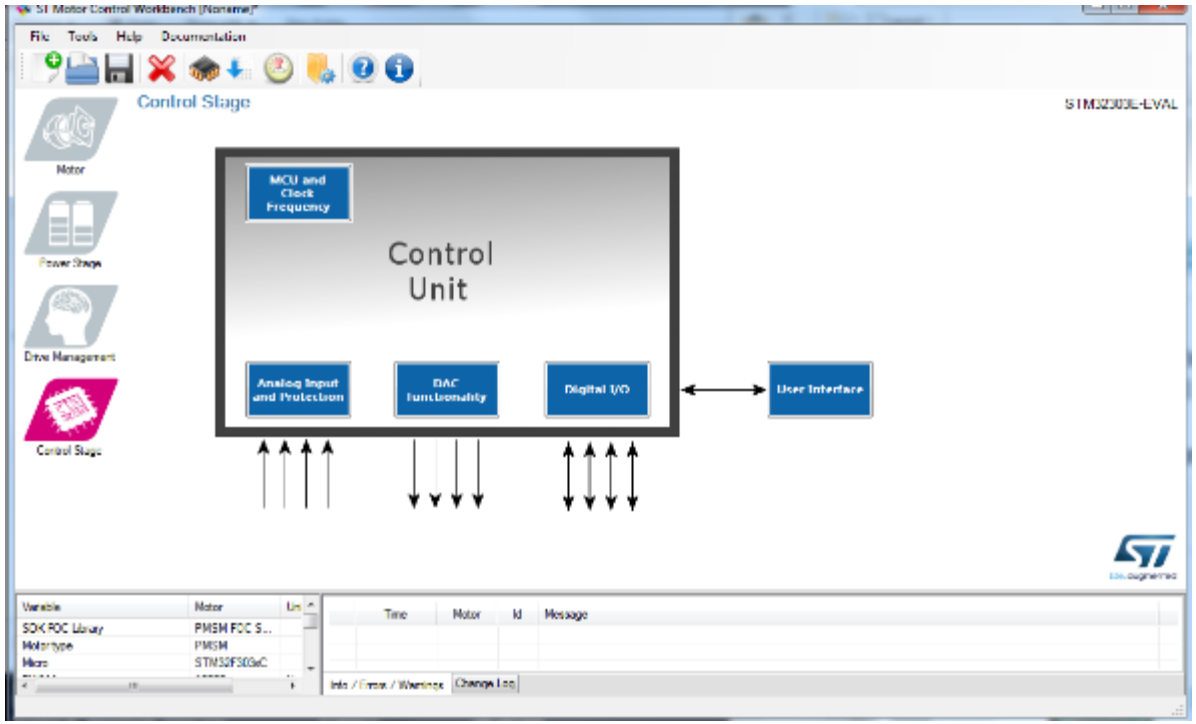


Step #7 – Create a new Workbench project

- Starting from the board selection or example project, the control stage parameters will be populated with the correct values.
- For a custom project, the user can set all the parameters.

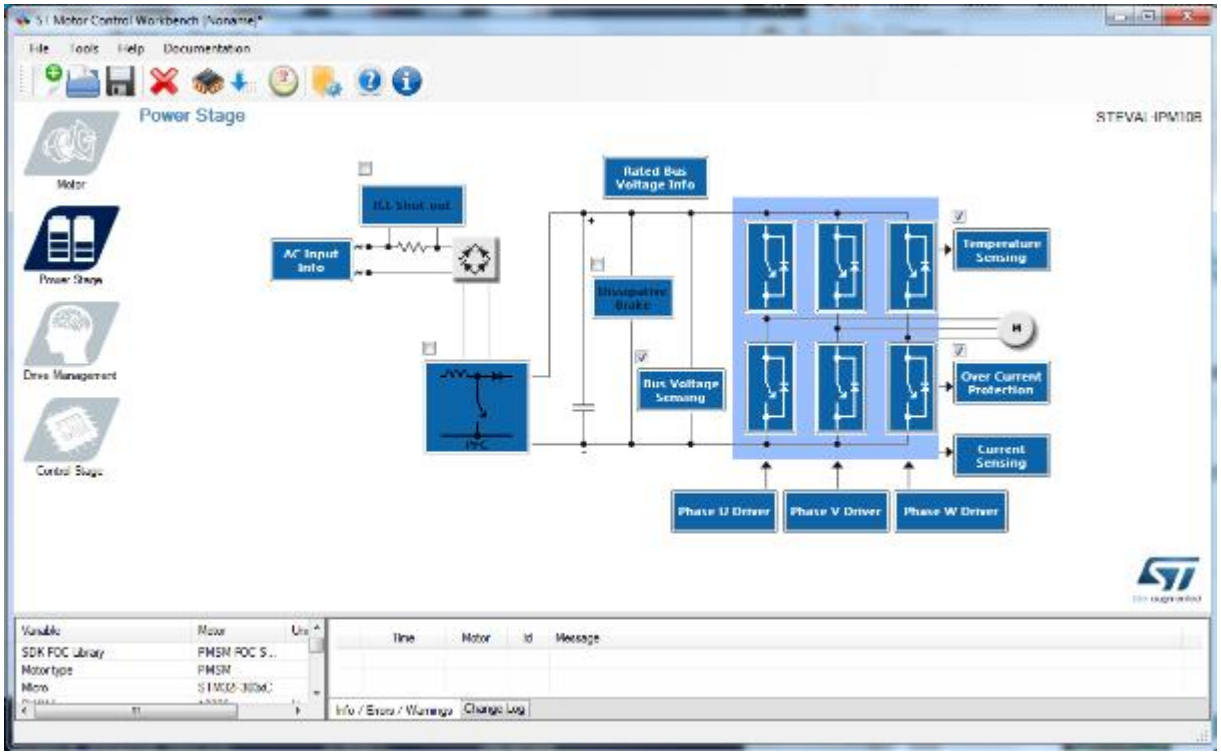
STM32303E-EVAL





Step #7 – Set up power stage

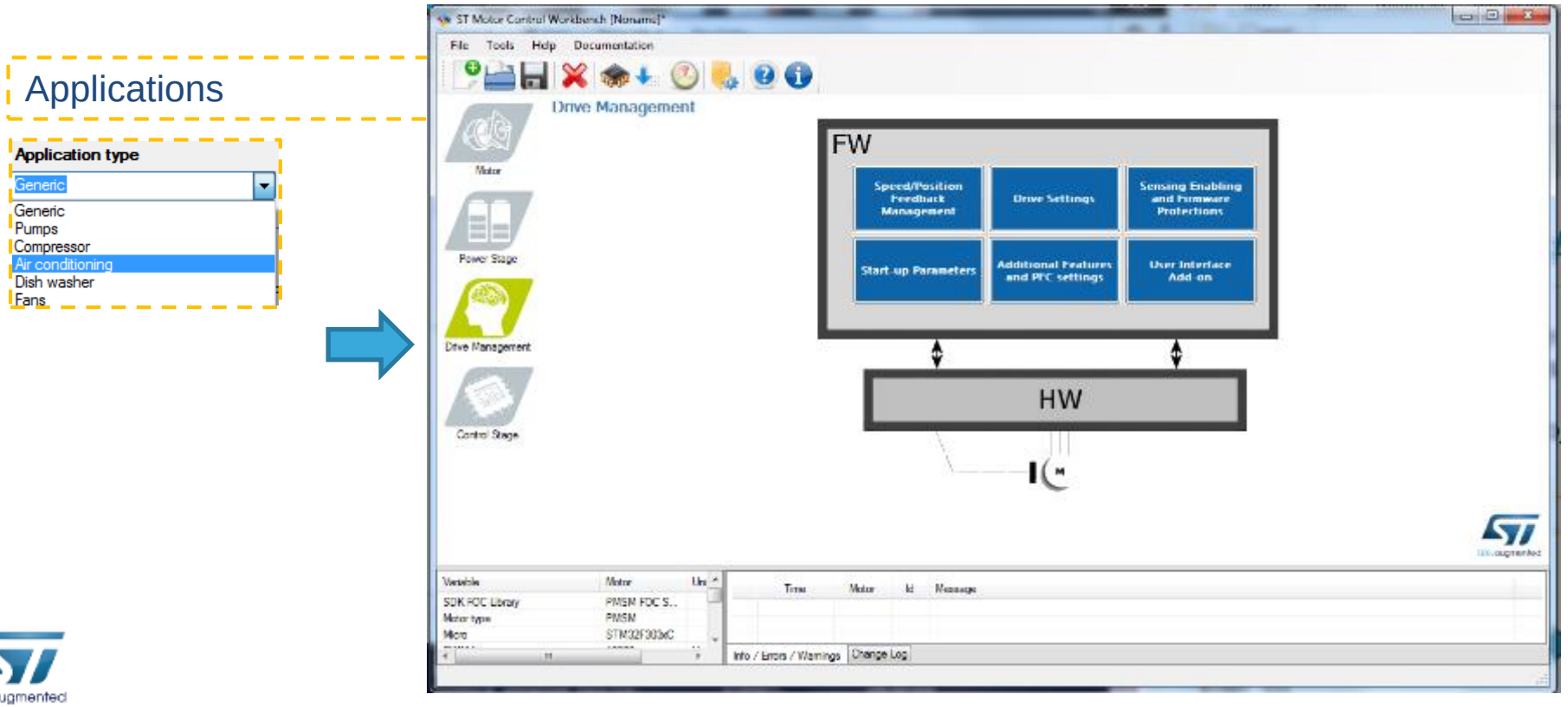
- Starting from the board selection or example project, the power stage parameters will be populated with the correct values.
- For a custom project, the user can set all the parameters.



life.augmented

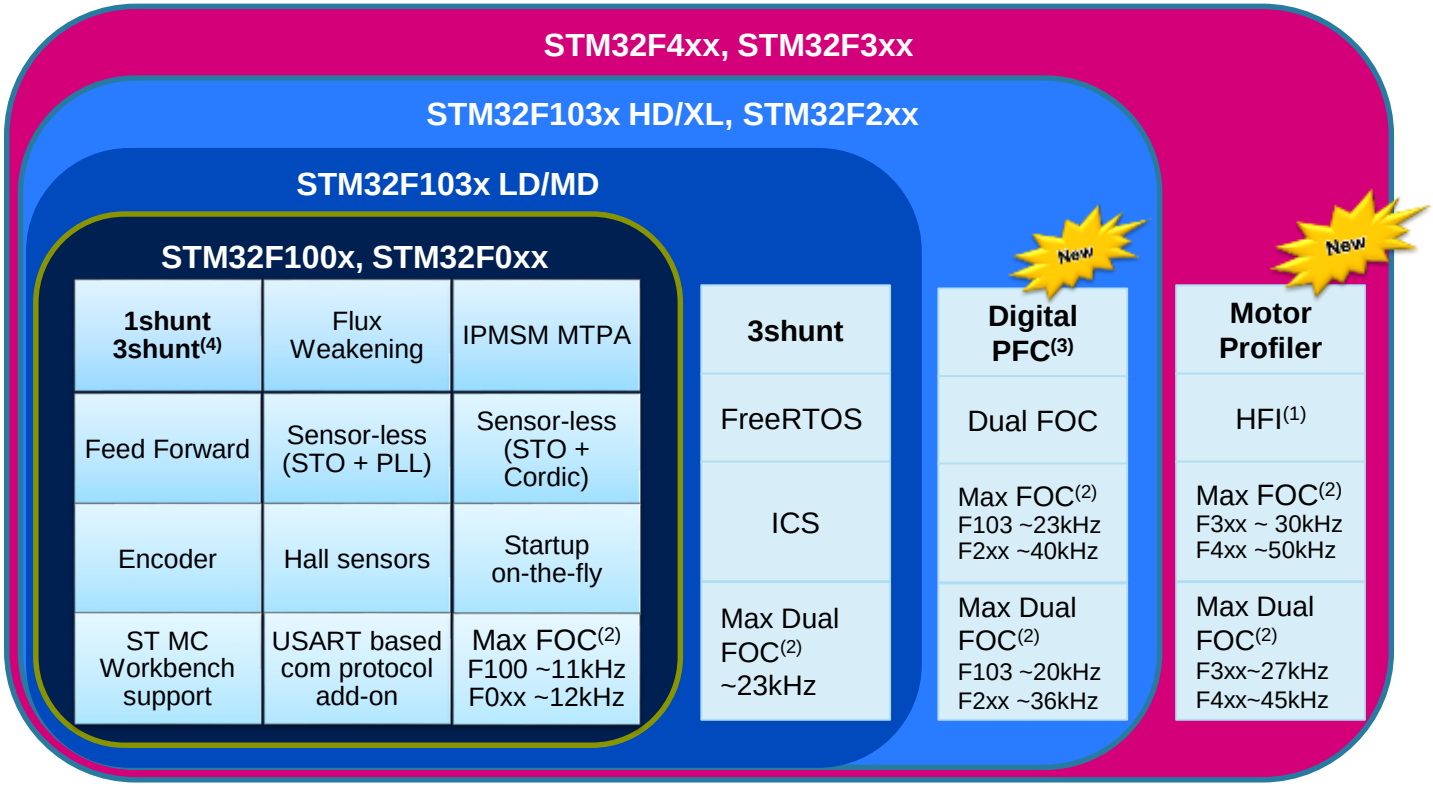
Step #7 – Set up drive parameters

- Starting from the board selection according to the chosen application, drive parameters will be populated with the correct values.
- For a custom project, the user can set all the parameters.



Step #7 – Drive Parameter

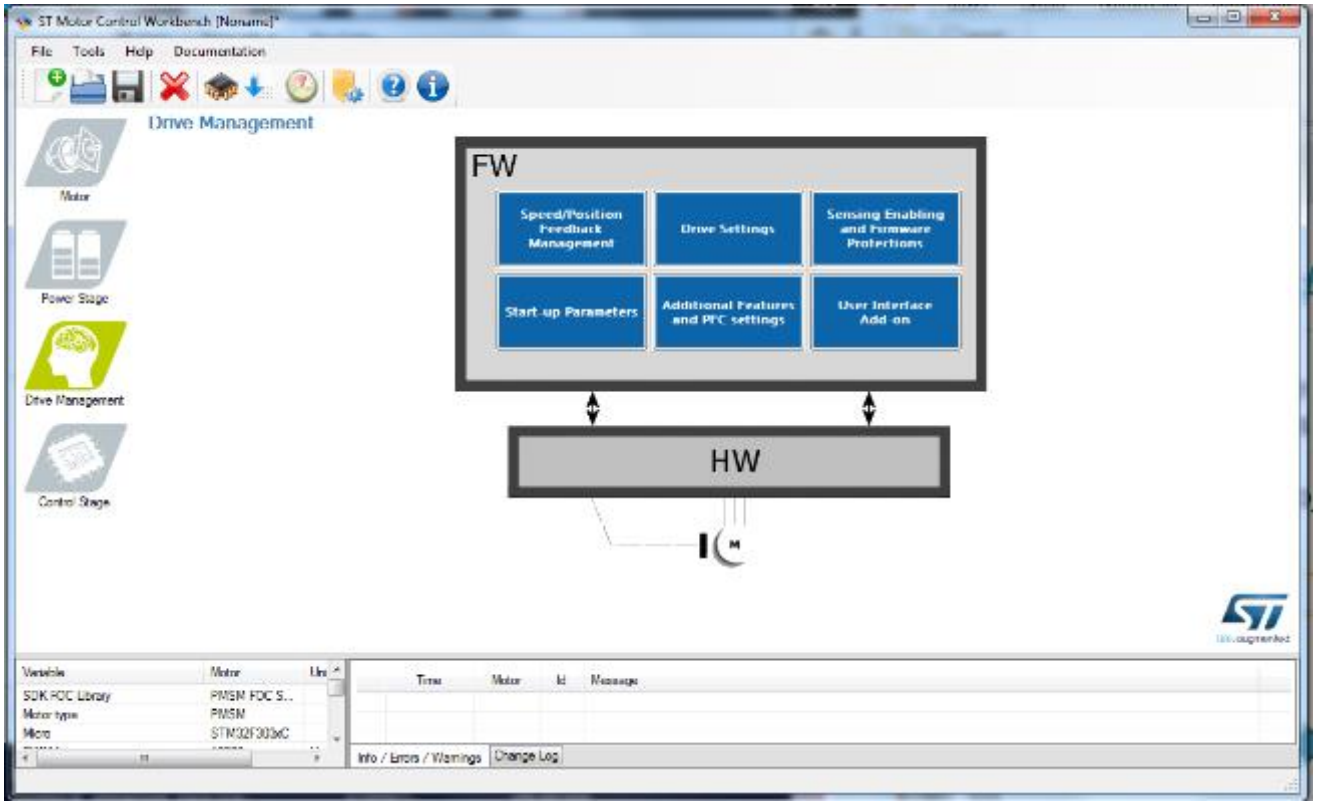
- In Drive settings, choose a correct PWM frequency and torque and flux execution rate in such a way that the $FOC\ rate = \frac{PWM\ freq}{Execution\ rate}$ is compatible with the maximum FOC rate according to the microcontroller used.



(1) High Frequency Injection
(2) Max FOC estimated in sensorless mode
(3) STM32F103xC/D/E/F/G and STM32F303xB/C
(4) No for STM32F100

Step #7 – Drive parameter tricks

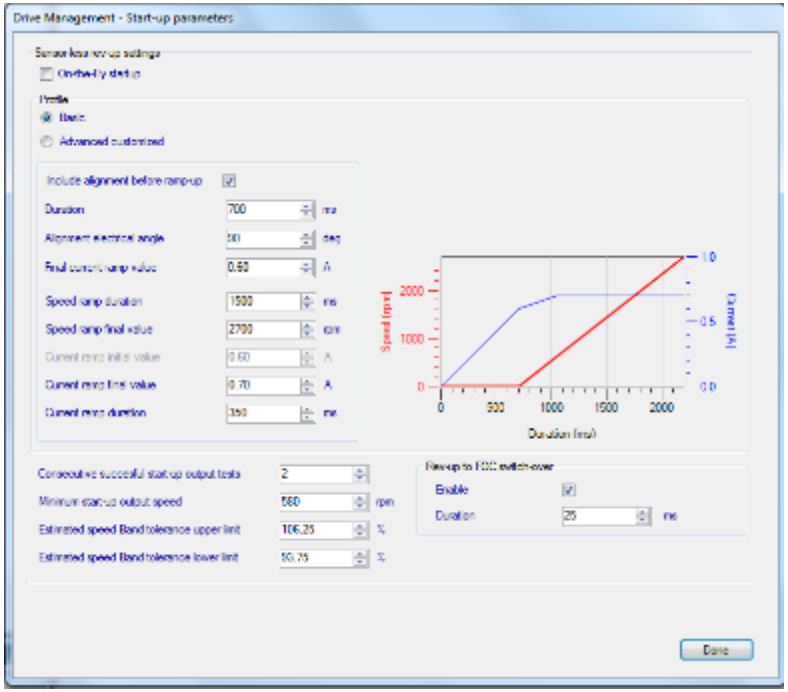
- In Drive settings, decrease cut-off frequency of torque and flux regulator down to 2000 rad/s if power stage → current reading topology is single shunt.
- In Sensing enabling and FW protections, uncheck the sensing options not supported by power stage and check any “Set intervention threshold to power stage xxx” buttons.
- In Drive settings, initially set default target speed to at least 20% of maximum application speed.
- In additional features, start without any additional method (possible to add them later).



Step #7 – Drive parameter tricks

- ***If motor profiler is not used***, in Start-up parameters, select the *basic* profile.
- Set *current ramp initial and final values* equal to the motor nominal current value / 2 (if load is low at low speed, otherwise it can be set up to 0.8-1.0 times the nominal current value).
- Set *speed ramp final value* to approximately 30% of the maximum application speed.
- Depending on the motor inertia, it may be required to increase the *speed ramp duration*.
- Set *minimum start-up output speed* to 15% of the maximum application speed (if required, decrease it later).
- Set *estimated speed band tolerance lower limit* to 93.75%
- Enable the alignment at the beginning of your development (duration 2000 ms, final current ramp value from 0.5 to 1 times the motor nominal current depending on the load)

Basic



Step #7 – Example of configuration Digital PFC

life.augmented

Step #7 – Digital PFC

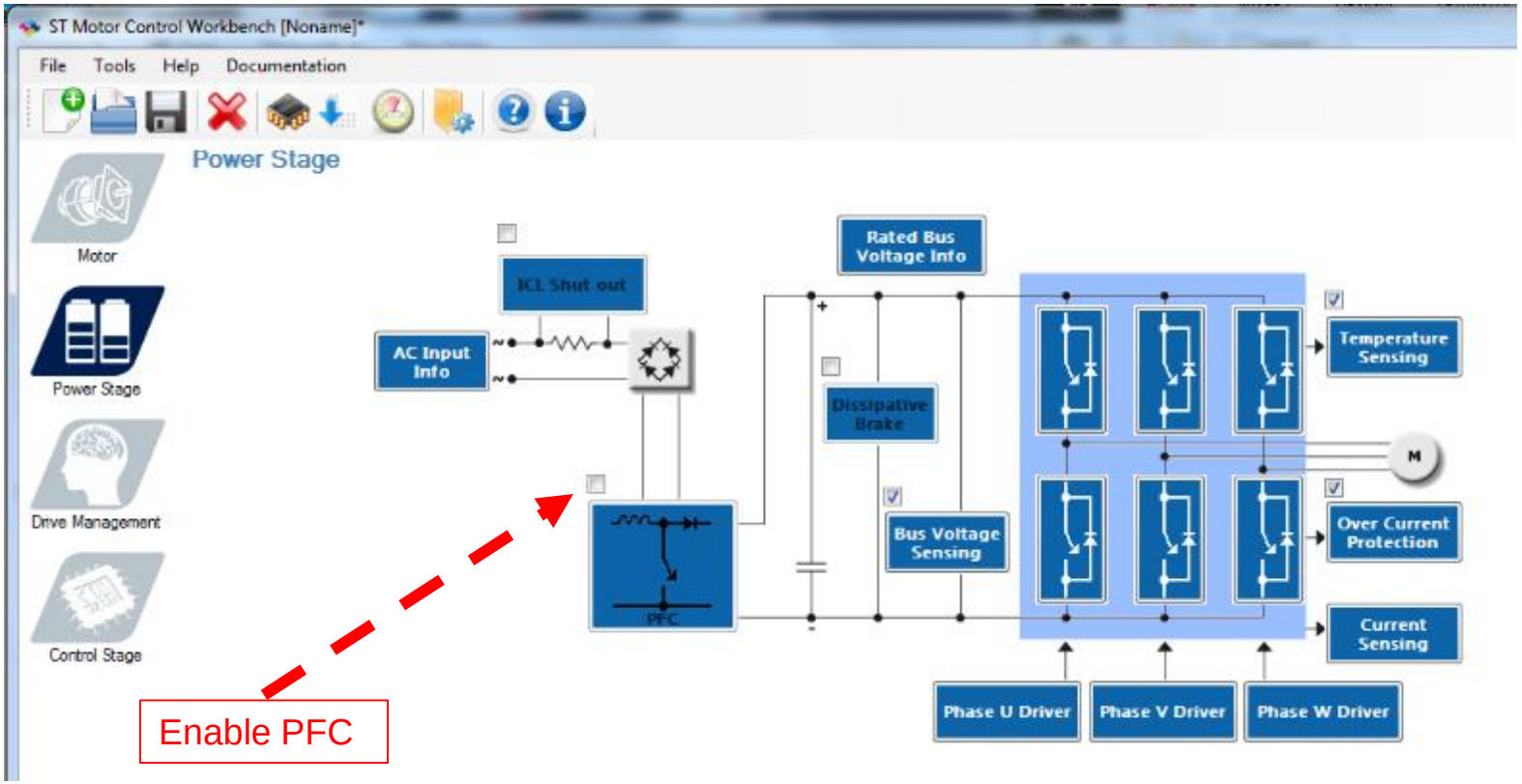
Advantages of implementing active power-factor-correction (PFC) using the same microcontroller which is driving the motor with ST FOC algorithm:

- **Performance optimization** because the microcontroller knows information on the load (for instance the power requested by the motor) and can improve the performance of the PFC
- Cost saving (reduction of components count)

Note. In the library's current version, the digital PFC FW is available for the STM32F103 line (**STM32F103xC, STM32F103xD, STM32F103xE, STM32F103xF** and **STM32F103xG**) or for the STM32F303 line **(STM32F303xB** and **STM32F303xC**).

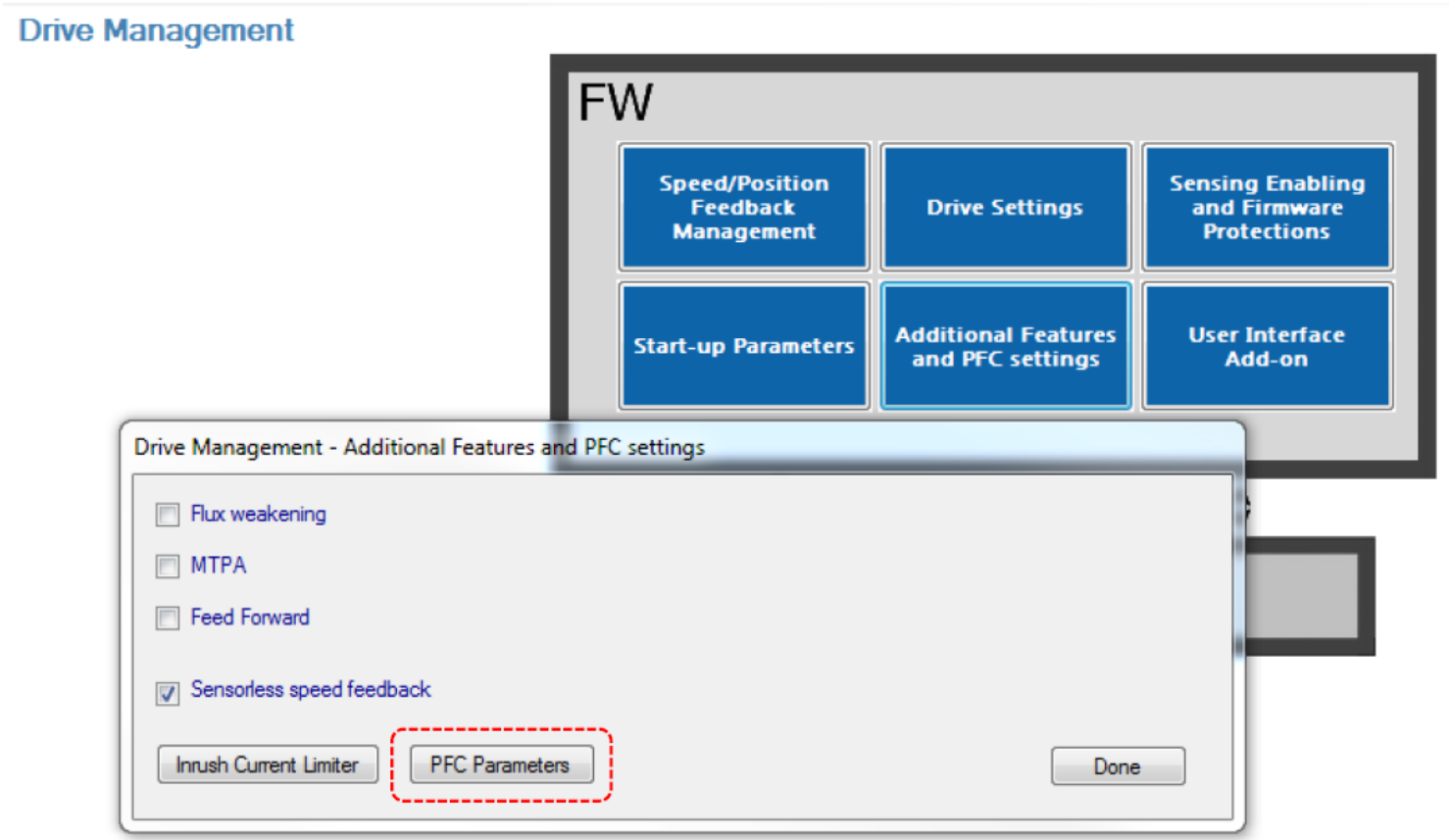
Step #7 – Digital PFC Enabling

- Digital “Power-factor-correction” algorithm working together with the ST motor control FOC firmware is included in the ST MC FOC SDK and can be enabled using the ST MC Workbench



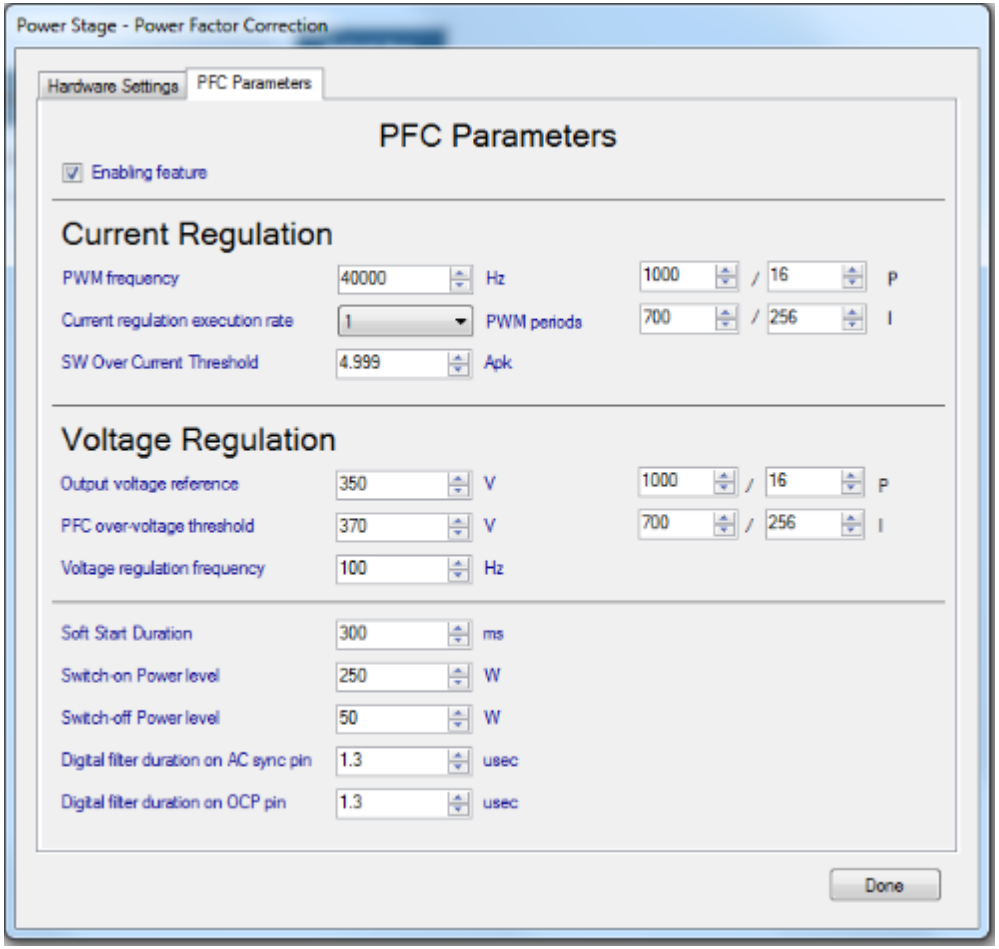
Step #7 – Digital PFC where to set parameters

- To enable the digital PFC, go in the Drive Management -> Additional Features and PFC settings and click PFC Parameters



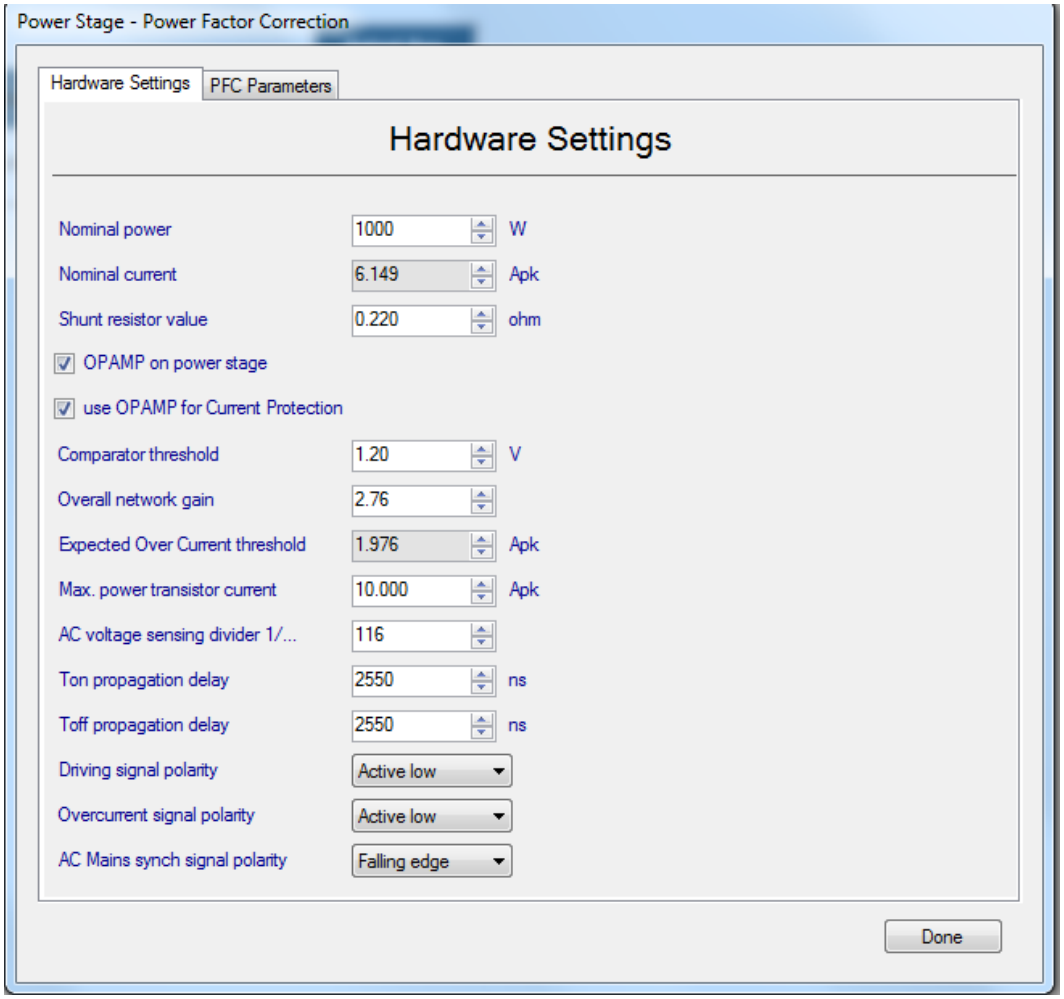
Step #7 – Digital PFC SW settings

- Select “Enabling feature” to enable the PFC in the firmware.



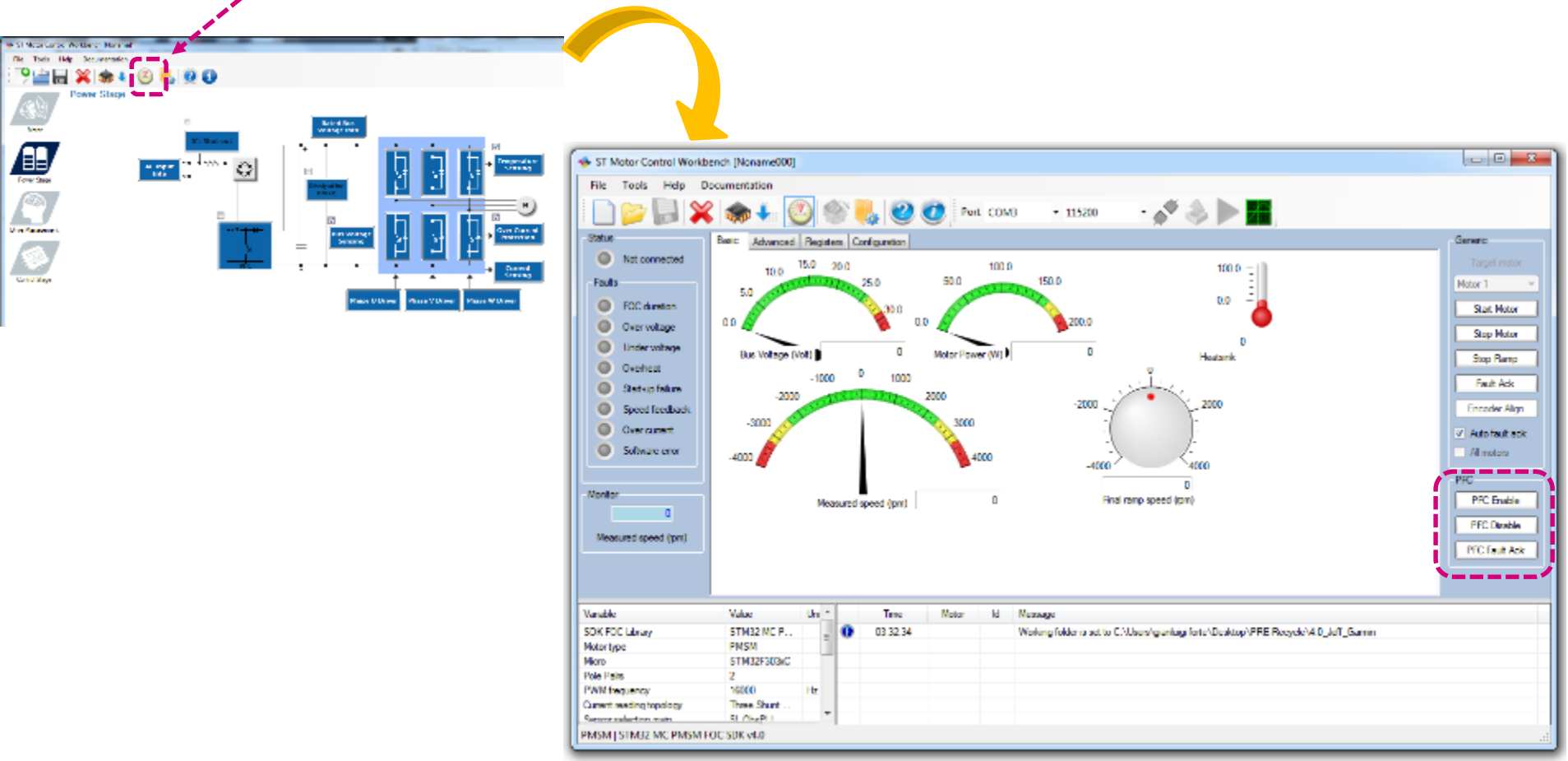
Step #7 – Digital PFC HW settings

Set the Physical hardware parameters according to the selected power stage.



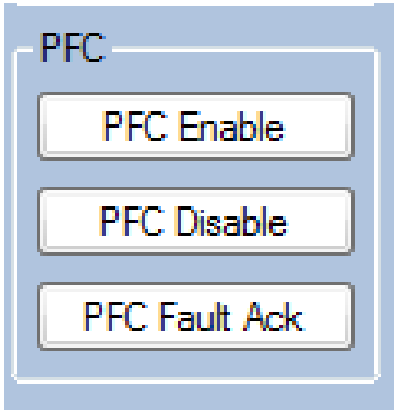
Step #7 – Digital PFC Real Time monitoring

It is possible to enable, disable or make on-the-fly modifications on the PFC variable using the WB monitor feature.



Step #7 - Digital PFC Real-time monitoring

- The PFC section must be enabled.
- To switch off the PFC, click “PFC Disable”.
- Click “PFC Fault Ack” to clear the PFC faults.

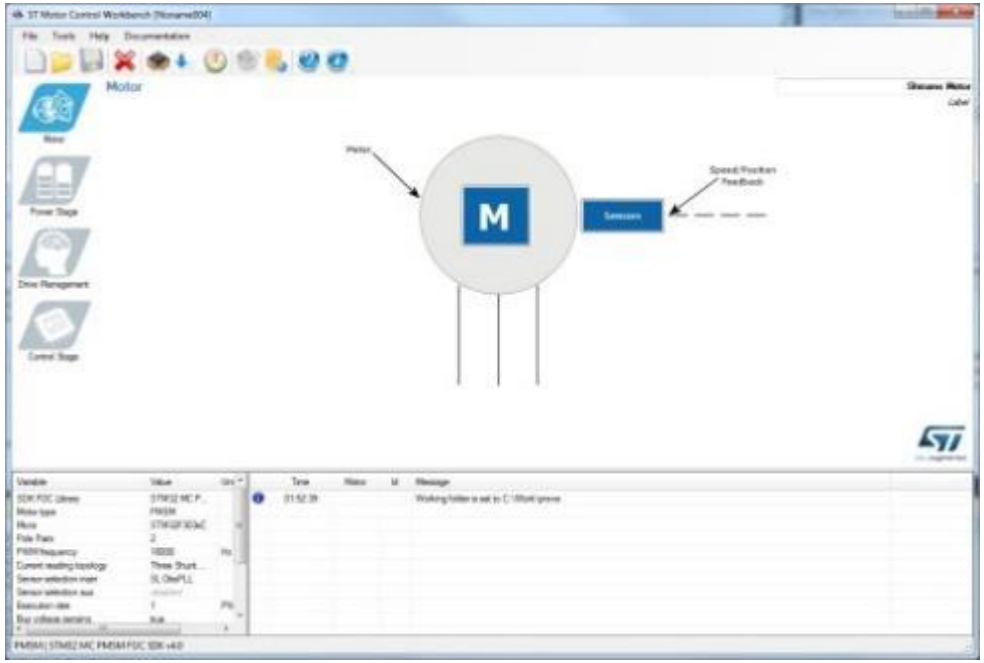


- The PFC status and register can be viewed and/or modified using the direct access in the “Register” tab.

0x4D	PFC Status		0
0x4E	PFC Flags		0
0x4F	PFC DC bus reference	Volt	0
0x50	PFC DC bus measured	Volt	0
0x51	AC Mains frequency	Hz	0
0x52	AC Mains voltage 0-to-pk	Volt	0
0x53	PFC Current loop Kp		0
0x54	PFC Current loop Ki		0
0x55	PFC Current loop Kd		0
0x56	PFC Voltage loop Kp		0
0x57	PFC Voltage loop Ki		0
0x58	PFC Voltage loop Kd		0
0x59	PFC startup duration	ms	0
0x5A	PFC abilitation status		0

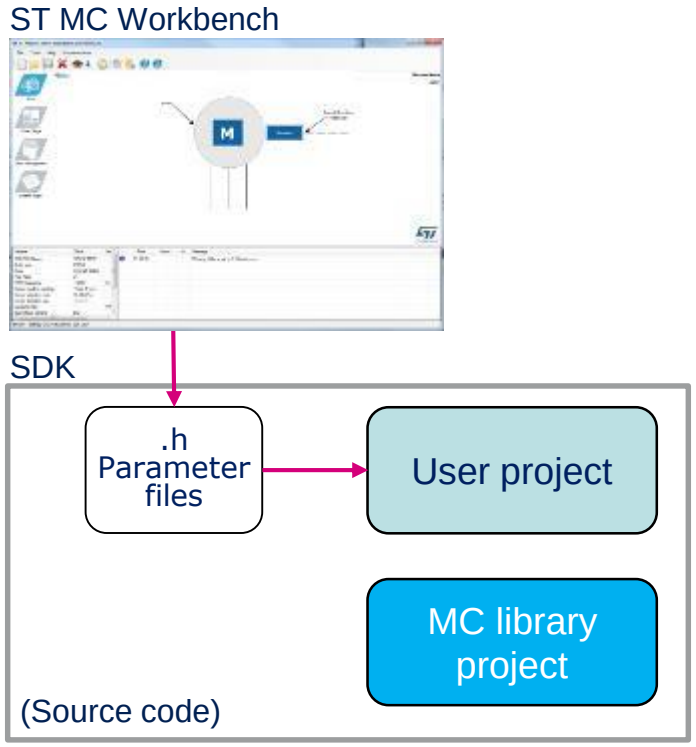
Step #7 Finalizing the firmware 1/5

ST MC Workbench



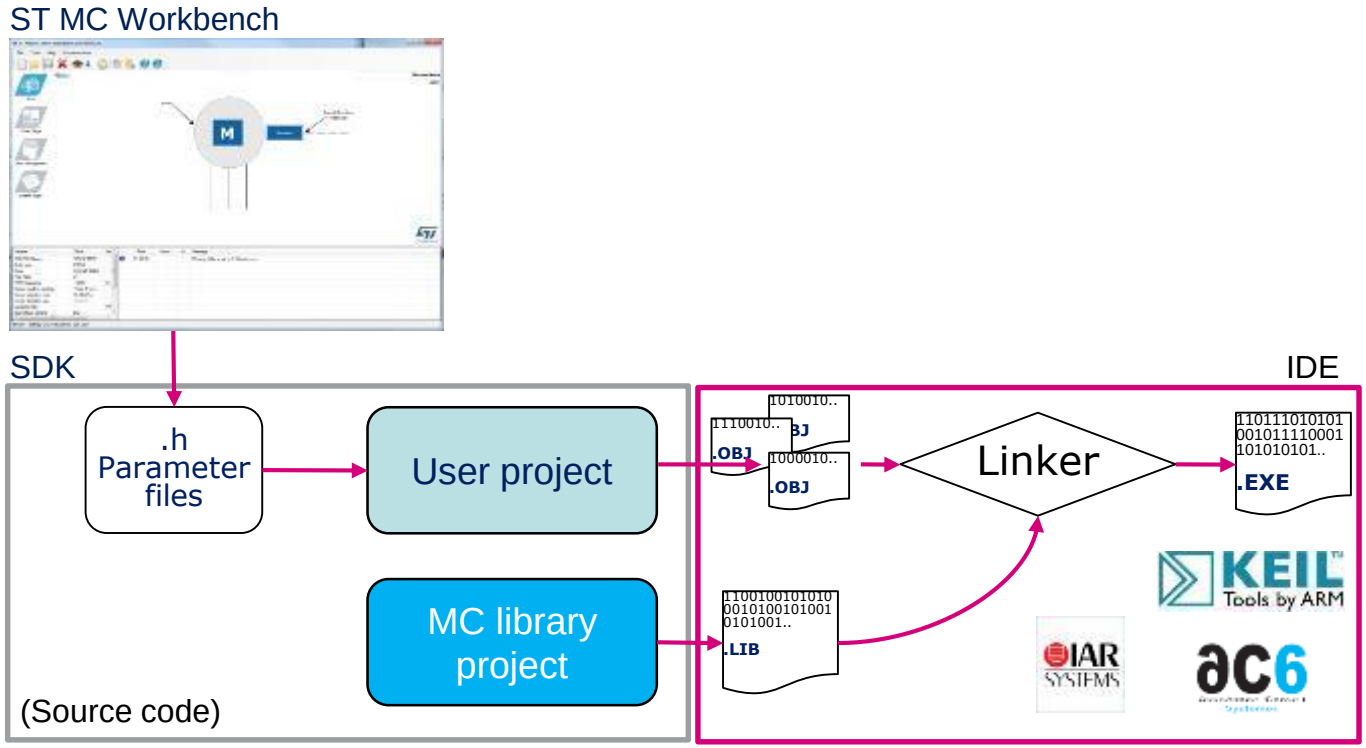
- Open the ST MC Workbench and create a new project.

Step #7 - Finalizing the firmware 2/5



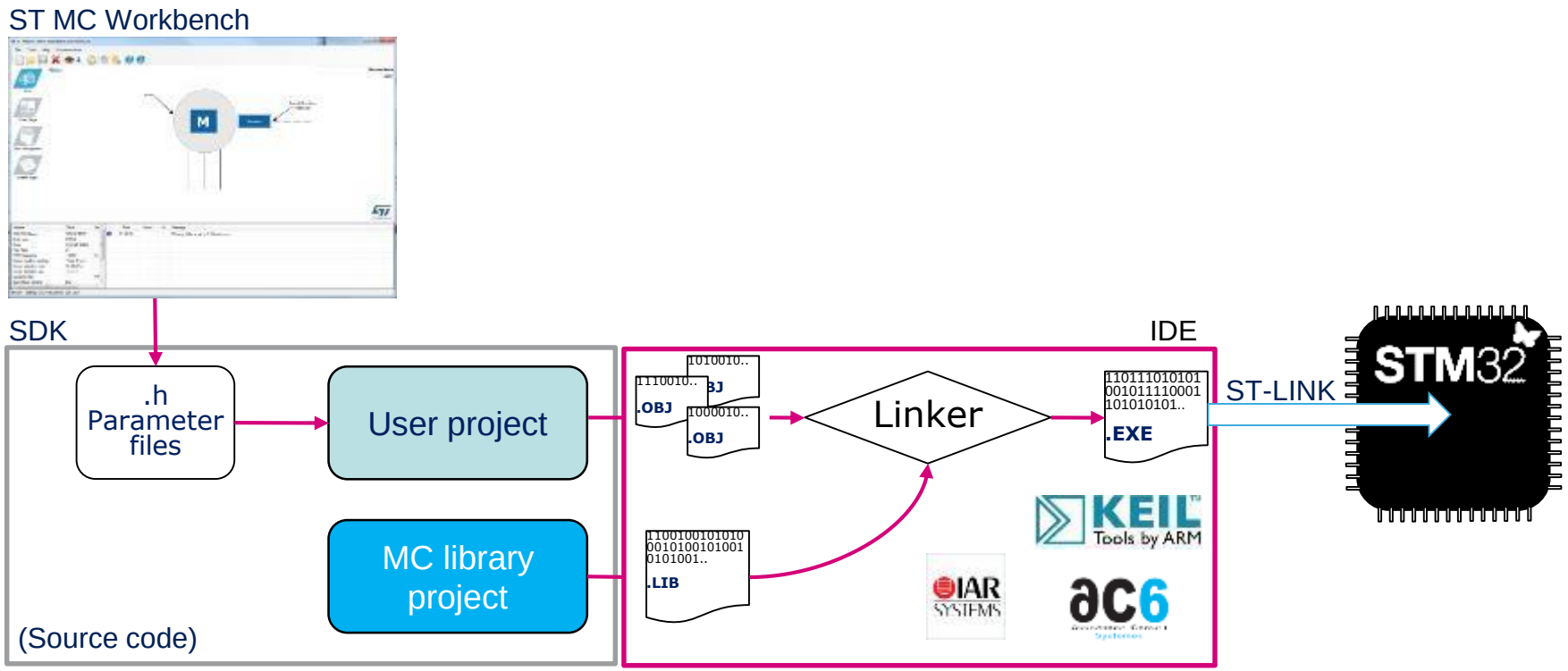
- Generate the configuration (.h) files for the firmware library (see Step #9).

Step #7 - Finalizing the firmware 3/5



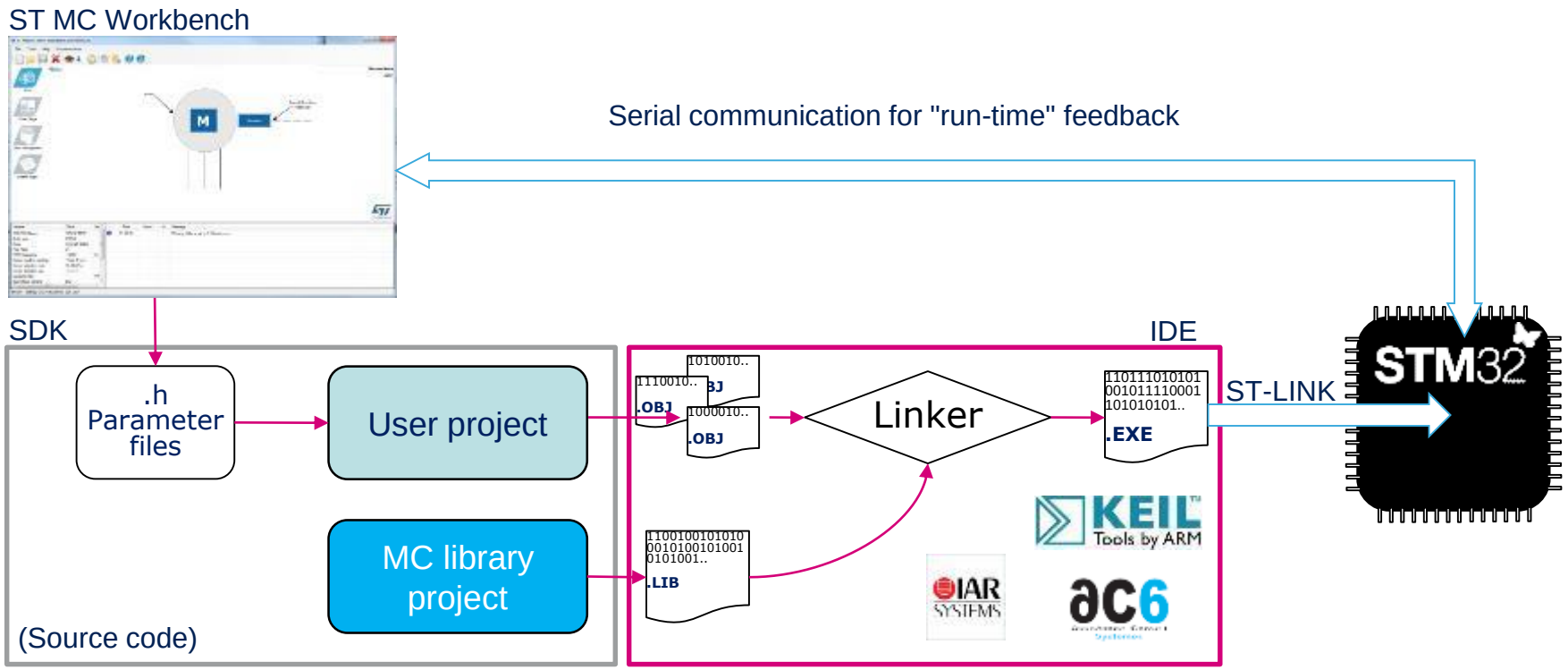
- Compile the firmware library using the available IDE (IAR, Keil and AC6) (see step #10).

Step #7 - Finalizing the firmware 4/5



- Flash the executable into the microcontroller using ST-LINK (see Step #10).

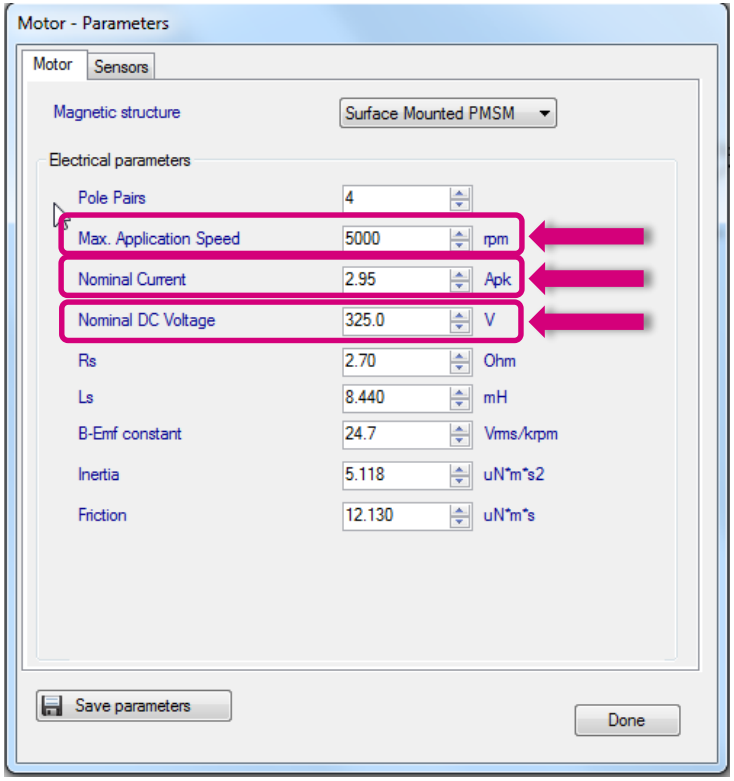
Step #7 - Finalizing the firmware 5/5



- Establish a real-time communication with the firmware using the monitor feature of ST MC Workbench to start the motor, set the speed and get feedback (see Step #12).

Step #8 – Set up motor parameters manually

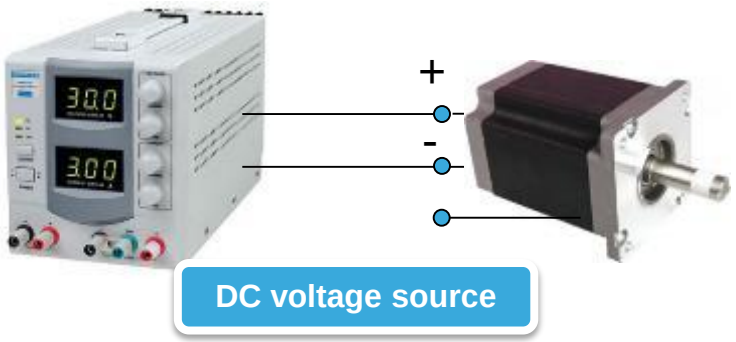
- Set ***Max Rated Speed*** with the maximum motor speed according to the application specs.
- Set ***Nominal Current*** with maximum peak current provided to each of the motor phases according to the motor specs.
- Set ***Nominal DC Voltage*** with value of DC bus provided to the inverter or the rectified value of AC input.

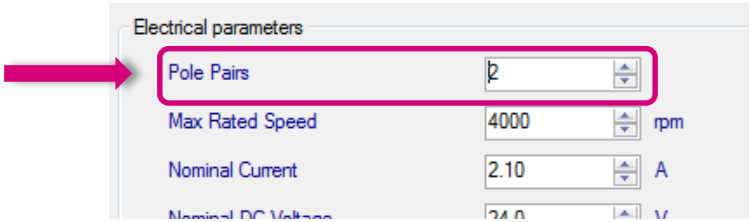


Step #8 – Set up motor parameters manually

Pole pair number

- The number of pole pairs is usually provided by the motor supplier, but in case it's not or if you'd like to double-check it:
  - Connect a DC power supply between two (of the three) motor phases and provide up to 5% of the expected nominal DC bus voltage. (You may also set current protection to nominal motor current.)
  - Rotate the motor with your hands, you should notice a little resistance, otherwise:
    - If you are not able to rotate the motor, decrease the applied voltage.
    - If the motor does not generate any resistance, gradually increase the applied voltage.
  - The number of rotor stable positions in one mechanical turn represents the number of pole pairs.

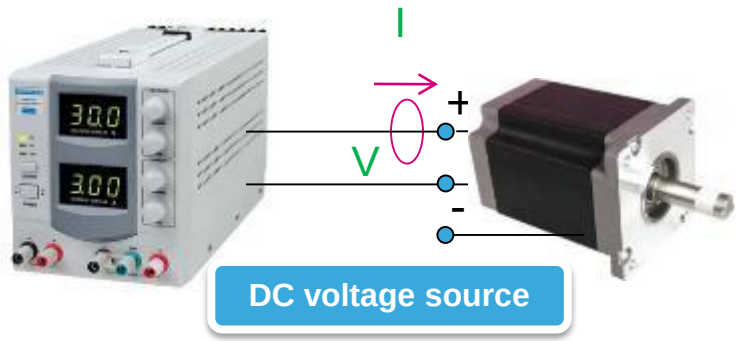




Step #8 – Set up motor parameters manually

Stator resistance and inductance

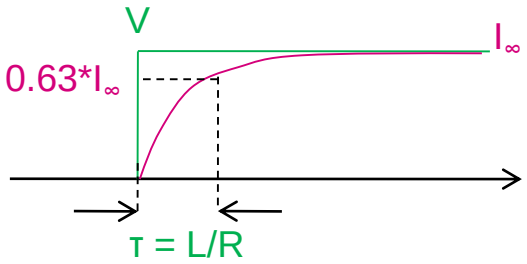
- Using the multimeter, measure the DC stator resistance phase-to-phase (Rs) and divide it by two.
- Connect the DC voltage between two motor phases.
- Connect the oscilloscope voltage and current probes as shown in the figure.
- Increase the voltage up to the value where the current equals the nominal value, so the rotor will align with the generated flux.
- Don’t move the rotor anymore.



Step #8 – Set up motor parameters manually

Stator resistance and inductance

- Disable the current protection of DC voltage source.
- Unplug one terminal of the voltage source cable without switching it off.
- Plug the voltage source rapidly and monitor on the scope the voltage and current waveform until you get something like the one shown in the figure.
- The measurement is good if the voltage can be assimilated to a step and the current increase such as $I_\infty * (1-e^{-t*L/R})$.
- Measure the time required to current waveform to rise up to 63%.
- This time is Ld/Rs constant. Multiply it by Rs and you'll get the Ld value.



life.augmented

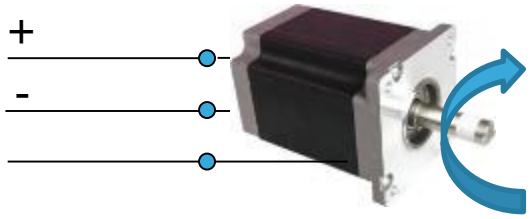
Step #8 – Set up motor parameters manually

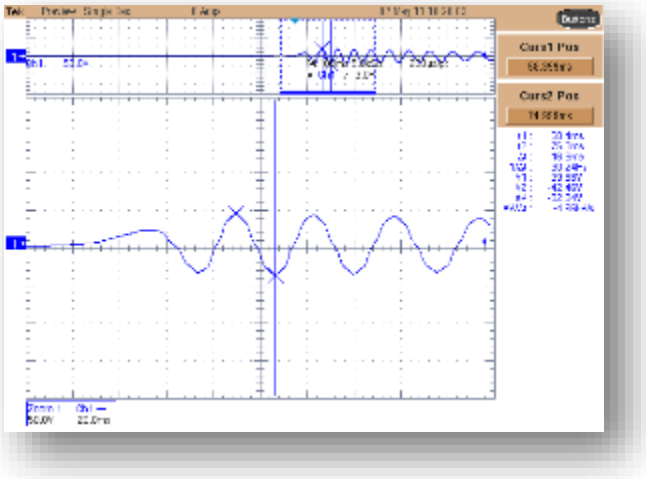
Back EMF constant Ke

- The Back-EMF constant represents the proportionality constant between the mechanical motor speed and the amplitude of the B-EMF induced into the motor phases:

$$V_{Bemf} = K_e \cdot \omega_{mec}$$

- To measure Ke, it usually suffices to turn the motor with your hands (or using a drill or another motor mechanically coupled) and use an oscilloscope to look for the phase-to-phase induced voltage (V_{Bemf})



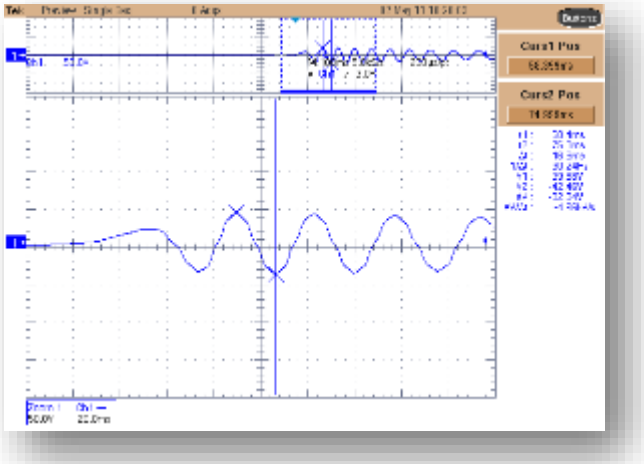


Step #8 – Set up motor parameters manually

Back EMF constant Ke

- Measure the V_{Bemf} frequency (f_{Bemf}) and the peak-to-peak amplitude (V_{Bemf-A})
- Compute Ke in V_{RMS} / K_{RPM}:

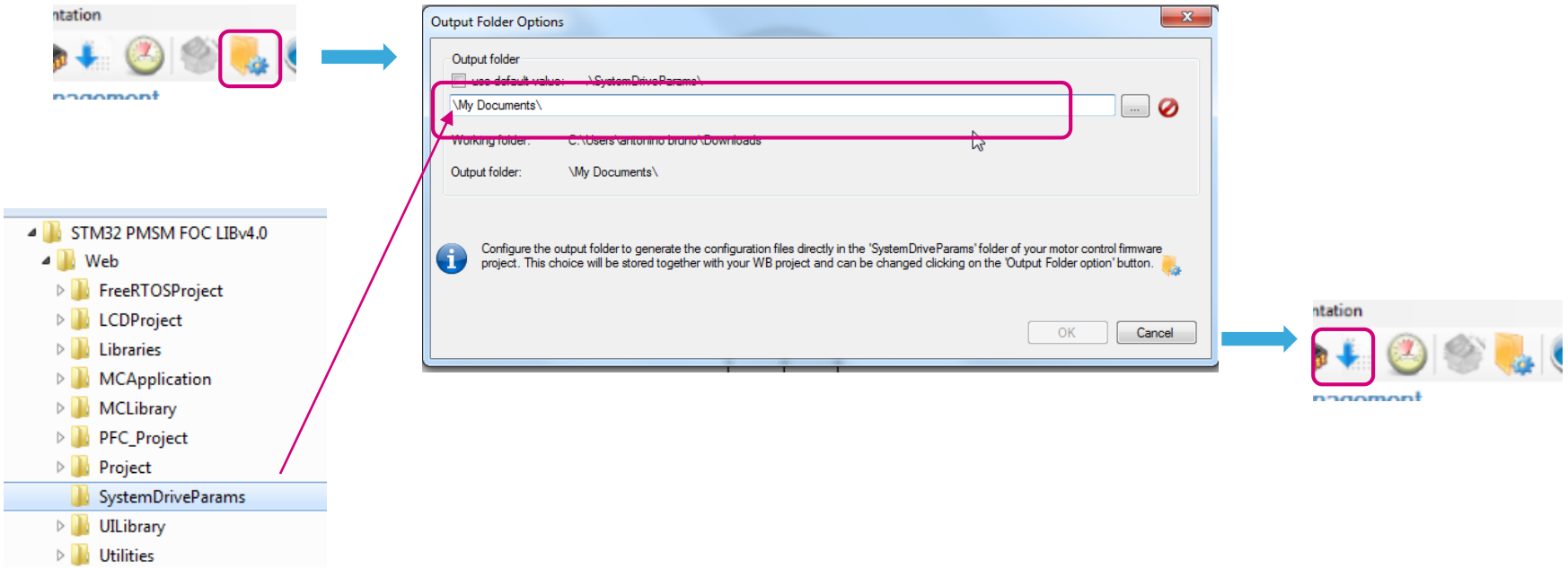
$$K_e = \frac{V_{Bemf-A}\ [V\ peak-to-peak] \cdot pole\ pairs\ number \cdot 1000}{2 \cdot \sqrt{2} \cdot f_{Bemf}\ [Hz] \cdot 60}$$



Generate, compile, debug and run

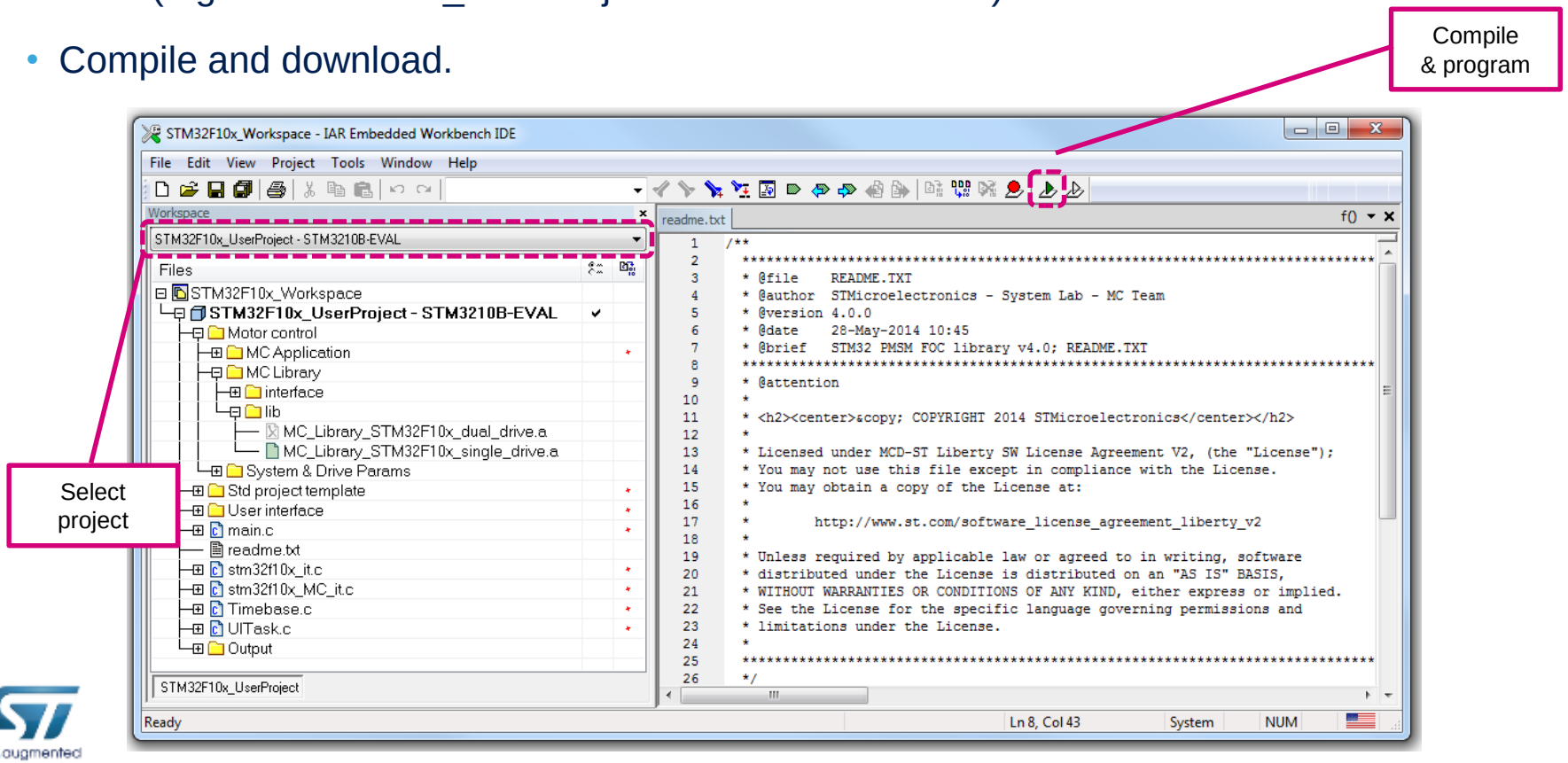
Step #9 – Parameter generation

- Once all the parameters have been entered in the ST MC Workbench, select the output path in the option form and choose '**SystemDriveParams**' present in the FW working folder.
- Click on the '**Generation**' button to configure the project.



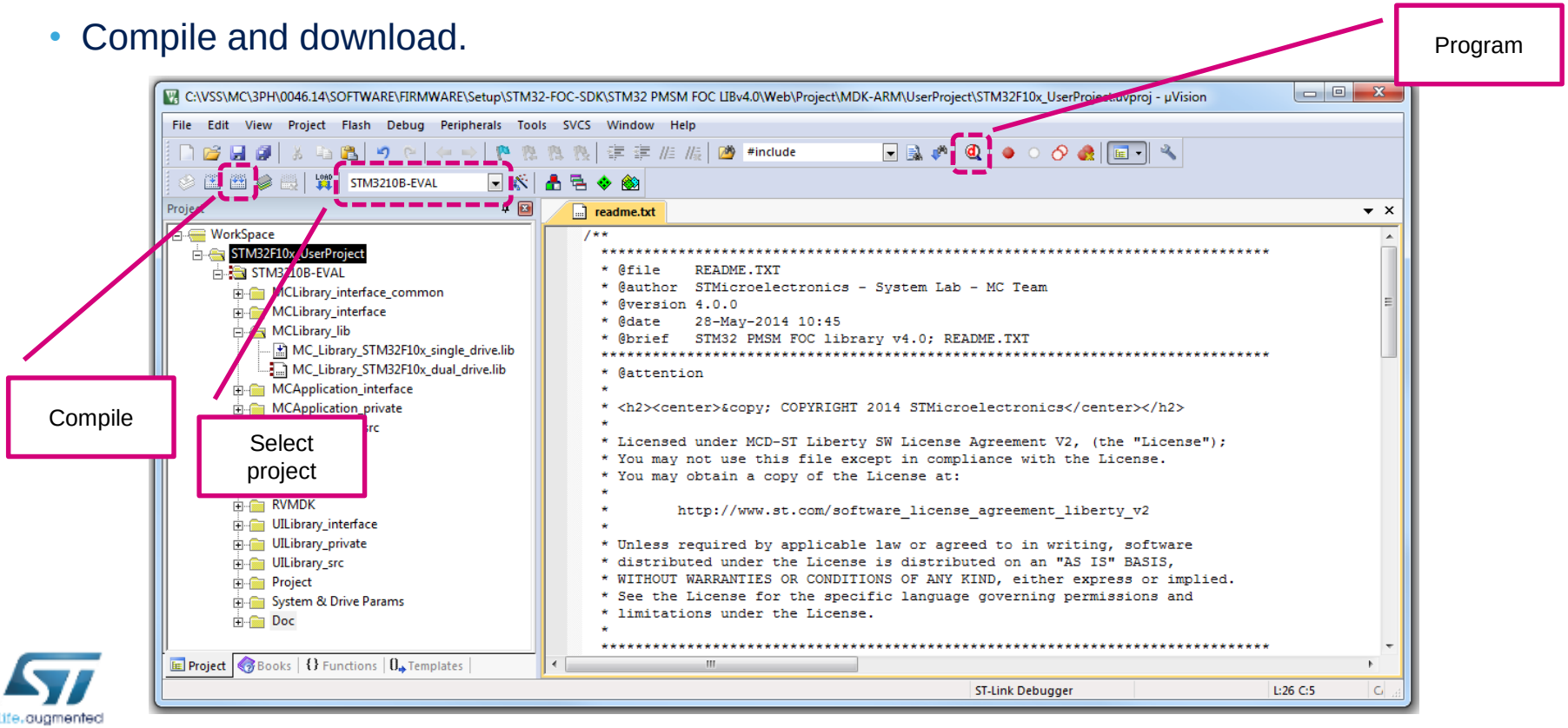
Step #10 – Compile and program the MCU 1/2

- Run the IAR Embedded Workbench. IAR Embedded Workbench
- Open the IAR workspace (located in Project\EWARM) folder according to the microcontroller family (e.g. STM32F10x_Workspace.eww for STM32F1).
- Select the correct user project from the drop-down menu according to the control stage used (e.g. STM32F10x_UserProject - STM3210B-EVAL).
- Compile and download.

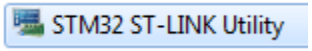


Step #10 – Compile and program the MCU 2/2

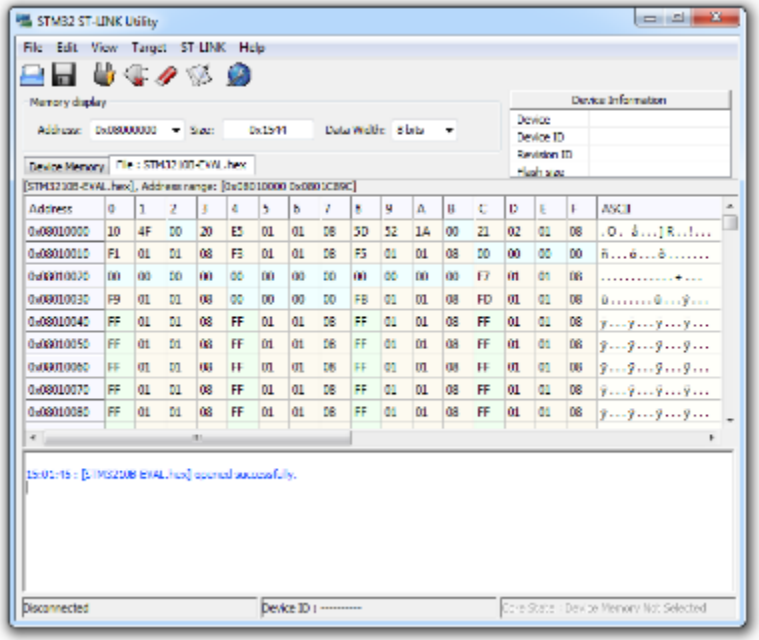
- Optionally, run Keil uVision. Keil uVision5
- Open the Keil workspace (located in Project\MDK-ARM) folder according to the microcontroller family (e.g. STM32F10x_Workspace.uvmpw for STM32F1).
- Select the proper user project from the drop-down menu according to the control stage used (e.g. STM3210B-EVAL).
- Compile and download.

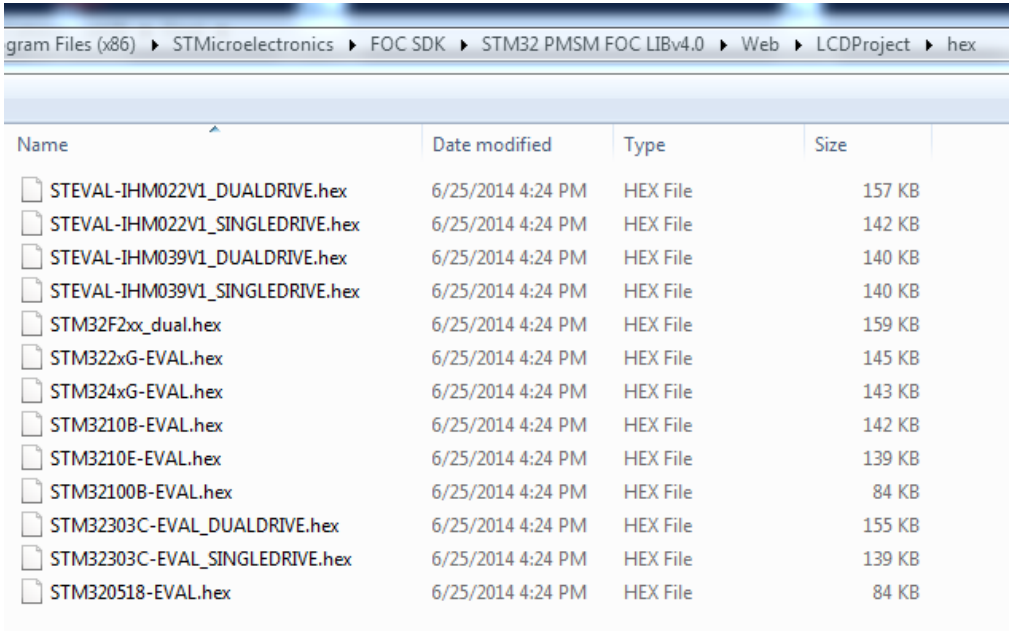


Step #11 – Program the LCD firmware

- Run the ST-LINK Utility. 

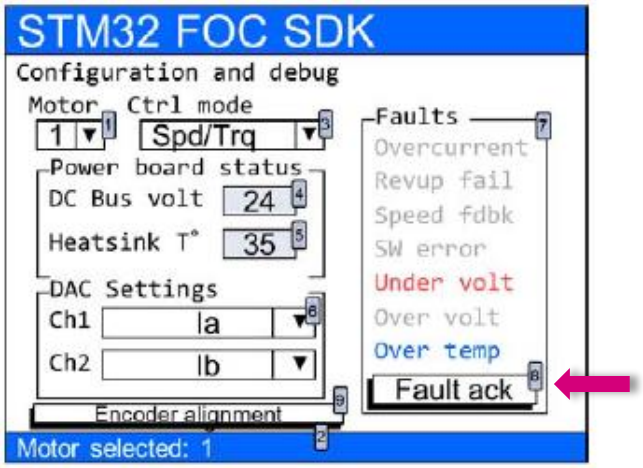
- File → Open file… and select the .hex file (located in LCDProject\hex) according to the control stage used (e.g. STM3210B-EVAL.hex).
- Target → Program…

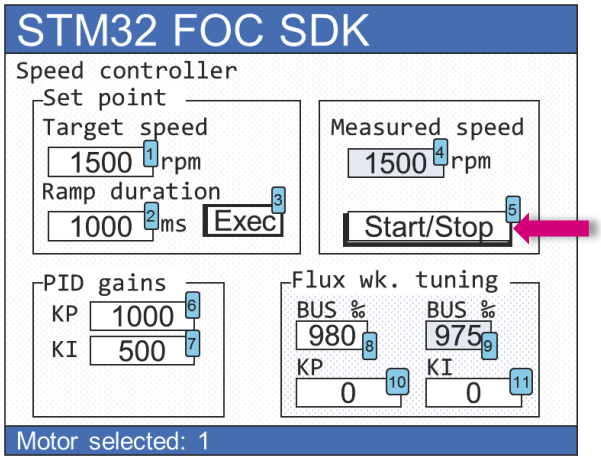




Step #12 – Run the motor

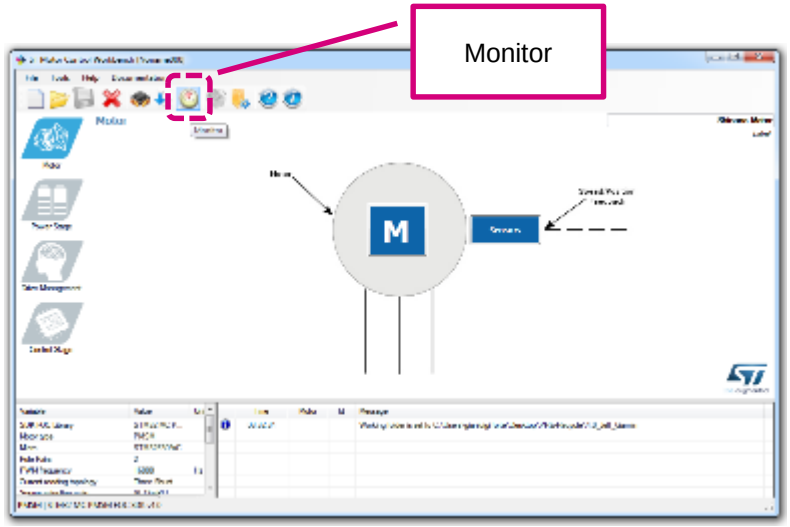
- Arrange the system for running the motor:
  - Connect the control board with the power board using the MC cable.
  - Connect the motor to the power board.
  - Connect the power supply to the power board and turn on the bus.
- If the board is equipped with the LCD:
  - Press joystick center on *Fault Ack* button to reset the faults.
  - Press joystick right until the *Speed controller* page is reached.
  - The press joystick down to reach the *Start/Stop* button.
  - Press the center of the joystick to run the motor.

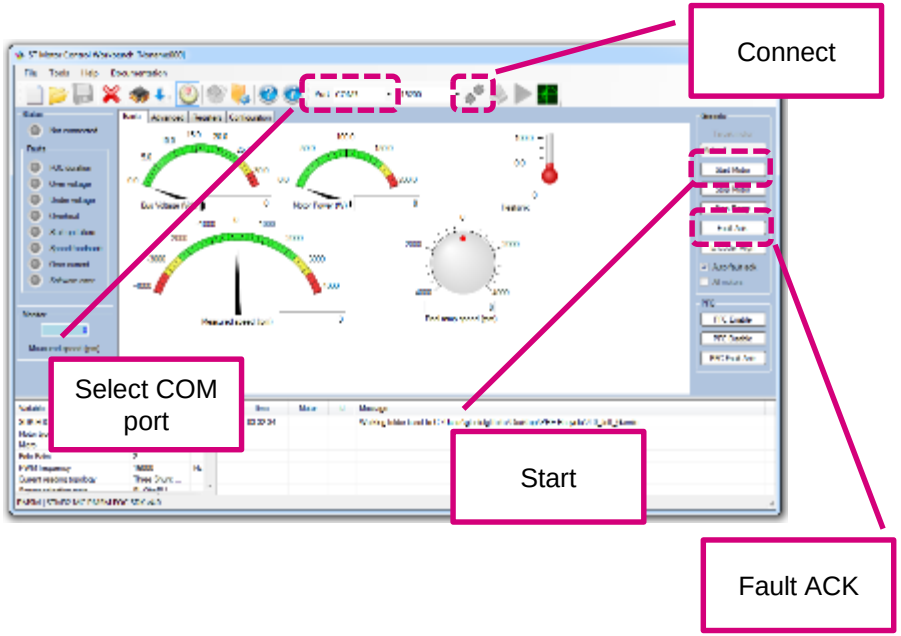




Step #13 – Run the motor

- Optionally you can start the motor using the ST MC Workbench.
- Connect the PC to the control board with the USB to RS-232 dongle (and a null modem cable).
- Open the Workbench project used to configure the firmware and click on *Monitor* button.
- Select the *COM port* and click *Connect* button. This establish the communication with the firmware.
- To clear the fault, click *Fault Ack* and then *Start Motor* button to run the motor.





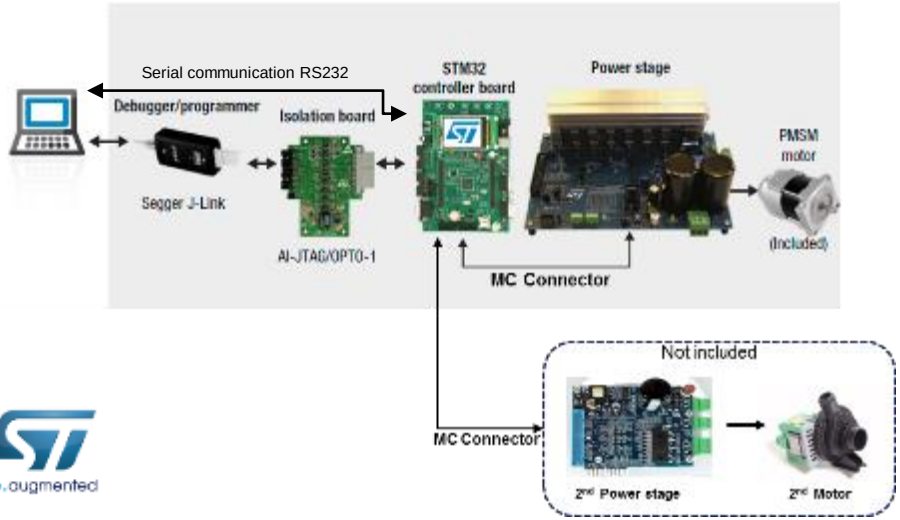
ST Evaluation Board Offer

Motor control kits

Part Number	Description	ST Link on-board	Type
P-NUCLEO-IHM001	STM32 Nucleo Pack FOC and 6-step control for Low voltage 3-ph motors with DC Power supply	Yes (embedded)	Single drive
P-NUCLEO-IHM002			
STM32100B-MCKIT	Motor control starter kit for STM32F100 (128KB Flash) Value Line MCUs	Yes	Single drive
STM3210B-MCKIT	Motor control starter kit for STM32 (128KB flash) Performance and Access Line microcontrollers	Yes	Single drive

The motor control kit connections represented below can also be applied when combining STM32 control boards and evaluation power boards.

STM3210B-MCKIT STM32100B-MCKIT



- P-NUCLEO-IHM001
- P-NUCLEO-IHM002

life.augmented

ST Complete Inverters

Part Number	Description	ST Link on-board	Type
STEVAL-IHM034V2	Dual-motor control and PFC demonstration board featuring the STM32F103 and STGIPS20C60	No	Single/Dual drive
STEVAL-IHM036V1	Low-power motor control board featuring the SLLIMM™ STGIPN3H60 and MCU STM32F100C6T6B	No	Single drive
STEVAL-IHM038V1	BLDC ceiling fan controller based on STM32 and SLLIMM-nano	No	Single drive
STEVAL-IHM040V1	BLDC/PMSM driver demonstration board based on STM32 and the SLLIMM-nano	No	Single drive
STEVAL-IHM042V1	Compact, low-voltage dual-motor control board based on the STM32F303 and L6230	Yes	Single/Dual drive
STEVAL-IHM043V1	6-Step BLDC sensorless driver board based on the STM32F051 and L6234	No	Single drive

STEVAL-IHM034V2

STEVAL-IHM036V1

STEVAL-IHM042V1

STEVAL-IHM043V1

STEVAL-IHM038V1

STEVAL-IHM040V1

life.augmented

Flexible MC Platform

Full set of control boards featuring all ST MCUs

Full set of power boards featuring Power Transistors, IPM, and MC Driver ICs.

STM32XX-EVAL
Control board

NUCLEO-XX
Control board

\+

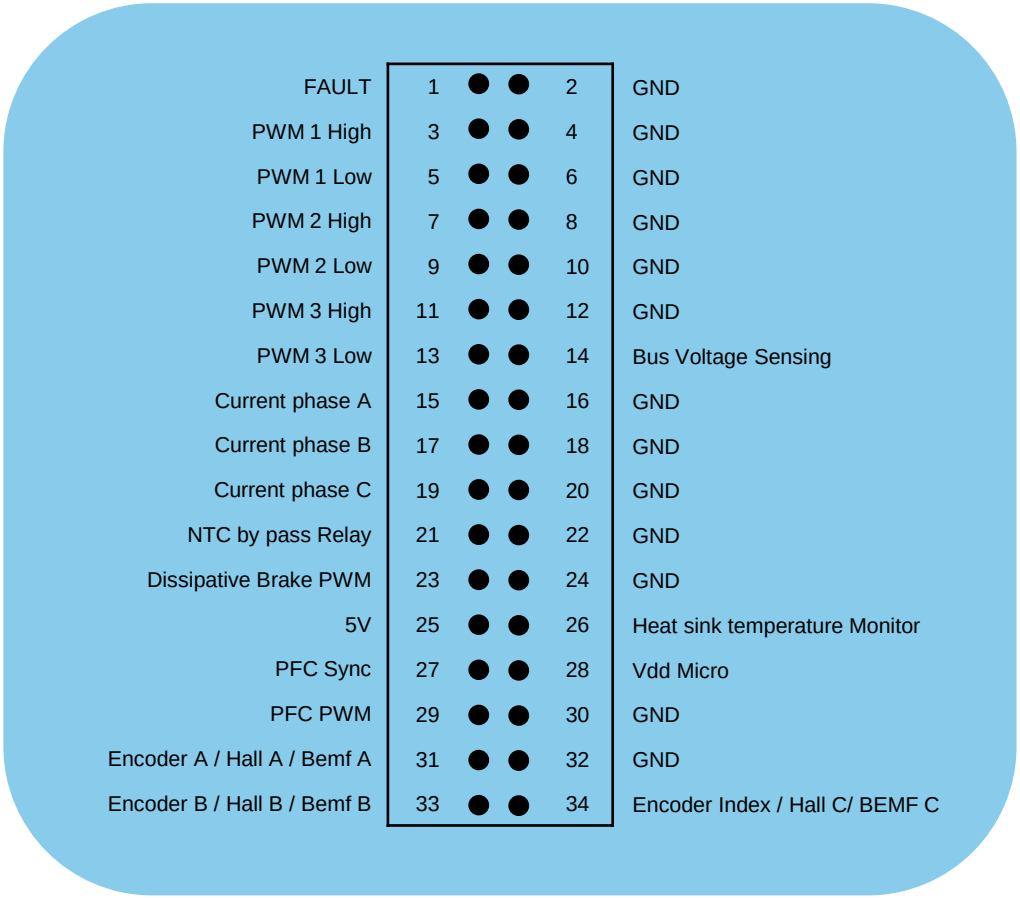
X-NUCLEO-IHM09M1
Connector Adapter

MC Connector

STEVAL-XX
Power board

The MC connector

34-pin connector dedicated to motor control applications, it is a standard ST interface between MCU evaluation boards and power boards.



STM32 evaluation boards with MC connector

Part Number	Description	ST Link on-board	Type
STM32072B-EVAL	Evaluation board with STM32F072VB MCU	Yes	Single drive
STM3210E-EVAL	Evaluation board for STM32 F1 series - with STM32F103 MCU	No	Single drive
STM3220G-EVAL	Evaluation board for STM32 F2 series - with STM32F207IG MCU	Yes	Single drive
STM32303E-EVAL	Evaluation board for STM32F303xx microcontrollers	Yes	Single/Dual drive
STM32446E-EVAL	Evaluation board for STM32F407 line - with STM32F407IG MCU	Yes	Single drive
STEVAL-IHM039V1	Dual motor drive control stage based on the STM32F415ZG microcontroller	No	Single/Dual drive

STM32072B-EVAL

STM32446G-EVAL

STM32303E-EVAL

For the complete list visit st.com

In-circuit debugger/programmer..

- ST-LINK/V2
- ST-LINK/V2-ISOL (2500 VRMS high isolation voltage)(1)

life.augmented

(1) for high-voltage applications if not implemented in the evaluation board

Key hardware features 1/3

Reference / bundle	Voltage	Power	Motor type / control type *	ST Parts	Application focus
STEVAL-IPM05F	125 – 400 V_{DC}	Up to 700 W (Up to 8A)	PMSM/BLDC FOC/6-step 3-shunt	• 1 x **STGIF5CH60TS-L** • 1x **TSV994**	Power board: water pumps, fans, dish washers and more
STEVAL-IPM07F	125 – 400 V_{DC}	Up to 800 W (Up to 10A)	PMSM/BLDC FOC/6-step Single/3-shunt	• 1 x **STGIF7CH60TS-L** • 1x **TSV994**	Power board: water pumps, fans and more
STEVAL-IPM10F	125 – 400 V_{DC}	Up to 1 kW (Up to 15A)	PMSM/BLDC FOC/6-step	• 1 x **STGIF10CH60TS-L** • 1x **TSV994**	Power board: pumps, compressors, washing machines and more
STEVAL-IPM10B	125 – 400 V_{DC}	Up to 1.2 kW (Up to 15A)	PMSM/BLDC FOC/6-step single/3-shunt	• 1 x **STGIB10CH60TS-L** • 1x **TSV994**	Power board: pumps, compressors, air conditioning and more
STEVAL-IPM15B	125 – 400 V_{DC}	Up to 1.5kW (Up to 20A)	PMSM/BLDC FOC/6-step single/3-shunt	• 1 x **STGIB15CH60TS-L** • 1x **TSV994**	Power board: pumps, compressors, fans, dish washers and more

Key hardware features 2/3

Reference / bundle	Voltage	Power	Motor type / control type *	ST parts	Application focus
STEVAL-IHM021V2	120/230 V_{AC} nominal (60/50 Hz)	Up to 100 W	PMSM/BLDC FOC/6-step 3-shunt	• 3x **L6390** • 1x **Viper12** • 6x **STD5N52U**	Power board: water pumps, fans, dish washers, washing machines
STEVAL-IHM023V3	90 – 285 V_{AC} 125 – 400 V_{DC}	Up to 1 kW	PMSM/BLDC FOC/6-step Single/3-shunt	• 3x **L6390** • 1x **Viper16** • 7x **STGP10H60DF**	Power board: pumps, compressors, washing machines and more
STEVAL-IHM028V2	90 – 285 V_{AC} 125 – 400 V_{DC}	Up to 2 kW	PMSM/BLDC FOC/6-step Single/3-shunt	•1x **STGIPS20C60** • 1x **VIPer26LD** • 1x **STGW35NB60SD**	Power board: pumps, compressors, air conditioning and more
STEVAL-IHM032V1	230 V_{AC} nominal 86 to 260 V_{AC}	Up to 150 W	PMSM/BLDC FOC/6-step Single/3-shunt	• 2x **L6392D** • 1x **L6391D** • 1x **Viper12** • 6 x **STGD3HF60HD**	Power board: pumps, compressors, fans, dish washers and more
STEVAL-IHM035V2	120/230 V_{AC} nominal	Up to 100 W	PMSM/BLDC FOC/6-step single-shunt	• 1x **STGIPN3H60** • 1x **VIPer16L**	Power board: pumps, compressors, fans, dish washers and more
STEVAL-IHM045V1	30 – 270 V_{AC} 40 – 400 V_{DC}	Up to 100 W	PMSM FOC Single/3-shunt	• 1x **STGIPN3H60A** • 1x **VIPer06L** • 1x **TSV994**	Power board: pumps, compressors, fans, dish washers and more

End

Key hardware features 3/3

Reference / bundle	Voltage	Power / current	Motor type / control type *	ST Parts	Application focus
X-NUCLEO-IHM07M1	Up to 48V	Up to 2.5A	PMSM/BLDC FOC/6-step Single/3-shunt	• **1x L6230** • **1x BAT30KFILM** • **1xTSV994IPT**	Sewing machines, pumps, drones,
X-NUCLEO-IHM08M1	10 – 48Vdc	Up to 15A	PMSM/BLDC FOC/6-step Single/3-shunt	• 6x**STL220N6F7** • 3x**L6398** • 1x**TSV994IPT**	Drones, e-bikes, drills, pumps, etc.
X-NUCLEO-IHM09M1	-	-	Motor control connector adapter	• **Not silicon devices**	Allow connection of STM32 NUCLEO boards with any ST motor control power boards