

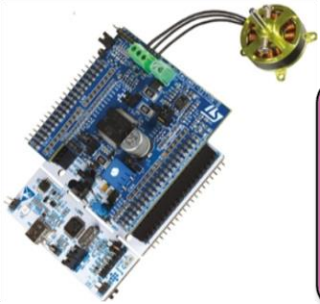
STM32 PMSM SDK 5.2 training

T.O.M.A.S. team



Motor Control Development Workflow

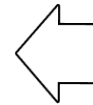
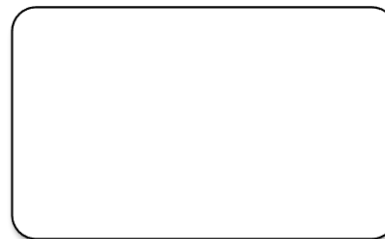
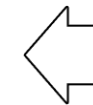
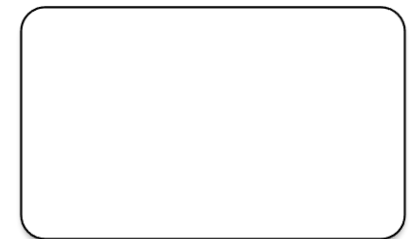
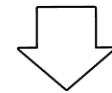
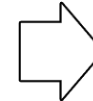
#2 – Motor Characterization



Hardware Setup



Motor Characterization





Hands-on:

How to set
motor, power stage,
startup,... parameters

Tools: ST Motor Control Workbench

The STMCWB software reduces the design effort and time in the STM32 PMSM FOC firmware library configuration. The user, through a graphical user interface (GUI), generate all parameter header files which configures the library according with the application requirements

Quick setup of the library according with customer needs

The screenshot displays the ST Motor Control Workbench (STMCWB) software interface. The main window shows a schematic diagram of a motor control system. The schematic includes an AC input section with an inrush current limiter and a PFC (Power Factor Correction) stage. The rated bus voltage is 11 V (5-36 V). The control unit is connected to the motor (M) through three phases: Phase U, Phase V, and Phase W. The control unit includes a firmware drive management block, MCU and clock frequency, digital I/O, DAC functionality, analog input and protection, and a user interface. The motor is connected to the control unit through a sensorless main block. The schematic also shows various sensing and protection blocks: bus voltage sensing, dissipative brake, temperature sensing, current sensing, over current protection, and speed sensing.

Two configuration windows are overlaid on the main interface:

- Motor - Electrical parameters:** This window shows the magnetic structure set to "Surface Mounted PMSM". The electrical parameters are listed as follows:

Parameter	Value	Unit
Ra	2.50	Ohm
Pole Pairs	4	
Max Rated Speed	5000	rpm
Nominal Current	2.00	A
Nominal DC Voltage	325.0	V
Ls	8.000	mH
Demagnetizing Current	2.0	A
B-EmfConstant	22.0	Vms/Krpm
- Drive Management - Start-up parameters:** This window shows the sensorless rev-up settings. The initial electrical angle is set to 90 degrees. The start-up parameters are listed in the following table:

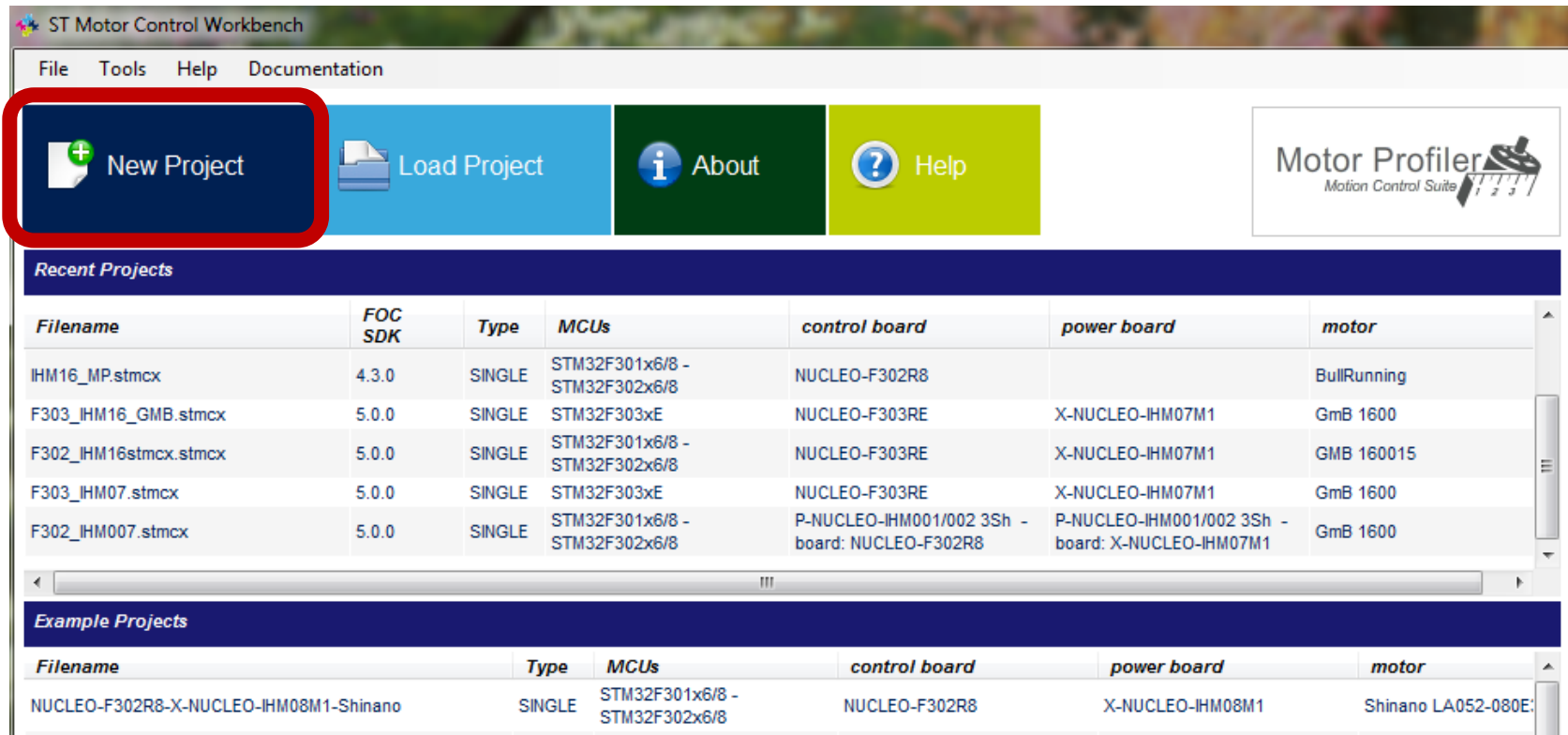
Duration (ms)	Final speed (rpm)	Final current (A)
0	2000	2.0
1000	3000	2.0
2000	3000	1.0
3000	3000	1.0
4000	3000	1.0



Hands-on:

How to measure motor parameters

- Press the button **New Project**



The screenshot shows the ST Motor Control Workbench interface. The 'New Project' button is highlighted with a red box. Below the main navigation bar, there are two tables: 'Recent Projects' and 'Example Projects'. The 'Recent Projects' table lists several projects with columns for Filename, FOC SDK, Type, MCUs, control board, power board, and motor. The 'Example Projects' table shows a single project entry.

Filename	FOC SDK	Type	MCUs	control board	power board	motor
IHM16_MP.stmcx	4.3.0	SINGLE	STM32F301x6/8 - STM32F302x6/8	NUCLEO-F302R8		BullRunning
F303_IHM16_GMB.stmcx	5.0.0	SINGLE	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM07M1	GmB 1600
F302_IHM16stmcx.stmcx	5.0.0	SINGLE	STM32F301x6/8 - STM32F302x6/8	NUCLEO-F303RE	X-NUCLEO-IHM07M1	GMB 160015
F303_IHM07.stmcx	5.0.0	SINGLE	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM07M1	GmB 1600
F302_IHM007.stmcx	5.0.0	SINGLE	STM32F301x6/8 - STM32F302x6/8	P-NUCLEO-IHM001/002 3Sh - board: NUCLEO-F302R8	P-NUCLEO-IHM001/002 3Sh - board: X-NUCLEO-IHM07M1	GmB 1600

Filename	Type	MCUs	control board	power board	motor
NUCLEO-F302R8-X-NUCLEO-IHM08M1-Shinano	SINGLE	STM32F301x6/8 - STM32F302x6/8	NUCLEO-F302R8	X-NUCLEO-IHM08M1	Shinano LA052-080E:



Select the Application type

7


- 1 – Select “**Custom**” Application type
- 3 – Select “**MC Kit**” Select boards check box


New Project

1 **Application type**
Custom

2 **System**
 Single Motor Dual Motors

3 **Select Boards:** Inverter MC Kit Power & Control

Motor Control Kit
P-NUCLEO-IHM001/002 3Sh STM32 Nucleo Pack FOC and 6-step control for Low voltage 3-ph motors
Control: NUCLEO-F302R8 based on STM32F302R8 ST-LINK/V2 Embedded  Active

Power: X-NUCLEO-IHM07M1 3Sh based on L6230PD
DC Input voltage 8 - 48 Vdc
Output pk current up to 2.8 Apk
Nominal Power up to 40 W  Active

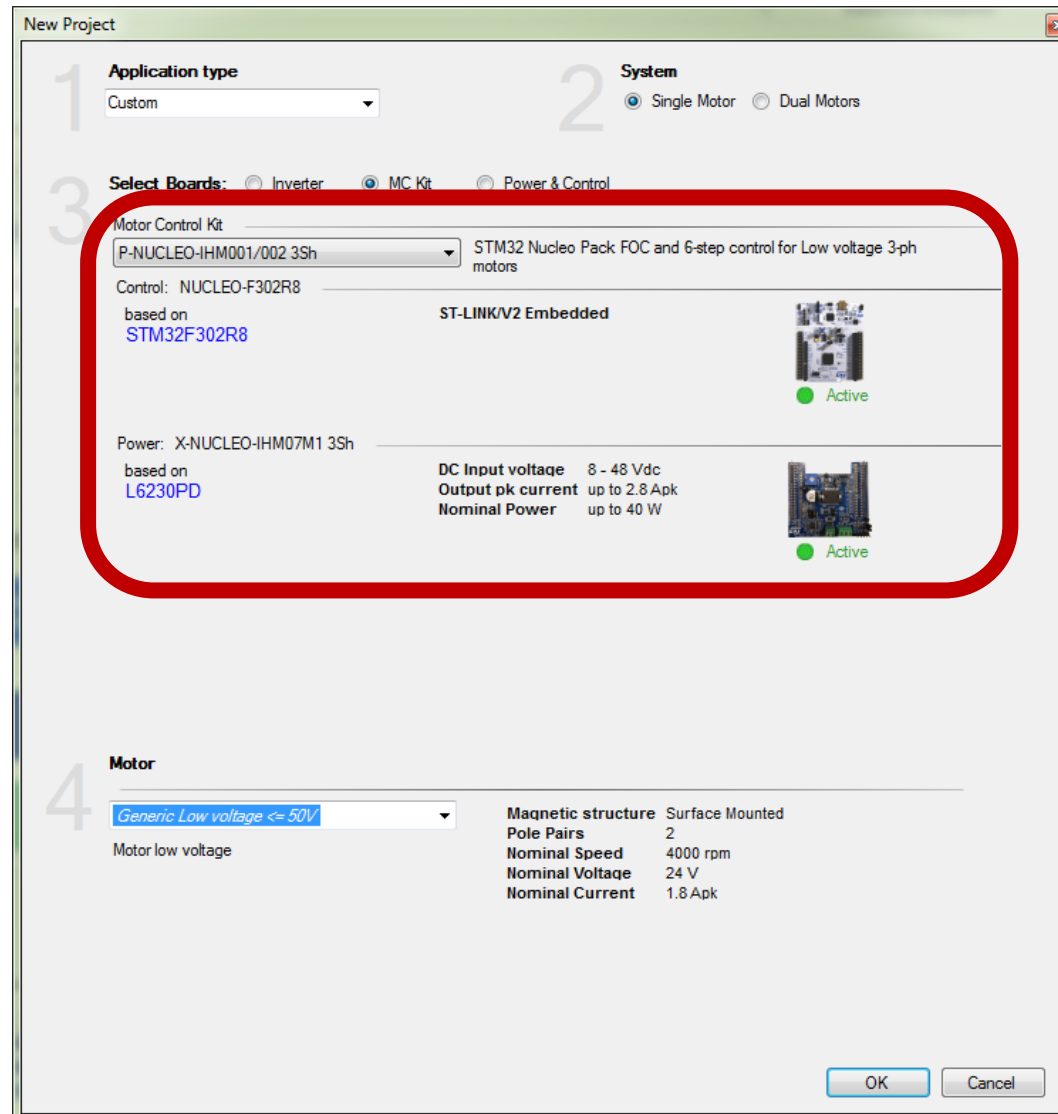
4 **Motor**
Generic Low voltage <= 50V
Motor low voltage
Magnetic structure Surface Mounted
Pole Pairs 2
Nominal Speed 4000 rpm
Nominal Voltage 24 V
Nominal Current 1.8 Apk

OK Cancel



Use motor in MC Workbench

- Select “P-NUCLEO-IHM001/002 3Sh” in MC Kit part





Select the motor

- Select Generic Low voltage $\leq 50V$ at the bottom of the window New Project.


1 Application type
Custom

2 System
 Single Motor Dual Motors


3 Select Boards: Inverter MC Kit Power & Control

Motor Control Kit
P-NUCLEO-IHM001/002 3Sh STM32 Nucleo Pack FOC and 6-step control for Low voltage 3-ph motors

Control: NUCLEO-F302R8
based on STM32F302R8

ST-LINK/V2 Embedded  Active

Power: X-NUCLEO-IHM07M1 3Sh
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DC Input voltage 8 - 48 Vdc
Output pk current up to 2.8 Apk
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4 Motor
Generic Low voltage $\leq 50V$

Motor low voltage

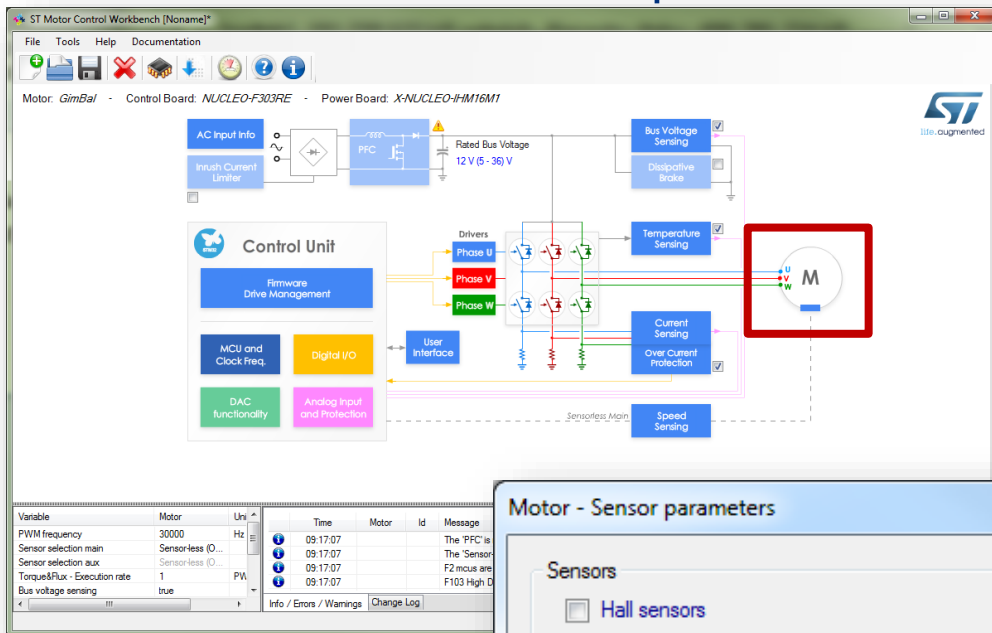
Magnetic structure Surface Mounted
Pole Pairs 2
Nominal Speed 4000 rpm
Nominal Voltage 24 V
Nominal Current 1.8 Apk

OK Cancel

PMSM - motor parameters

STMCWB – Motor section contains:

- Electrical motor parameters
- Motor sensor parameters



Motor - Electrical parameters

Magnetic structure: Surface Mounted PMSM

Electrical parameters:

- Rs: 2.50 Ohm
- Pole Pairs: 4
- Max Rated Speed: 5000 rpm
- Nominal Current: 2.00 A
- Nominal DC Voltage: 325.0 V
- Ls: 8.000 mH
- Demagnetizing Current: 2.0 A Auto
- B-EmfConstant: 22.0 Vms/Krpm

Done

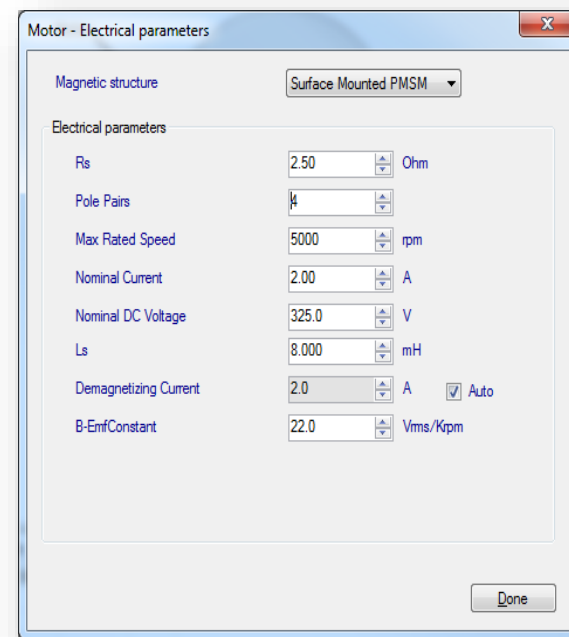
Motor - Sensor parameters

Sensors:

- Hall sensors
 - Sensors displacement: 120 deg
 - Placement electrical angle: 240 deg
- Quadrature encoder
 - Pulses per mechanical revolution: 2000

Done

- Select either Internal PMSM or Surface Mounted PMSM according to the magnetic structure of your motor
- If you don't have this information you need to measure both L_d and L_q inductance for verifying it
- IF $2 \cdot (L_q - L_d) / (L_d + L_q) < 15\%$ **→ SM-PMSM**
- See next slides for learning how to measure motor inductances



Thanks

