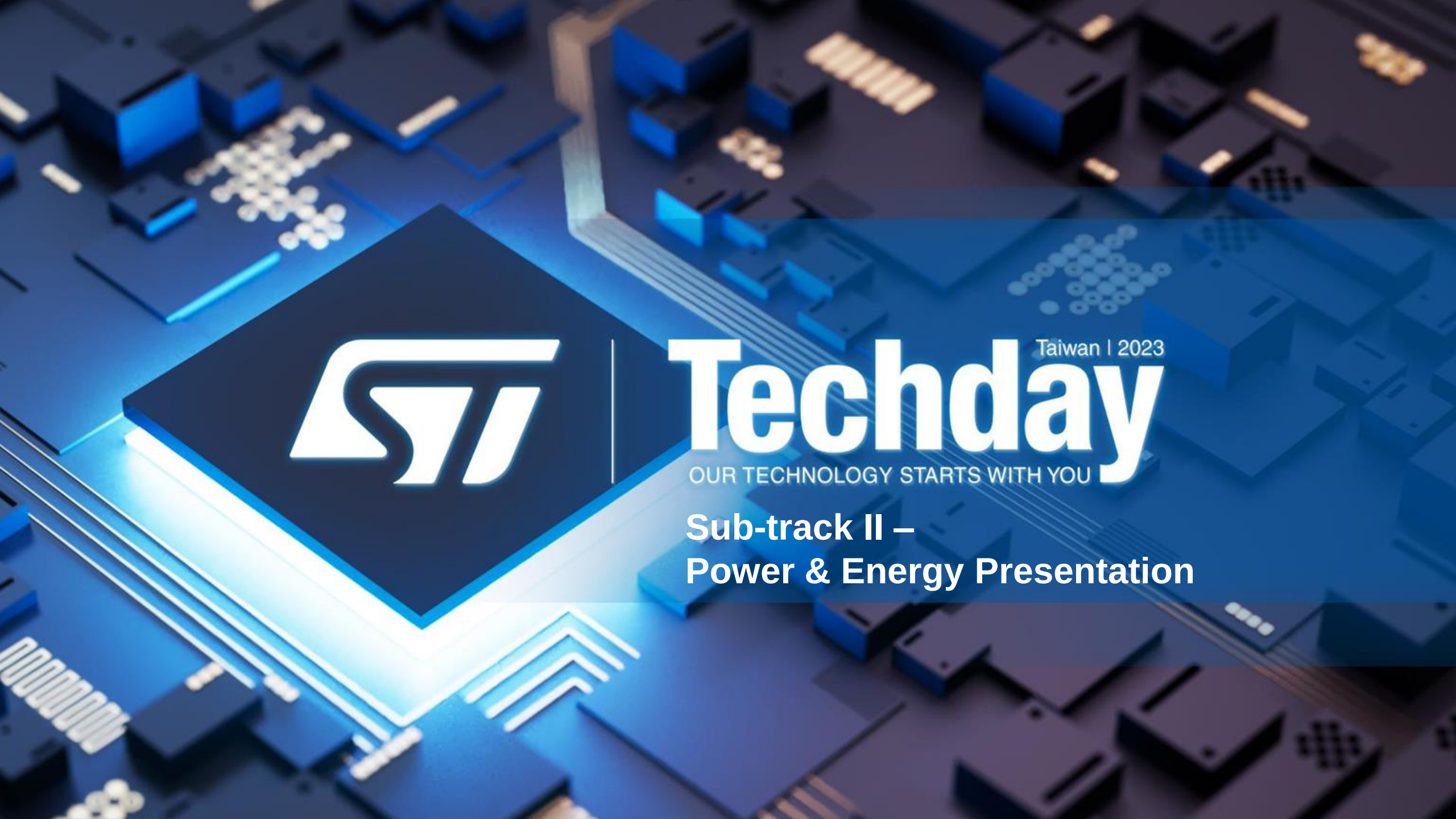

Sub-track II –
Power & Energy Presentation

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STM32 revolutionizing motor control solutions

Otis Chan

STMicroelectronics

STM32

Agenda

1 STM32 for motor control

2 Motor control ecosystem

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STM32 for motor control

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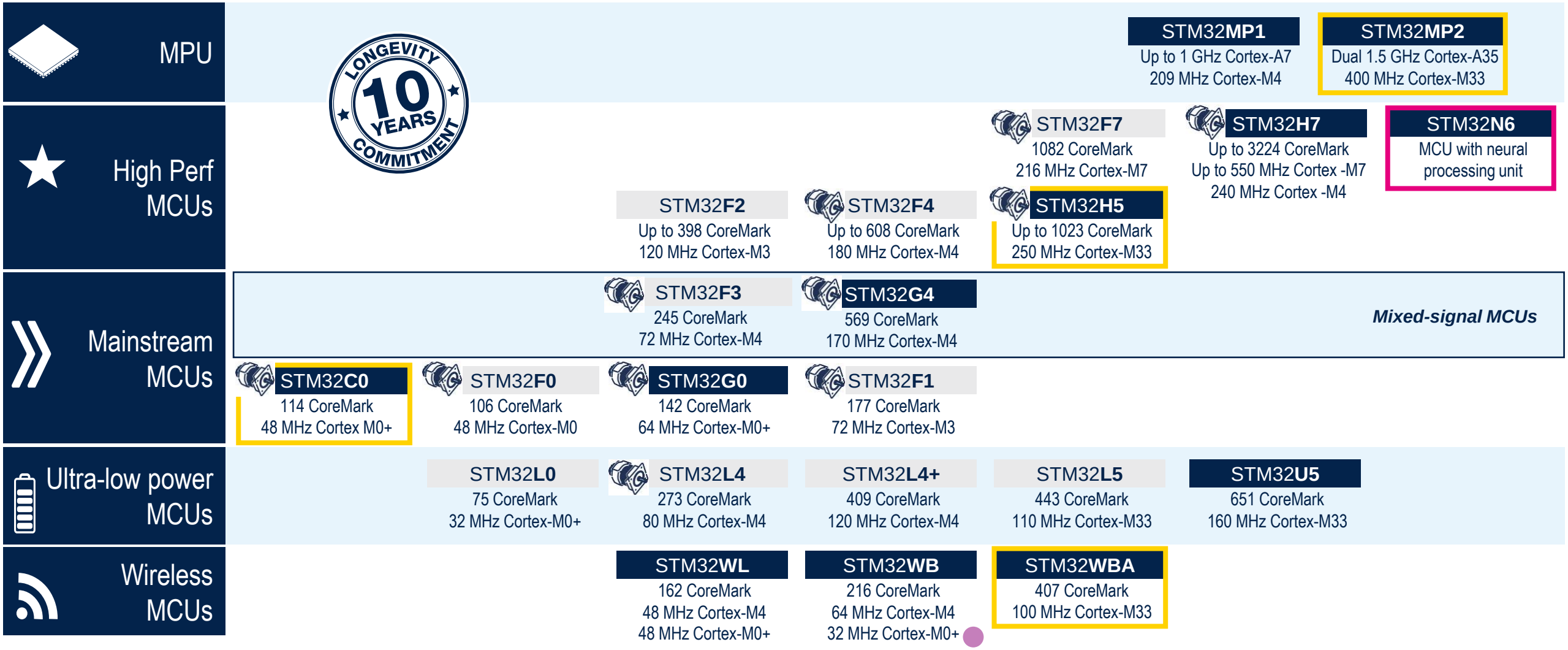
STM32 portfolio



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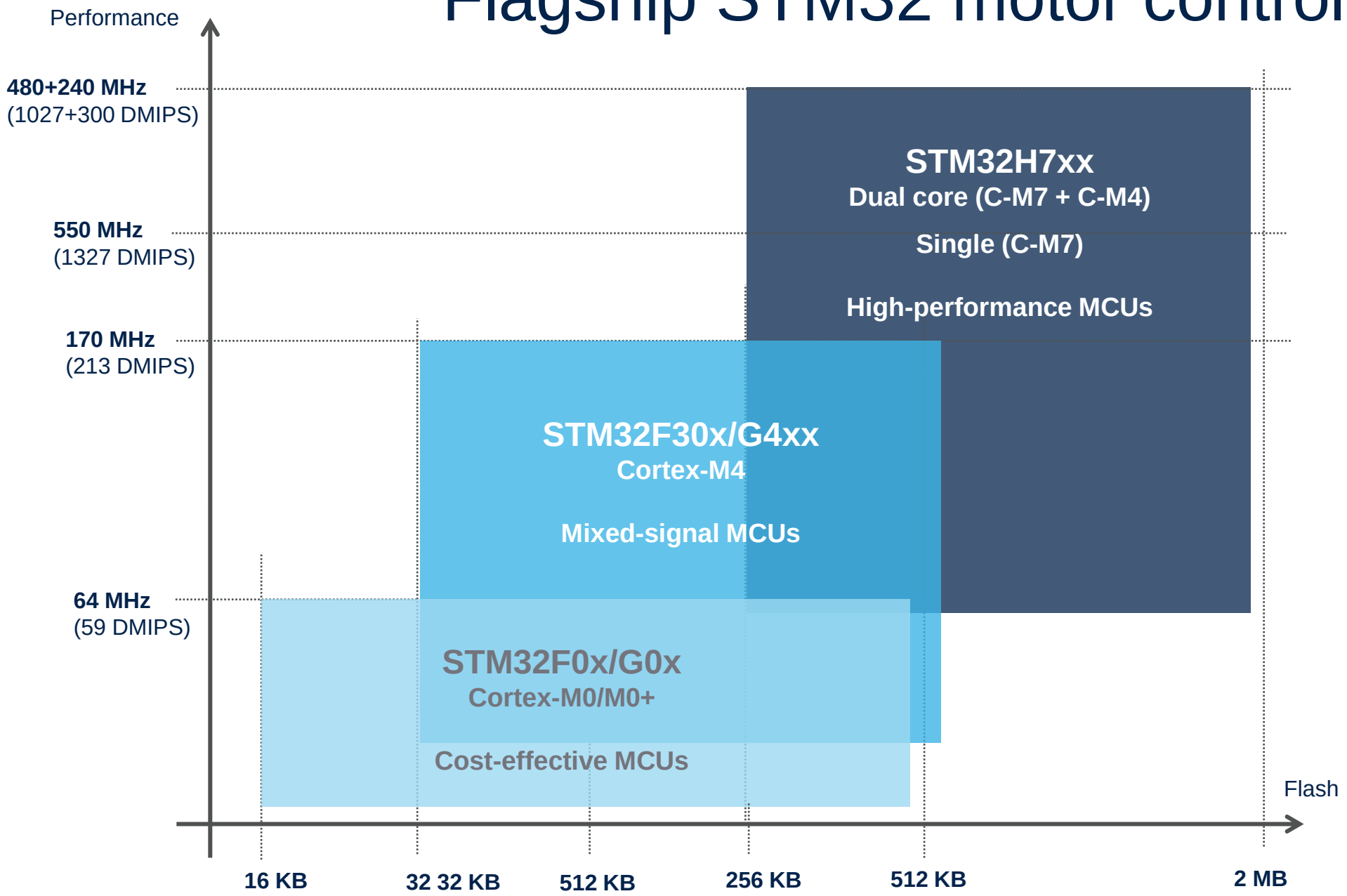
Latest product generation
Radio coprocessor only
New series introduced in 2023
Preannouncement

Flagship STM32 motor control MCUs



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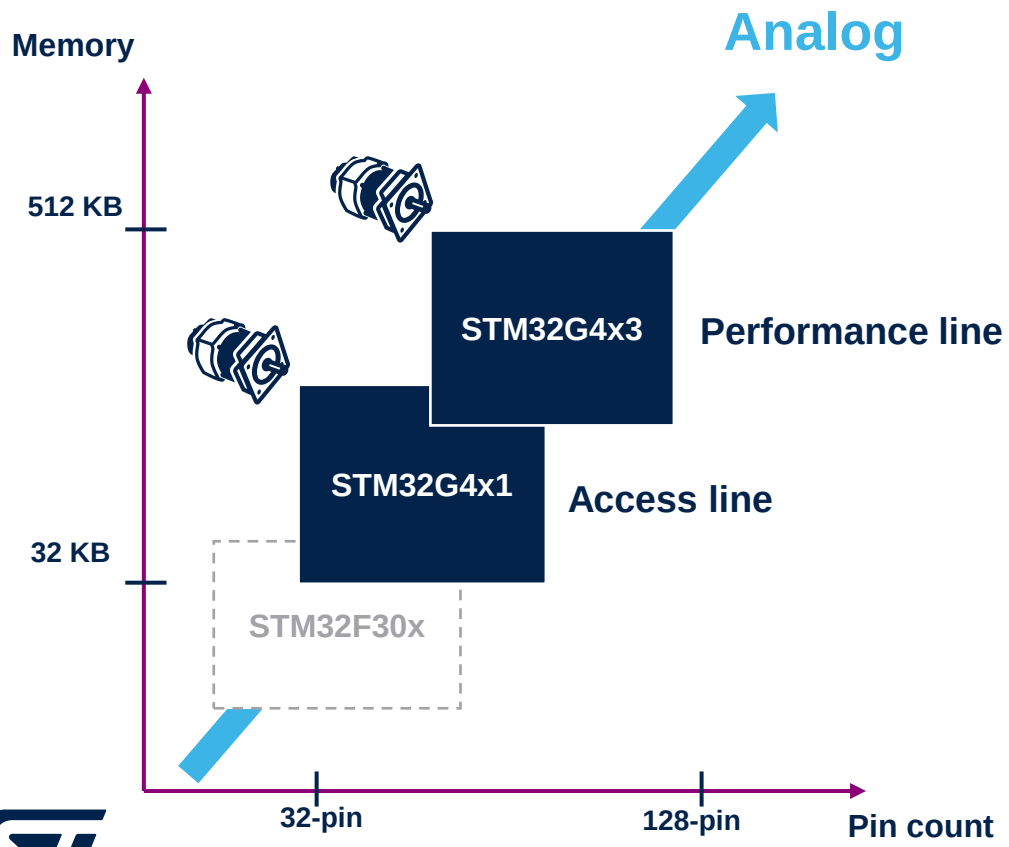
STM32G4 mixed-signal MCUs

Motor control pack

Full feature for motor control and analog

- P-NUCLEO-IHM03

General purpose / motor control



Motor Control

Home appliances, E-bikes, air conditioning,

- Arm Cortex-M4 CPU @ 170 MHz
- Mathematical accelerator (Cordic)
- Advanced Motor control timers
- Fast comparators
- 4 Msps ADC-12-bit + HW oversampling
- Op amp with built-in gain (PGA)
- DAC-12-bit
- 1% RC accuracy
  (UART communication w/o external Xtal)

Industrial devices

Industrial equipment

- Fast CPU 170 MHz
- Mathematical accelerator (Cordic)
- High temperature 125°C
- CAN FD support
- SPI, USART, I²C
- Advanced timers
- Real-time clock with backup registers
- Dual bank flash for live upgrade
- AES & security

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MC-SDK
motor control ecosystem

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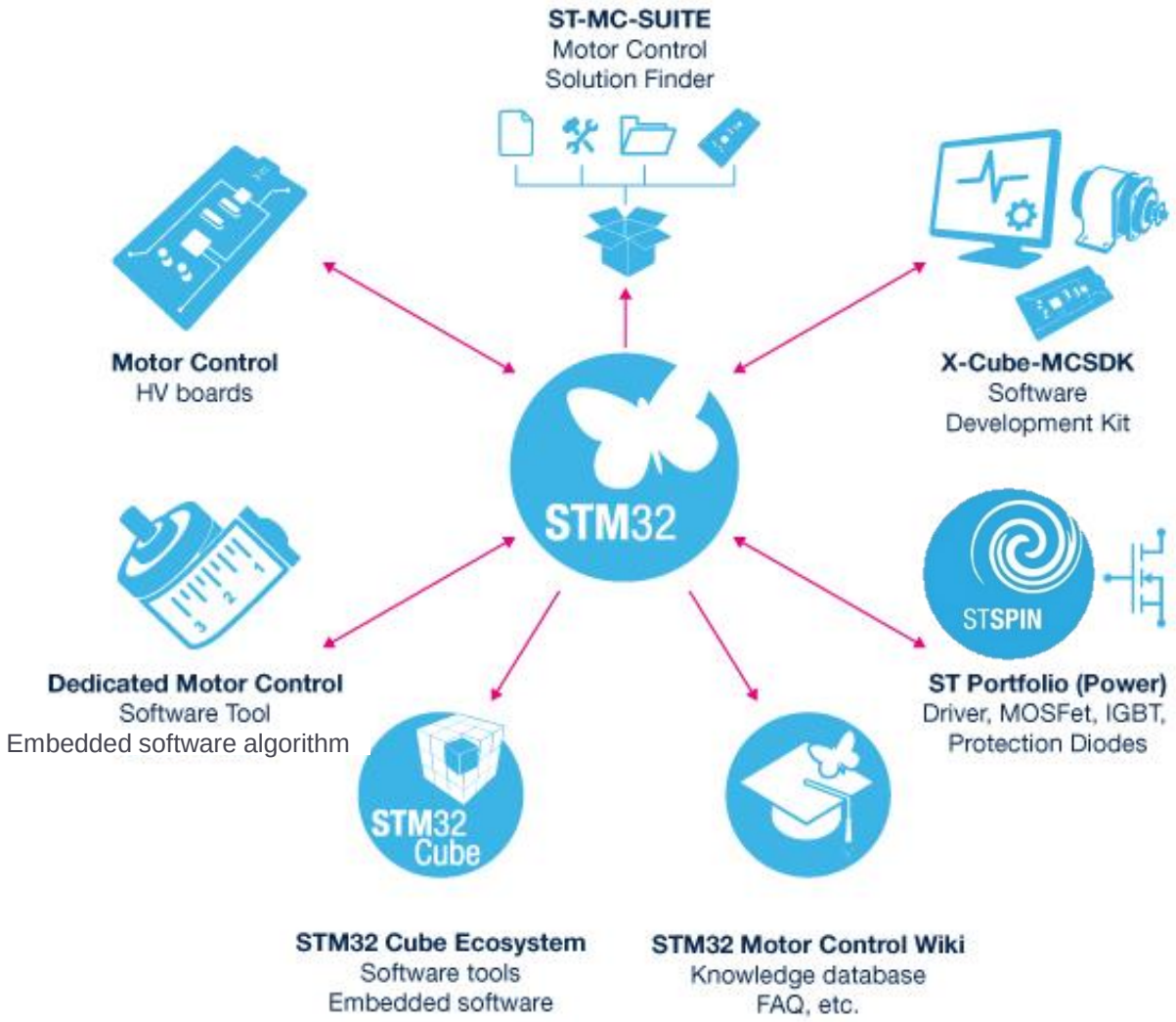
STM32 motor control ecosystem



Motor Control Suite (ST-MC-SUITE)

- Online tool that provides easy access to motor-control resources in the MCU ecosystem - for STM32, STSPIN32, and STM8 MCUs.

Motor Control SW Development Kit (X-CUBE-MCSDK)

- Motor Control FW lib: full feature library
- Motor Control Workbench: Graphical (GUI) configurator/monitor
- For STM32, STSPIN32 MCUs.

STM32Cube

- Embedded software bricks
- Most of STM32 series supported (STM32G4 = Motor Ctrl flagship)

Motor Control Profiler

- Automatic detection of key parameters (Rs, Ls, Ke)
- Zero equipment required
- For STM32 MCUs.

Visit the STM32 Motor control web page:
stm32-motor-control-ecosystem.html

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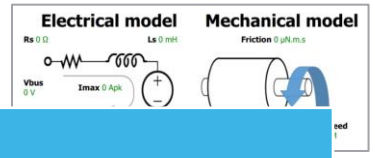
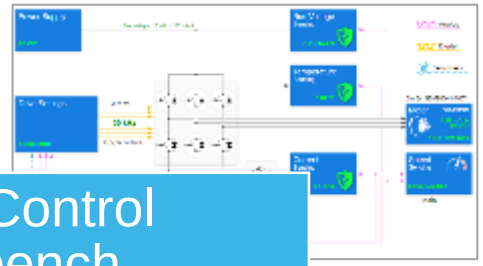
Use ST-MC-SUITE online tool to identify your most appropriate hardware board

From hardware to final motor control application

1 **Hardware setup**

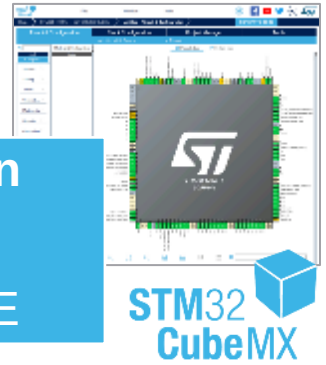


2 **Motor characterization**



3 Motor Control Workbench

System configuration



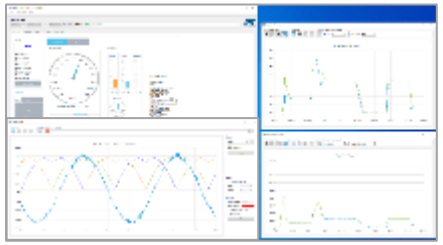
4 **Project configuration**

Project build

STM32CubeMX & IDE

5 **Motor drive tuning**

Motor Pilot



6 **Final application development**

User code

```
#include "MC.h"
{
   CMCI oMCI = GetMCI(M1);
   MCI_ExecSpeedRamp(oMCI, final speed, ramp duration);
   MCI_StartMotor(oMCI);
}
```

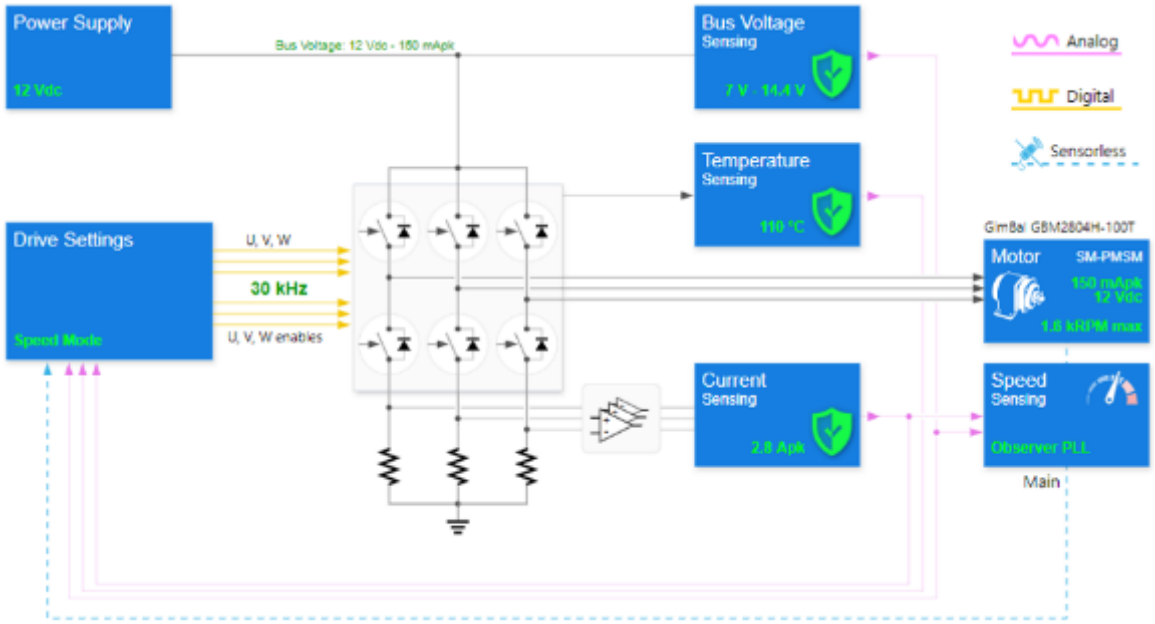
STM32 CubeIDE

IAR

KEIL Tools by ARM

X-CUBE-MCSDK v6.X

What's New in the MC-SDKv6.x?



➔ *Visit the STM32 Motor Control Wiki!*

NEW

FOC and 6-Step supported from the GUI Motor Control Workbench (MCWB)

More autonomy for designers: Designers can describe their own hardware boards and configure its features with the MCWB

More comprehensive graphical peripheral **configuration**

Firmware configuration options match the hardware capabilities
(no impossible case)

Support for all series supported by v5.4+5.Y (except **F1**)
Introduce support for **C0 and H5**

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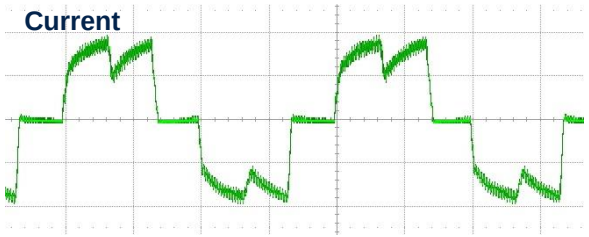
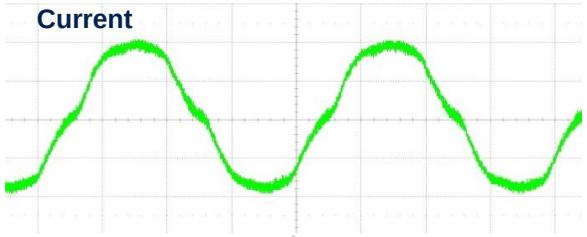
FOC target application and benefit

- Target applications:
  - In applications where:
    - Dynamic performance requirements are moderate
    - Quietness of sinusoidal current control (vs six steps drive) is valuable
    - Extended speed range is required
  - Particularly suitable for pumps, fans, and compressors

Six-steps drive



Sinusoidal control



DW spray & drain pumps

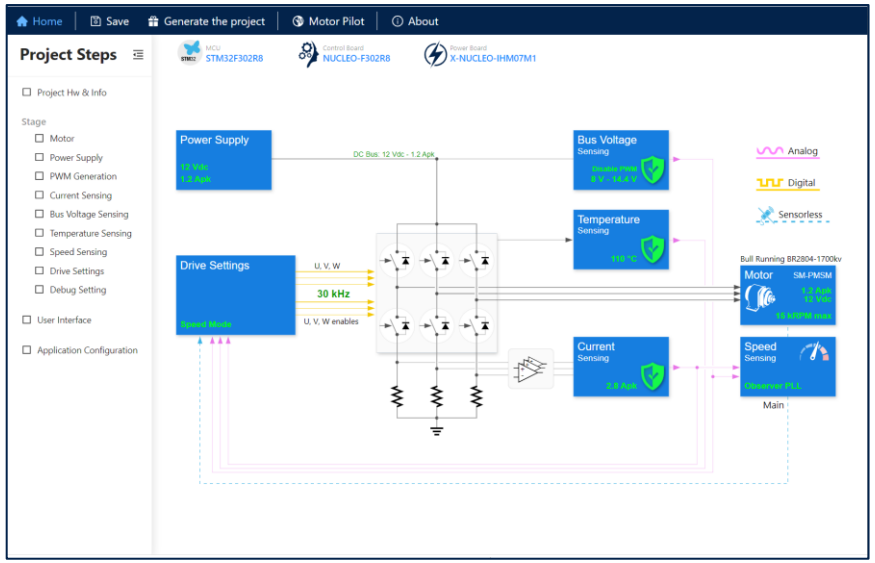
WM Drain pump

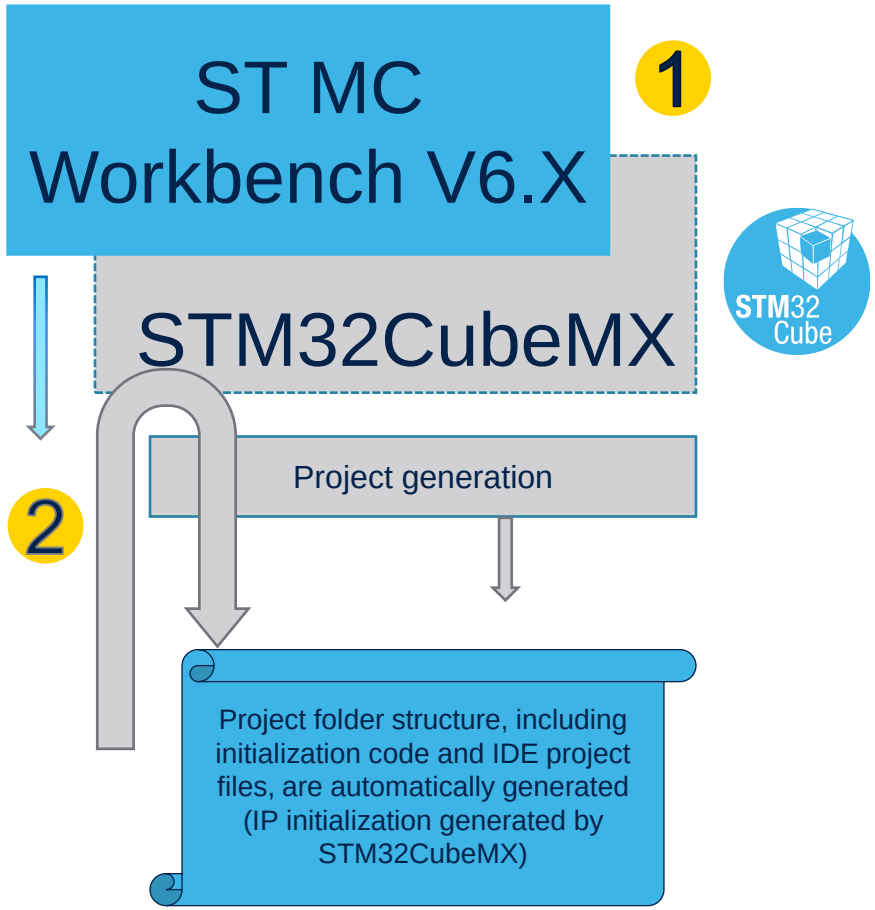
Fridge compressor

- More silent
- Lower torque ripple
- Extended speed range easier to be achieved

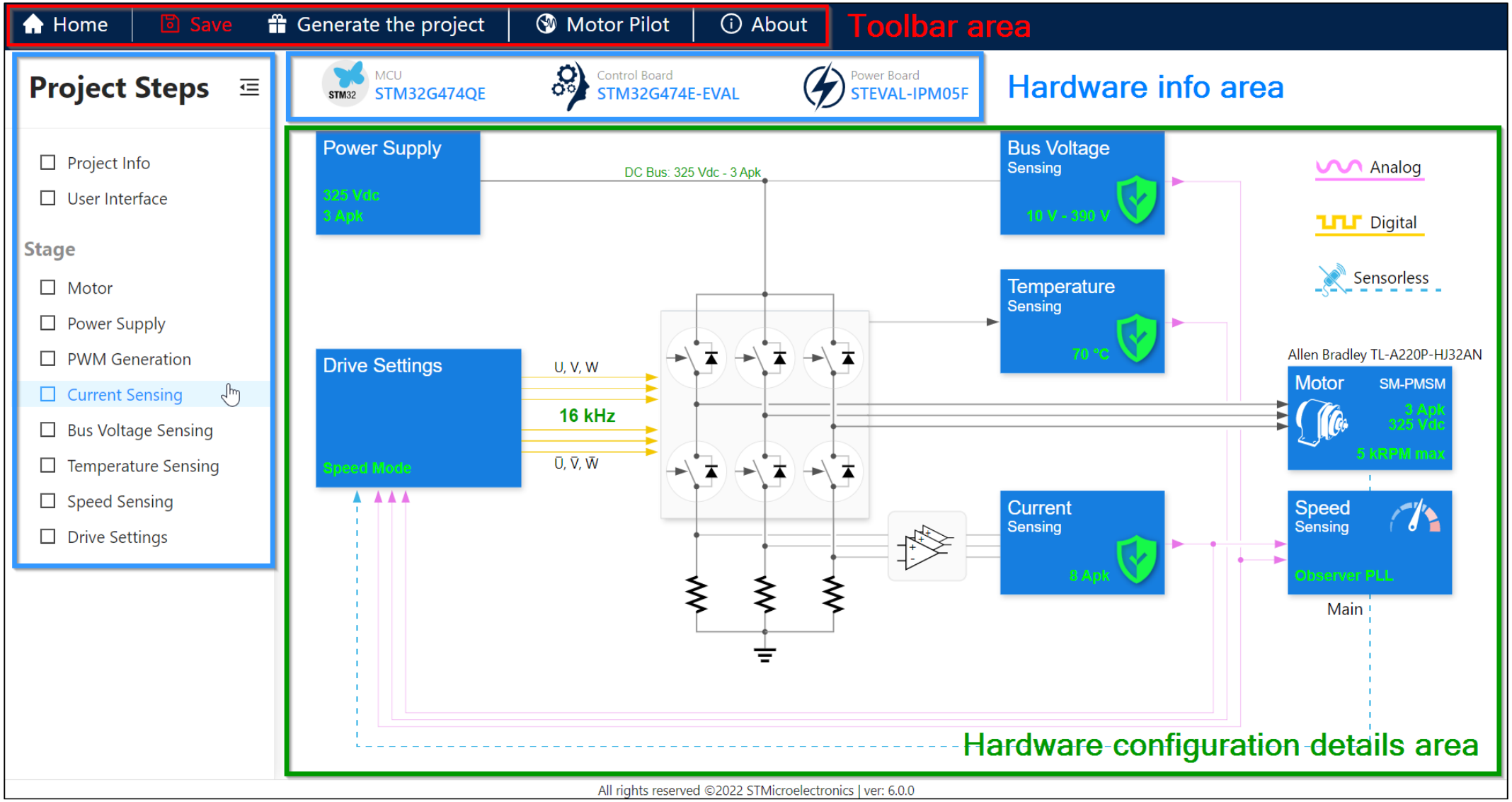
MC Workbench in MC SDK V6.X

- Enhanced for a better usage experience
  - New and nicer look GUI & feel
  - HAL/LL version usage selection
  - IDE version usage selection
  - Additional settings for code generation
  - Automatic migration from older version
- STM32CubeMX should already be installed



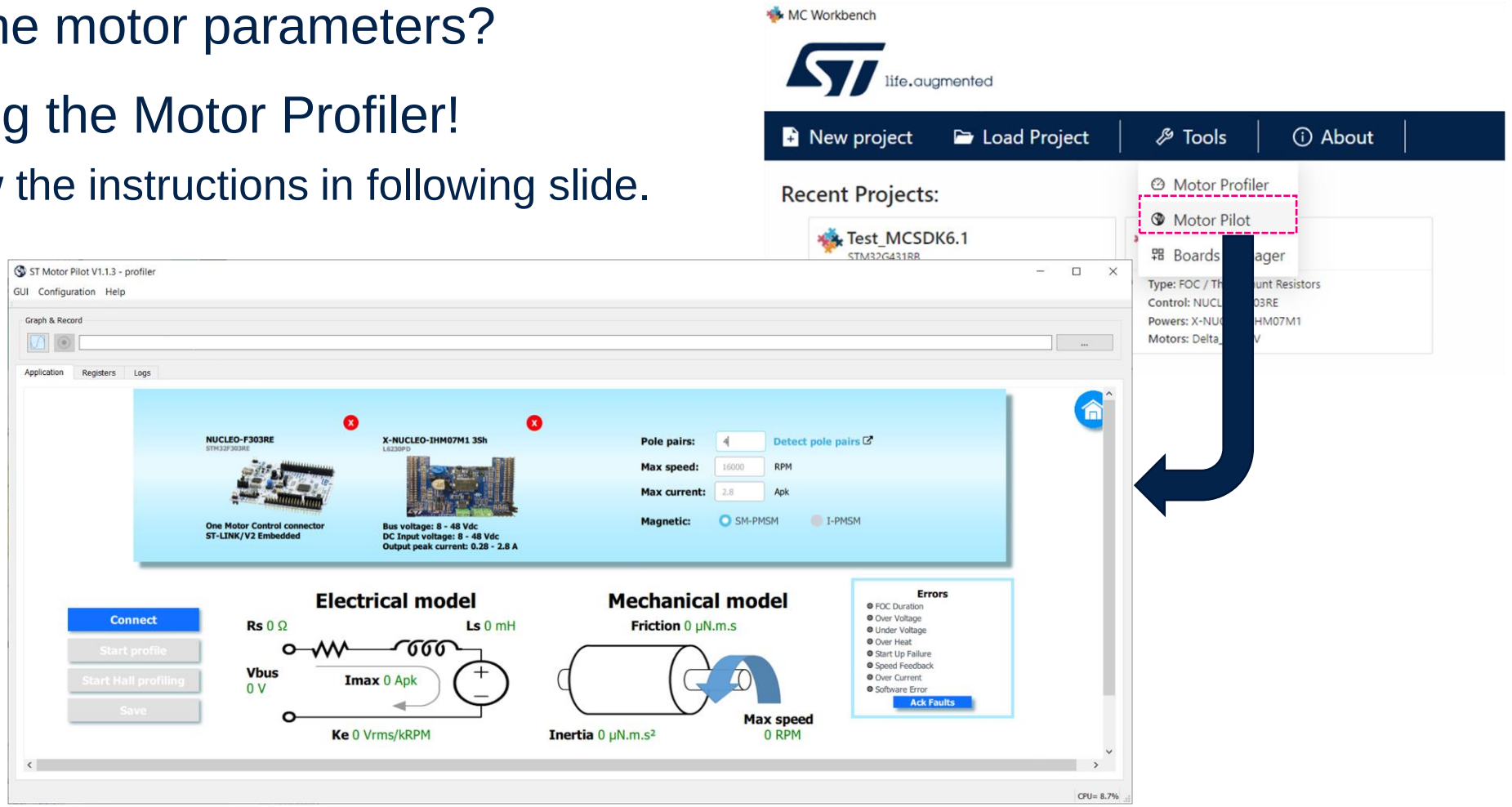


STM32 MC Workbench global view



MC SDK Motor Profiler

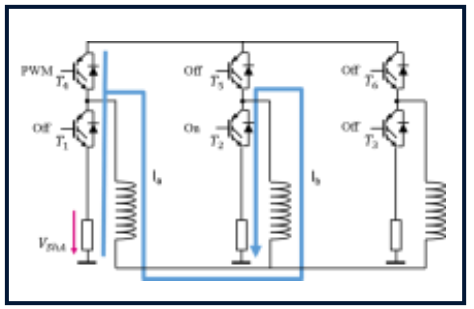
- When the hardware is ready, how can users identify the motor when they don't know the motor parameters?
- By using the Motor Profiler!
  - Follow the instructions in following slide.



Motor Profiler parameter detection step

Motor stopped

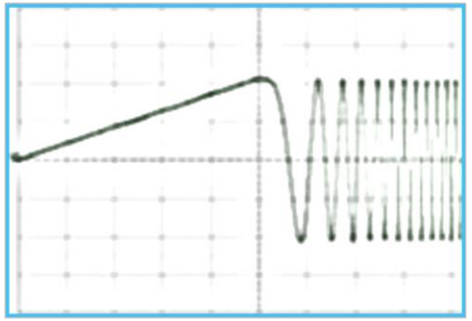
Rs measurement
Ls measurement
Current regulators set-up



10 sec

Open loop

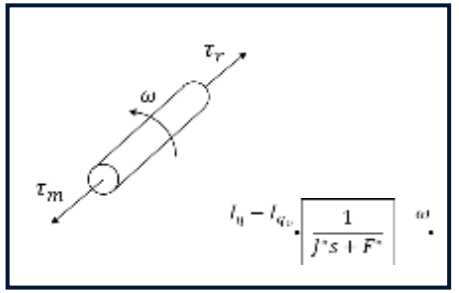
- Ke measurement
- Sensorless state observer set-up
- Switch over



5 sec

Closed loop

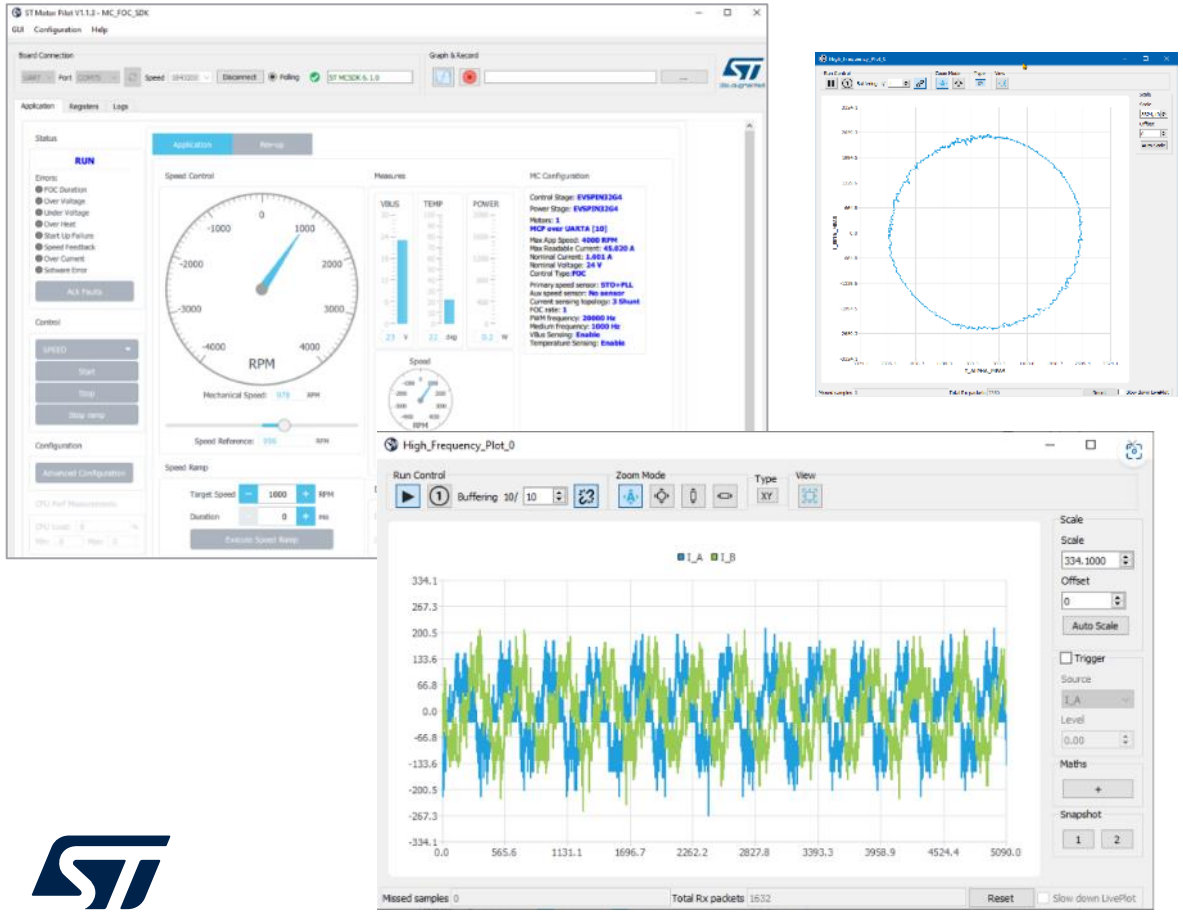
- Friction coefficient measurement
- Moment of inertia measurement
- Speed regulator set-up



45 sec

MC SDK Motor Pilot

Control, monitor, tune, and debug your real-time applications



Real time monitoring: each sample can be plotted and recorded

GUI customization: any developer can easily customize Motor Pilot GUI to fit application needs

Most MCU registers can be monitored

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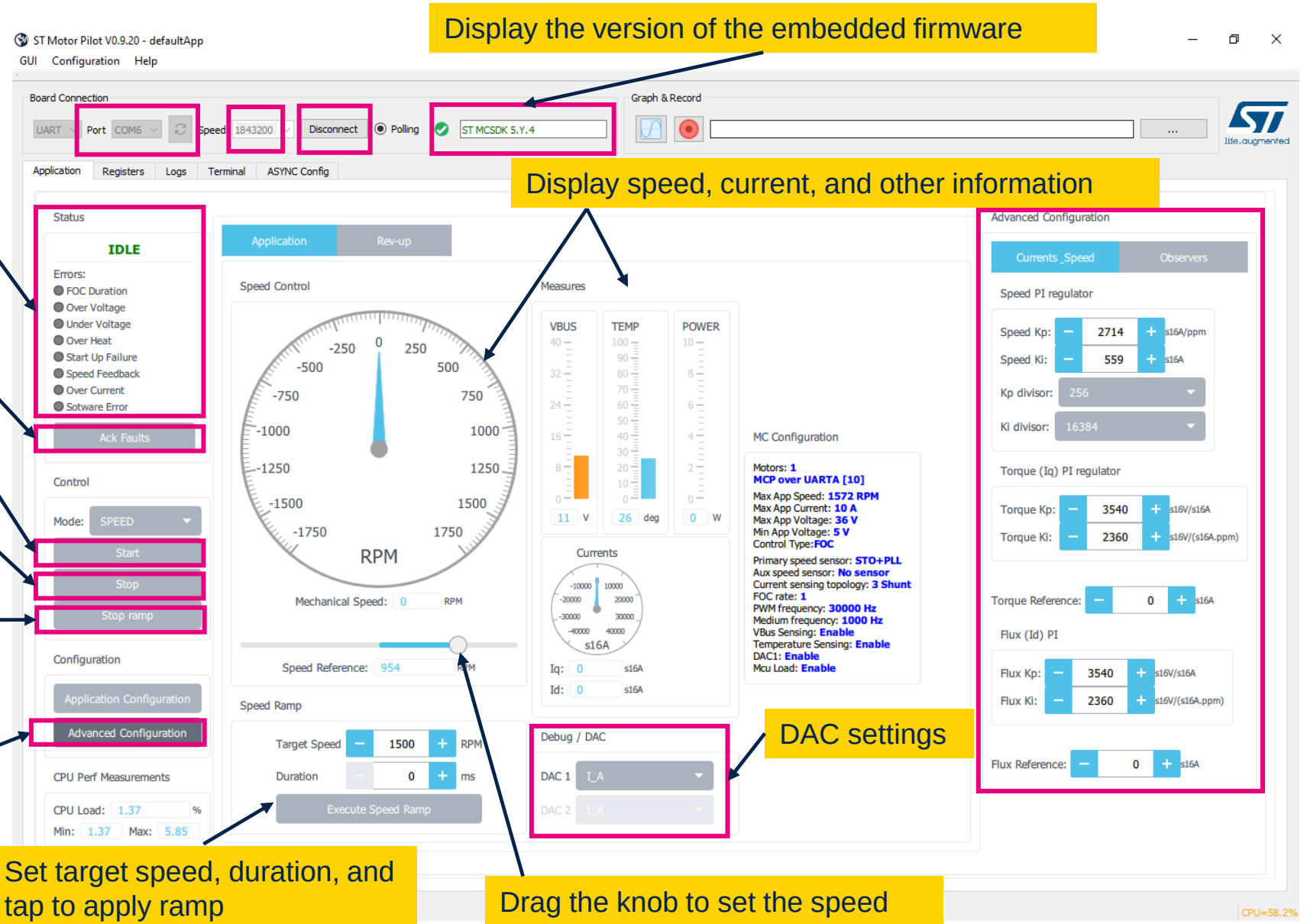
Motor pilot, your digital oscilloscope



Helping motor control designers select the best solution for their design

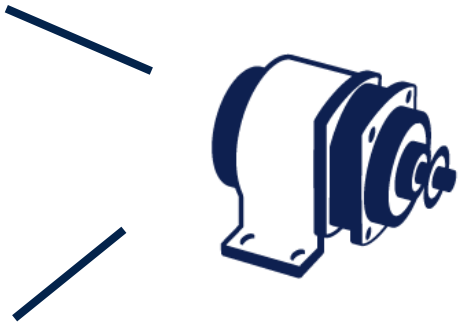
For the highest level of design flexibility, ST offers all products to address a broad range of low- and high-voltage applications, according to the most common application partitioning.

Solution 1
"Discrete"

STM8/32 *(MCU)* + **STDRIVE** *(Gate driver)* + **STPOWER** *(MOSFET)*

Solution 2
"Power integration"

STM8/32 *(MCU)* + **STSPIN / PWD-SPIN** *(Gate drivers + MOSFET)*



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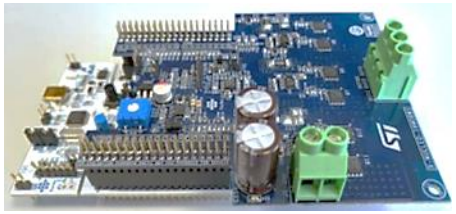
Flexible motor control platforms

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**			

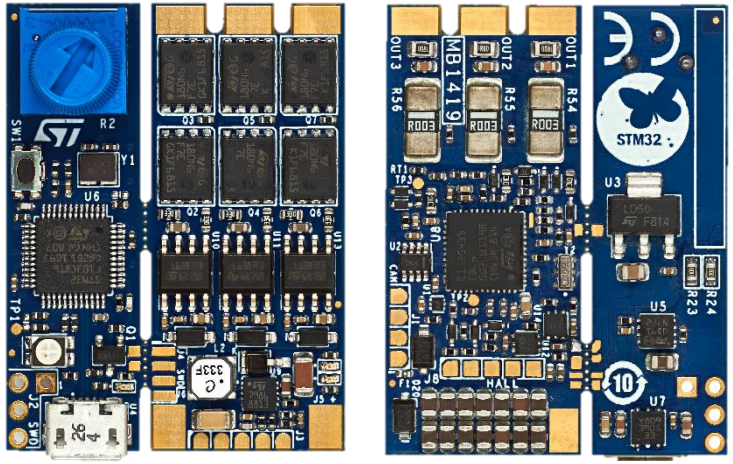
Board list

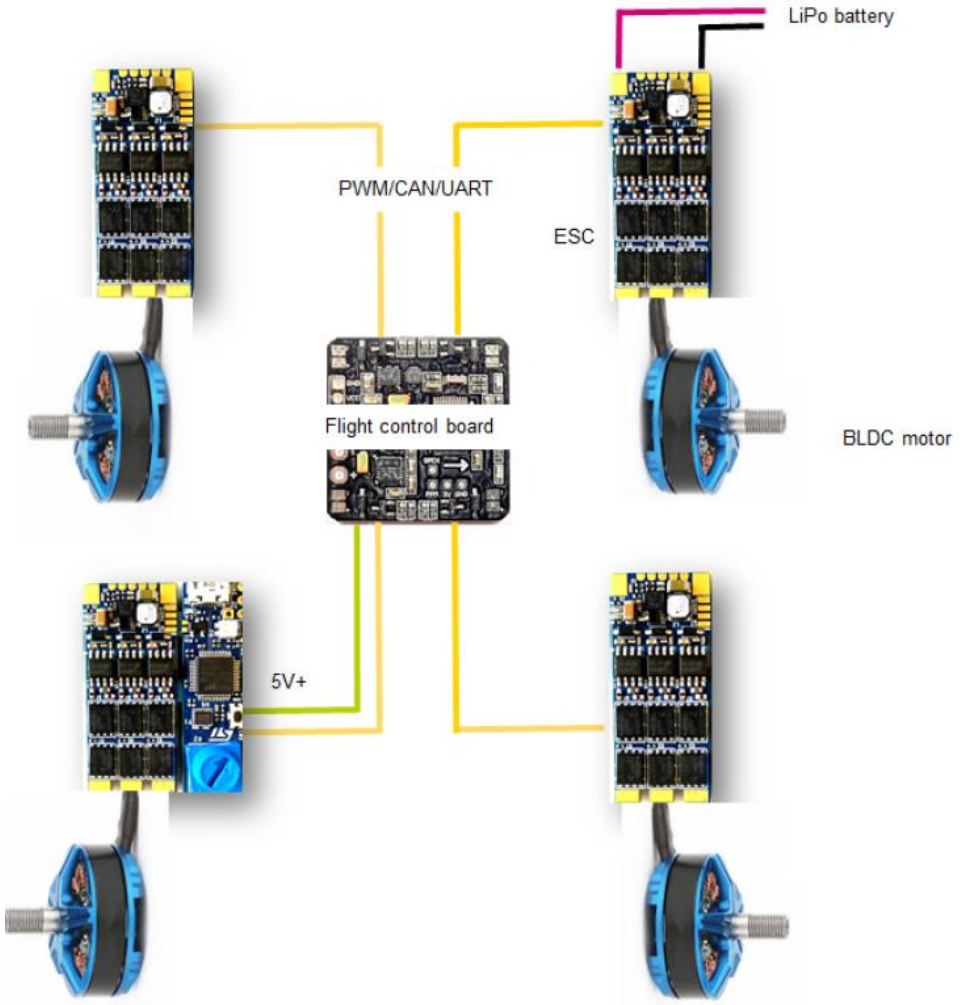
B-G431B-ESC1 discovery kit

Electronic speed controller

- FOC and 6-step algorithms for BLDC/PMSM
- Designed for drones with up to 6S LiPo
- Output peak motor current 40A

- STripFET F7 power MOSFETs – 60 V, 120 A
- Arm(a) Cortex®-M4 32-bit STM32G431CB MCU





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ST MC Workbench technical document

From ST website:

Title	Type	Contents
AN5143	Application note	How to migrate motor control application software from SDK v4.3 to SDK v5.x
AN5166	Application note	Guidelines for control and customization of power boards with STM32 MC SDK v5.0
UM2374	User manual	Getting started with STM32 motor control SDK v5.0
UM2380	User manual	STM32 motor control SDK v5.0 tools
UM1052	User manual	STM32F PMSM single/dual FOC SDK v4.3
UM1053	User manual	Advanced developer's guide for STM32F MCUs PMSM single/dual FOC library
UM1080	User manual	Quick start guide for STM32F PMSM single/dual FOC SDK v4.3
UM2392	User manual	STM32 Motor Control SDK_V5.x
UM3016	User manual	How to use STM32 motor control SDSK v6.0 profiler
UM3027	User manual	How to use STM32 motor control SDK v6.0 workbench

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