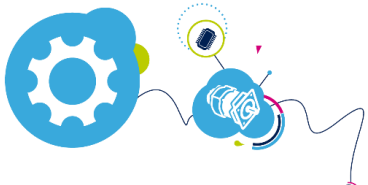
ST Motor Profiler

(STM32 PMSM FOC SDK)

Tips and Tricks

life.augmented



ST Motion Control Ecosystem
Easy Plug and Spin

ST Motor Profiler

What is the Motor Profiler tool?

- The Motor Profiler tool is a new algorithm able to automatically measure the electrical characteristics of Permanent Magnet Synchronous Motors (PMSM). It can be used to run an unknown motor from scratch in only few minutes.
- The “Motor Profiler” algorithm determines the correct motor parameters needed to configure the STM32 PMSM FOC firmware library: stator resistance (Rs), stator inductance (Ls), B-EMF constant, inertia and friction(1).
- The user have to know/measure few parameters before to lunch the ST Motor Profiler: Number of pole pairs, maximum speed of the application and maximum peak current of the motor and optionally Bus Voltage.
- The Motor Profiler tool works only with certain ST MC boards. Please check the boards listed in the Motor profile tool.

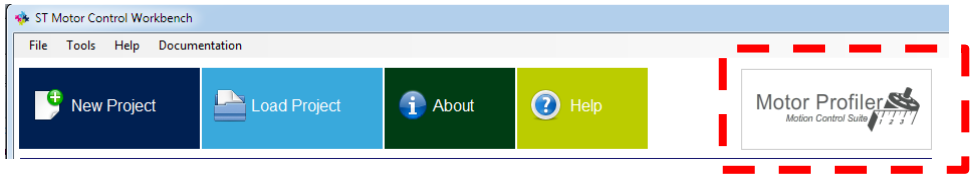
(1) In certain cases, Motor Profiler measurements may not be reliable. Please see the limits reported inside the MP.

Tips and tricks 1

How to open the Motor Profiler

- Installing the STM32 PMSM FOC SDK package from st.com.
- There are 2 ways to open the Motor Profiler, from:
  1. Directly from: Start menu →STMicroelectronics→…
  2. Lunching “ST Motor Control Workbench”

2. From ST Motor Control Workbench



For more information, refer to User manuals UM1052, UM1053 and UM1080.

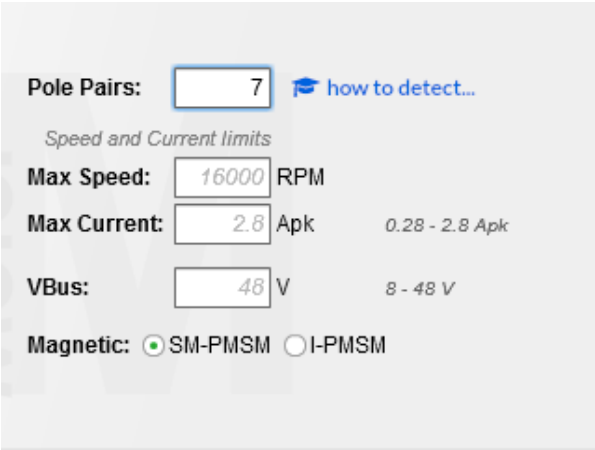
Tips and tricks 2

Set up the Motor Profiler (1/3)

Parameters set by the user:

- Motor pole pairs (mandatory)
  - There is a link to a web page which explains how to detect them
    (If you do not know and there is no way to measure it, you can try a number between 1 and 4)
- Maximum application speed
  It is recommended to use Max Speed values above 1000 RPM for best results from the algorithm.
  To avoid damaging motors intended for operating speeds below 1000 RPM (e.g., some fan motors), try progressively stepping up the speed until the algorithm converges
- Maximum peak current (protects motor from stress due to excessive current)
  - The maximum peak current delivered to the motor
- Expected bus voltage provided to the system.

The Speed and Current Limits, are set by the user in the motor profiling session.
If the maximum motor speed detected by the MP is very close to the imposed limit, the MP measurement is probably not a true reflection of the maximum speed of the motor.



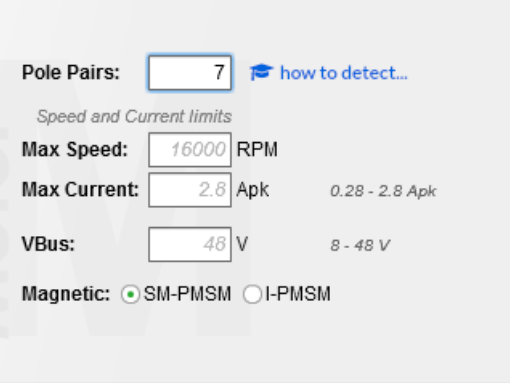
Tips and tricks 2

Set up the Motor Profiler (2/3)

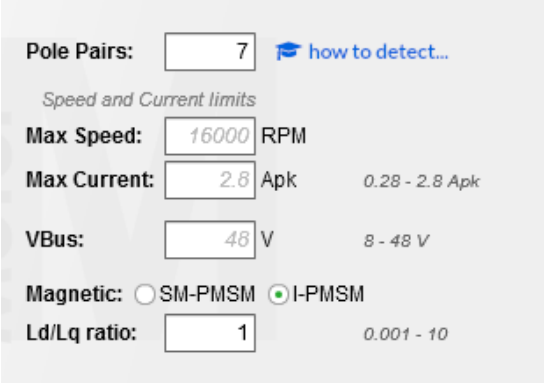
Parameters set by the user:

- Type of motor
  - Surface-mounted permanent magnet synchronous motor (SM-PMSM)
  - Internal permanent magnet motor (I-PMSM). In this case, an Ld/Lq ratio input is required (should be different from 1 for SM-PMSM but you can still try SM-PMSM or ratio 1)

SM-PMSM



I-PMSM



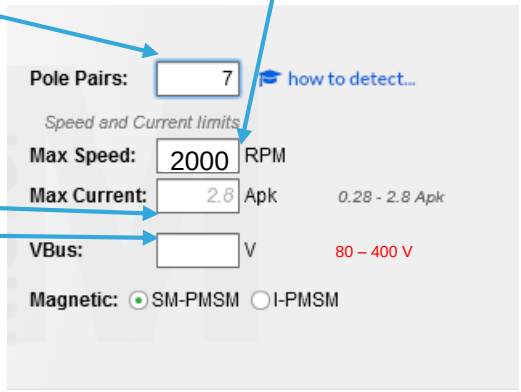
Tips and tricks 2

From motor datasheet to M.P. (3/3)

Example

Motor maker	Specifications			Model Synchronous Motor	Version 1.xxx
Description Motor PMSM Sensorless 230V, 80W, 2000 rpm		Code XXXXX	Customer xxxx	Brand Motor Maker	
Pole Pair 7	Voltage 230V	Power 80W	Current 0.5A	Speed 2000 rpm	Max temp. 150°C

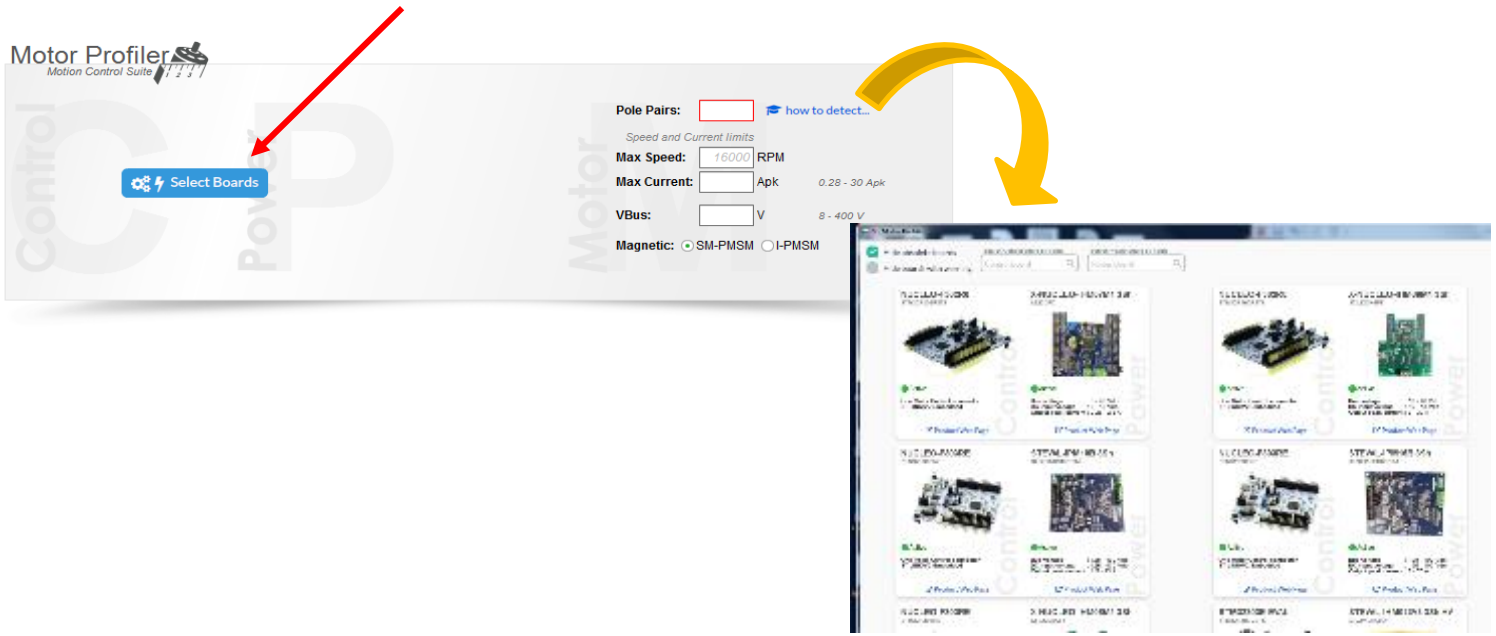
- The values in the DS are usually the effective – AC/ RMS voltage is between two phases.
- Nominal DC voltage and Nominal current are the peak values of the sinusoidal:
  - I_N=0.5 A_{RMS}*$\sqrt{2}$ =0,707 A_{pk}
  - $V_{N\ DC}$=230V_{RMS}*$\sqrt{2}$ =325V_{DC}



Tips and tricks 3

Select the HW for Motor Profiler (1/2)

- Click on “Select Boards” to list supported boards. The Motor Profiler feature can only be used for systems listed with the Cortex M4 and floating point unit for fast calculations (STM32F3xx and STM32F4xx).



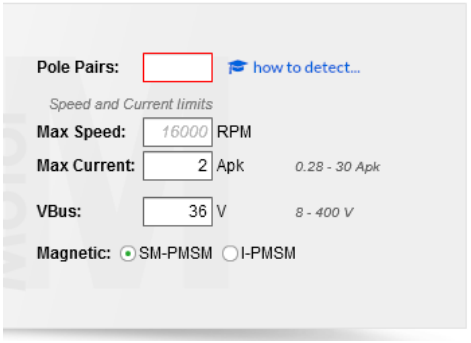
The user chooses the most suitable board according expected bus voltage and maximum peak current to be provided to the motor

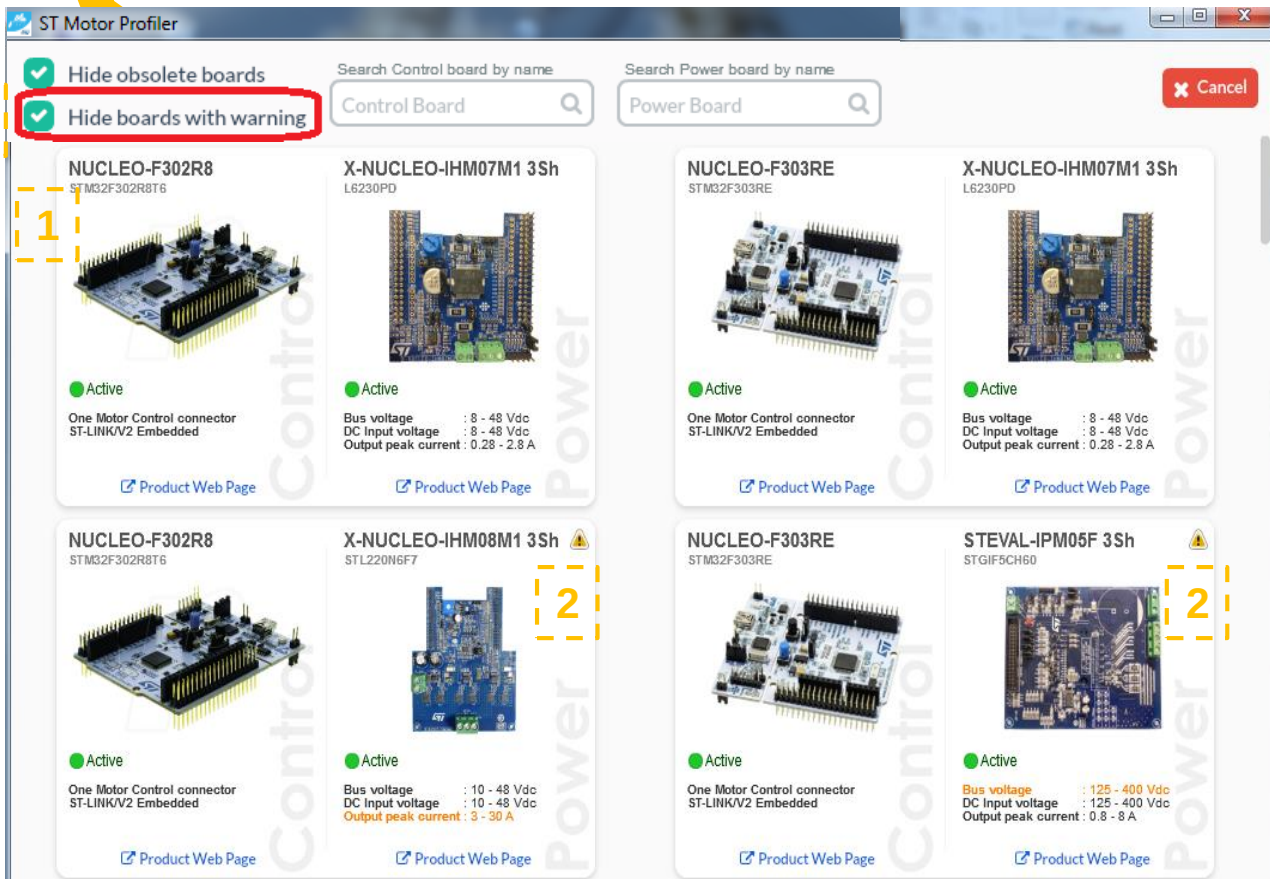
Tips and tricks 3

Select the HW for Motor Profiler (2/2)

- The user chooses the most suitable board according expected bus voltage and maximum peak current to be provided to the motor.

Example





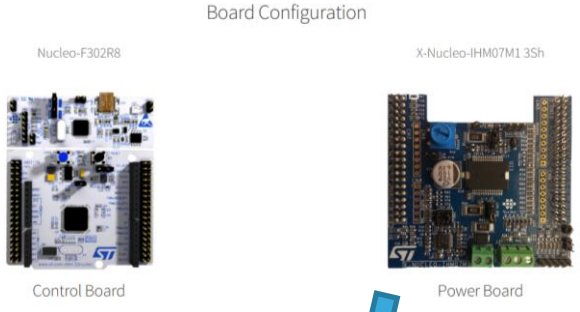
1. MP will suggest the boards closer to the Max Current, Vbus inserted.
2. For boards that do not fit the values inserted, a warning is shown and the text becomes orange.
3. It is possible to hide all the boards with a warning.

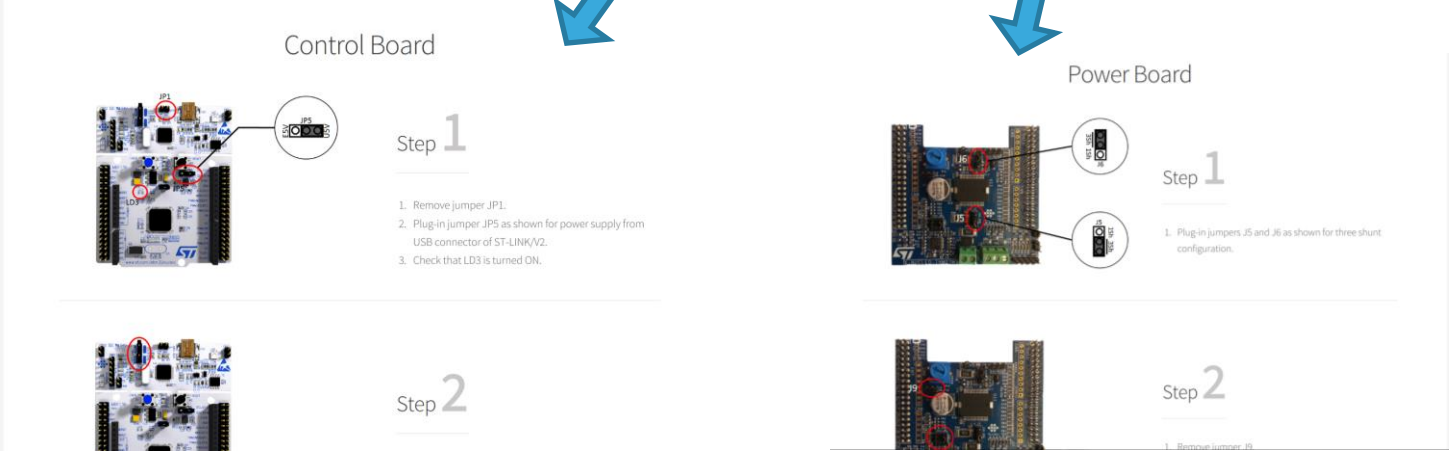
Tips and tricks 4

HW Board Configuration in Motor Control Mode

Inside the Motor Profiler the user can find information how to configure the boards according motor control needs.

Open Board configuration window by clicking on this text.





Tips and tricks 5

Why are the boards configured in 3-shunt topology?

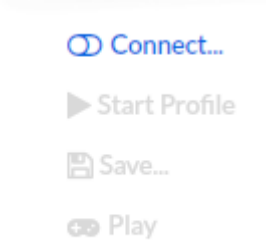
- **Answer:**

  3-shunt topology is better for current measurement and consequentially better Motor Profiler Algorithm performance, especially for low-inductance motors.

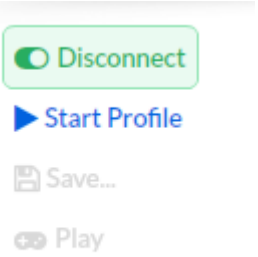
Tips and tricks 6

Start Motor Profiler session

- Connect the selected ST hardware to the PC through the ST-LINK/V2 in-circuit debugger/programmer. For high voltage board, the ST-LINK/V2-ISOL is recommended.
  - Remember to properly configure the ST boards in Motor Control mode.
- Click the “Connect” button.
  - If communication with the board is successful.



- Click the “Start Profile” button.



Tips and tricks 7

The Motor Profiler does not recognize my motor.

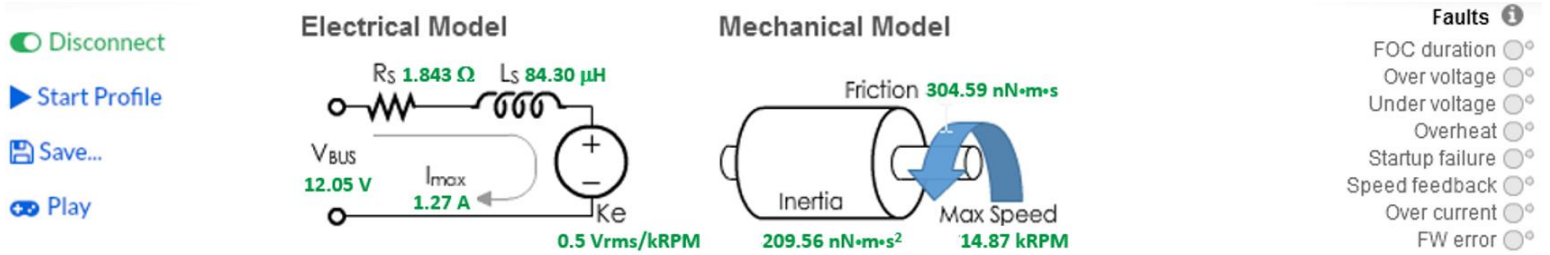
Try the following points:

- Make sure the nominal voltage is applied.
- Use power board with proper voltage (current) range for your motor (Low / High voltage)
- Select the power stage with the correct current range.
- Check if the pole pair number is correct.
- Enter the value of the nominal motor speed parameter or adjust this value.
- Decrease the value of the nominal current parameter.

Tips and tricks 8

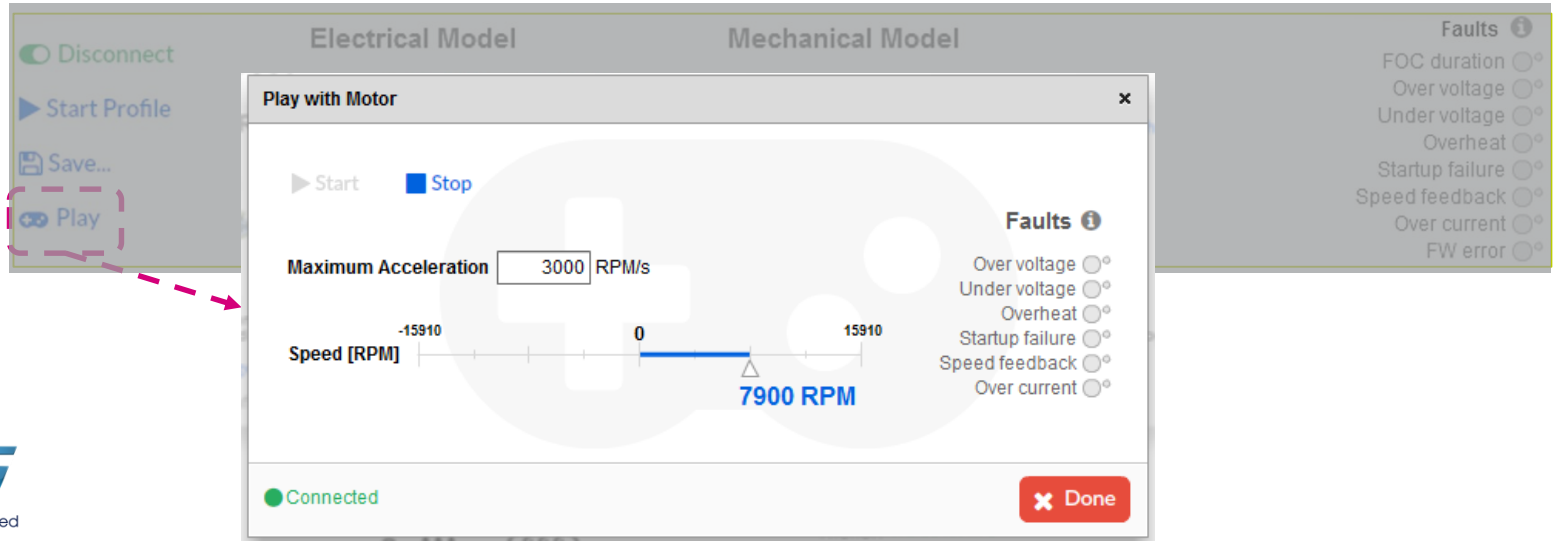
User's options after Motor Profiler completed

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



Play Mode

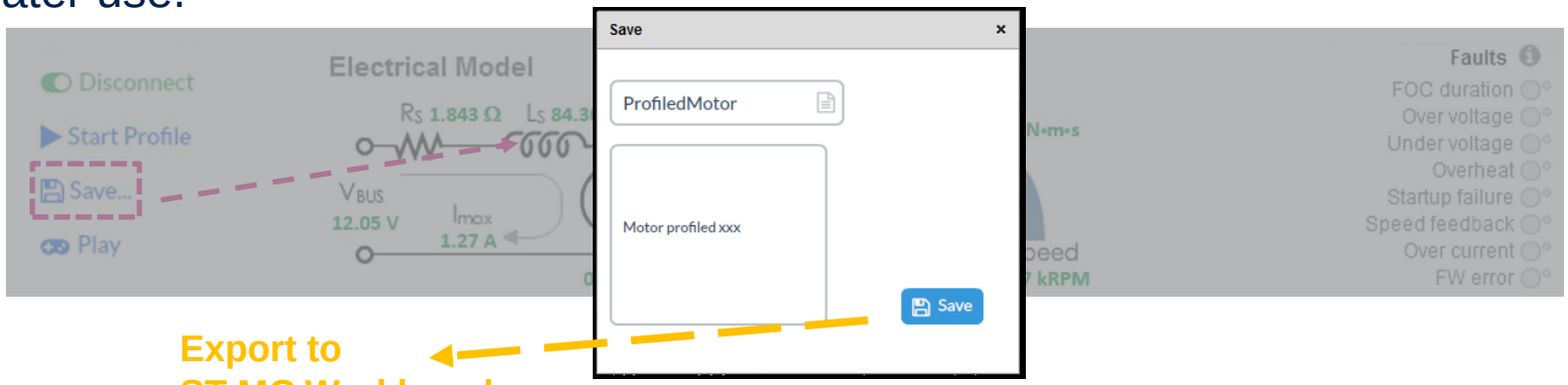
- At the end of the procedure, it is possible to run and control the motor's speed



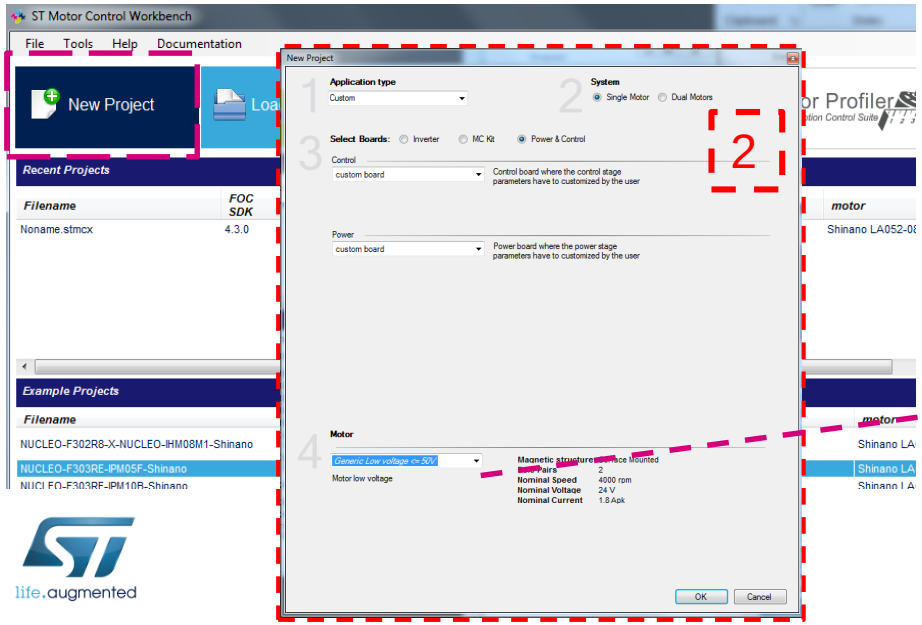
Tips and tricks 9

Transferring the MP results to WB projects

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

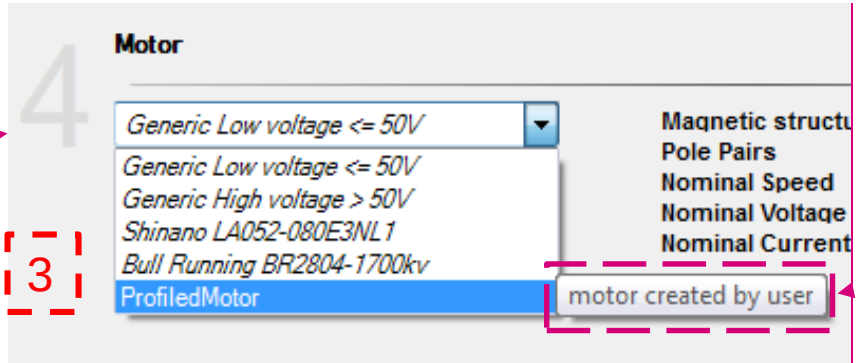


Export to ST MC Workbench



Open the WB

1. Press New Project
2. Select Control and Power board used
3. Select your saved motor at the bottom of the window New Project.

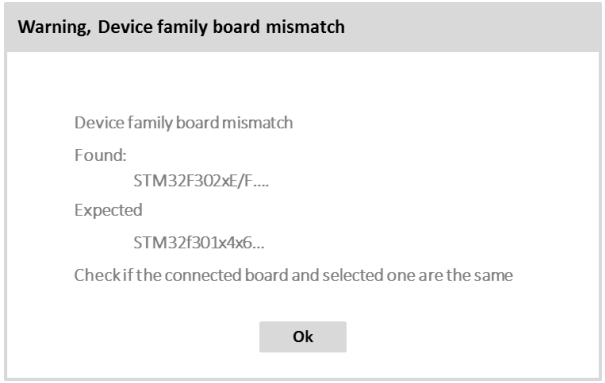


Tips and tricks 10

"Errors/Faults" handling (1/4)

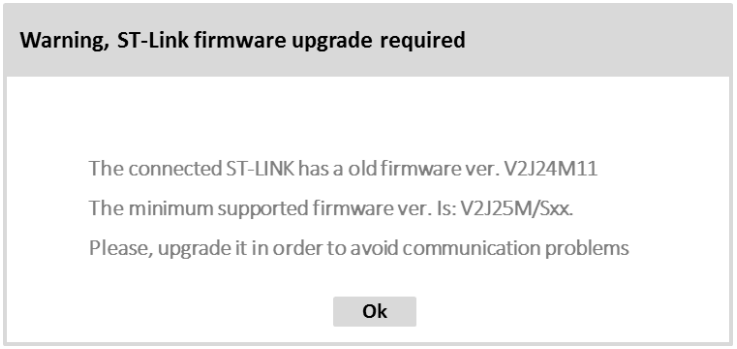
- Motor profiler checks that the connected board is the same as the one chosen by the user

Example



- Motor profiler checks that installed FW version in the ST-LINK is supported. STLINK is a in-circuit debugger and programmer for the STM32 microcontrollers.

Example

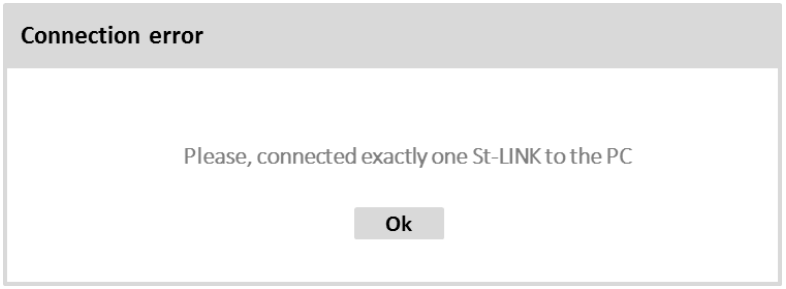


Tips and tricks 10

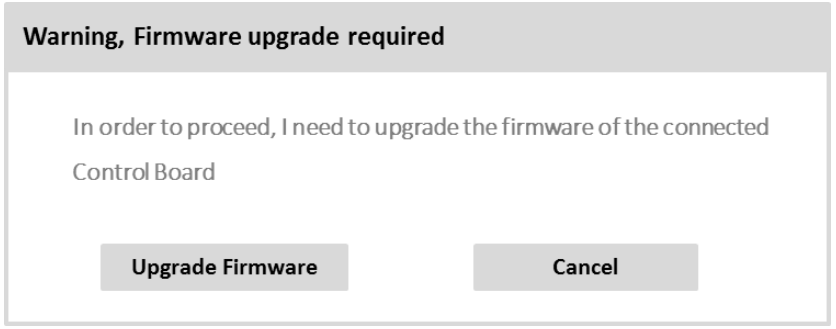
"Errors/Faults" handling (2/4)

- Motor profiler checks if the ST-LINK is connected to a PC

Example



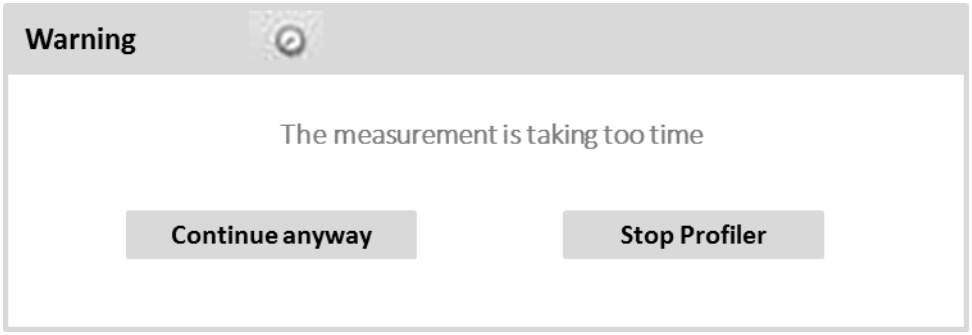
- Motor profiler checks the version of the installed FW in the control board.



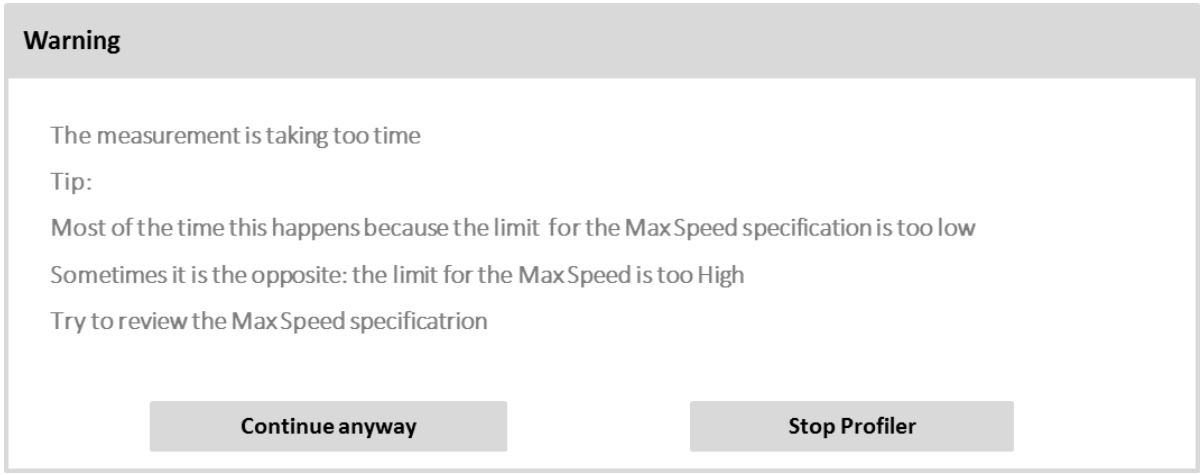
Tips and tricks 10

"Errors/Faults" handling (3/4)

- Motor profiler checks if the measurement phase is taking too long



- Motor profiler gives some tips:

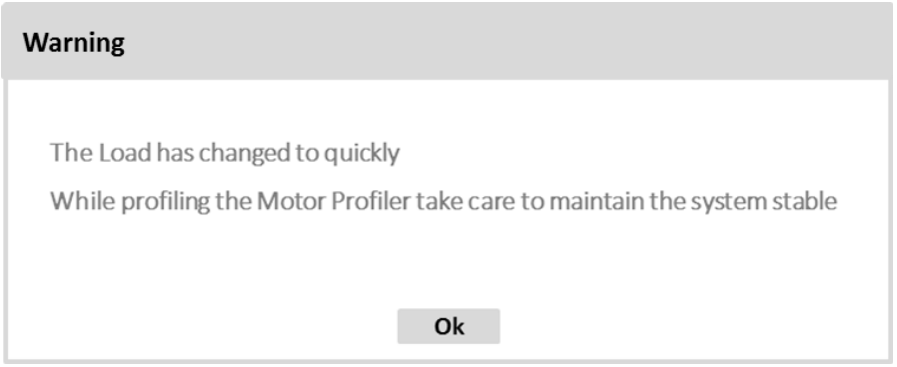


Or i.e. wrong connection from control board and power board

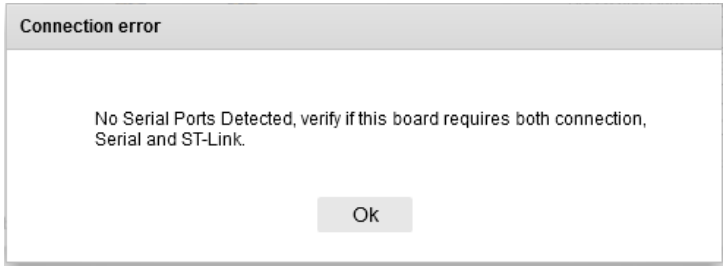
Tips and tricks 10

"Errors/Faults" handling (4/4)

- Motor profiler alerts during the measurement phase if the load of the motor has changed too quickly.



- Motor profiler checks the serial ports



Tips and tricks 12

Play mode fault management

- Problems in “Play mode“ after successful motor profilng phase
  1. PM not able start – OC fault
     - reduce the current and start MP again
  2. The fault speed feedback in PM (sometime only in reverse direction)
     - Modify parameters of STO/speed regulator in the Workbench project
  3. Profiling phase has succeeded, but the speed regulator does not react to the change of the requested speed in Play mode.
     - The speed regulator is set to a very long reaction time. You have to wait for initial stabilization. After a time, the speed regulator starts work (can be several minutes for high inertia motors)
     - You can tune parameters of speed regulator in the Workbench project
  4. Profiling phase has not successfully finished. It keeps restarting.

     a) Motor has high inertia and next test run is started while the motor is still spinning due to inertia from previous test.
        - Adjust application speed or stop it manually.

     b) Motor starts spinning, but the movement is not continuous.
        - The achieved test speed is too low - adjust application speed.
  5. Overheating
     - Wait for the motor to cool and then test with different parameters (different application speed).

Thank You