Motor Driver Solutions for Ultra-low Voltage Applications

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ST Applications Engineer

STSPIN™ Family

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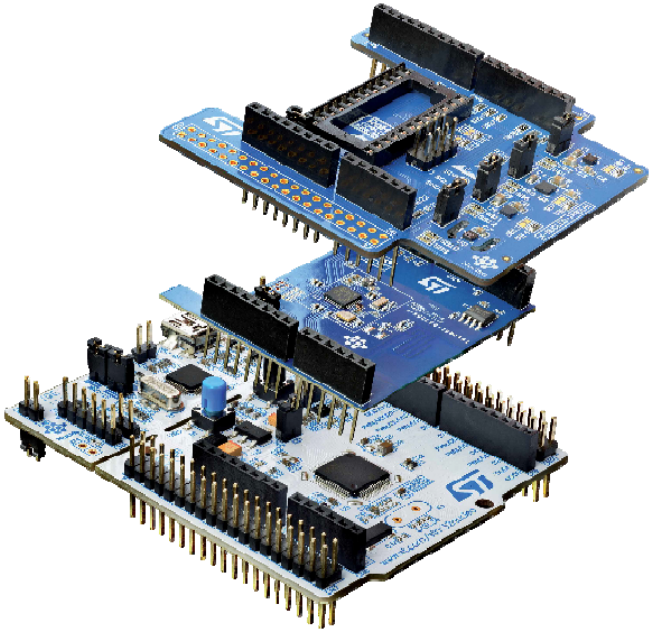
Technology Tour 2017

Agenda

- STSPIN family
- Design tip
- STSPIN Nucleo setup & tools
- Typical STSPIN BOM
- ST technical support
- Q & A



What you will learn today

- Quickly develop a prototype
- Overcome design challenges when running motors from a battery or low-voltage input
- Design motor-control solutions with minimal space/height requirements
- Test and improve various system-level characteristics
- Available evaluation boards and supporting software

STSPIN Family Overview

STSPIN220
Advanced Stepper-Motor Driver

STSPIN230
Advanced 3-Phase BLDC-Motor driver

STSPIN240
Multi DC Motor-Driver

STSPIN250
DC Motorr-Driver

Benefits that matter !
in a growing battery-powered world

Extremely low driving voltage range 1.8V-10V operating

Extremely low STBY I consumption (<80nA)

Fully protected with UVLO, over-current and thermal protections

Extremely compact ultra-small package QFN

STSPIN Applications

Medical & Appliances

Point of Sales

Toys and Gaming

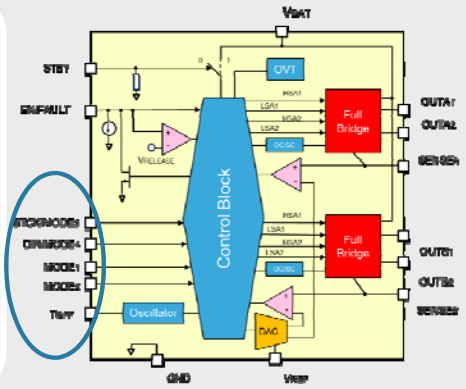
Drones

STSPIN$_{battery}$ never stop Your Low Power MOTOR

STSPIN Family Overview

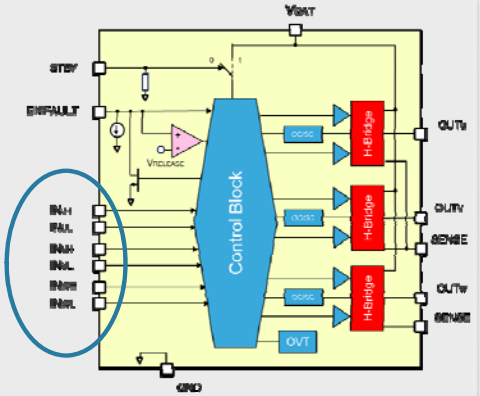
STSPIN220
Advanced Stepper-Motor Driver

- Easily driving with clock & direction control
- Up to 256 micro-steps
- Current control auto-adjusted decay



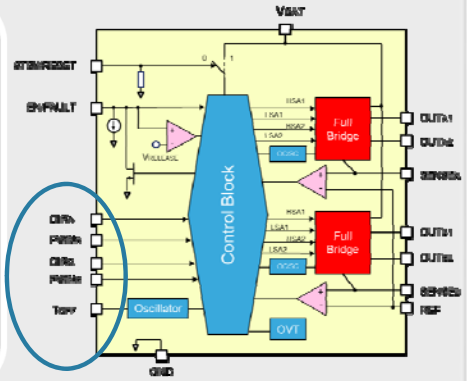
STSPIN230
Advanced 3-Phase DC-Motor Driver

- Easily driving with direct input control



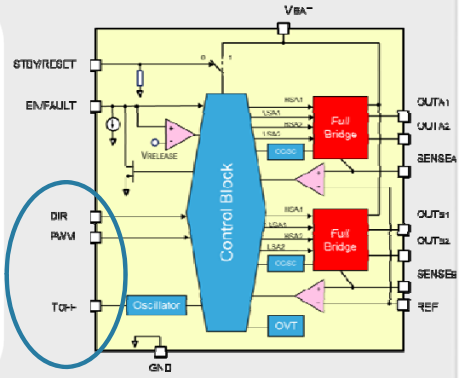
STSPIN240
Multi DC-Motor Driver

- Easily driving with direct input control
- Current limiter with programmable. threshold



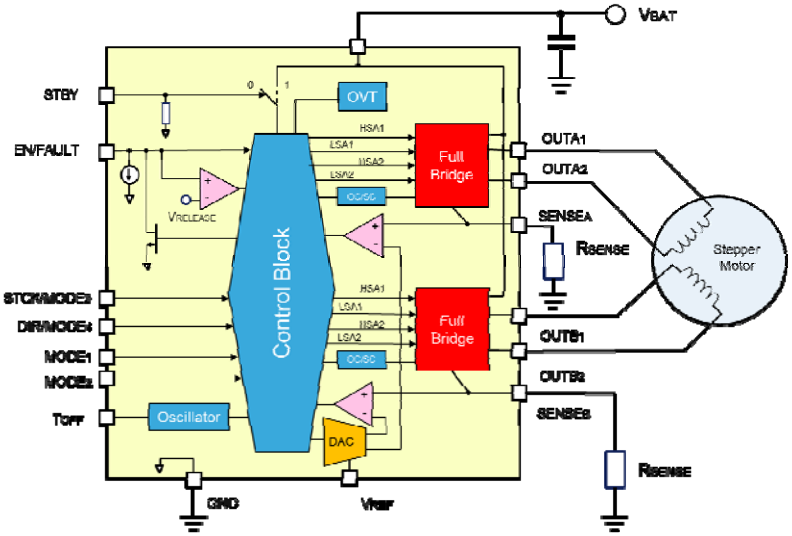
STSPIN250
DC-Motor Driver

- Outputs in Parallel for Current Doubling
- Easily driving with direct input control
- Current limiter with programmable. threshold



STSPIN Stepper-Motor Driver

STSPIN220 for battery-powered micro-stepping

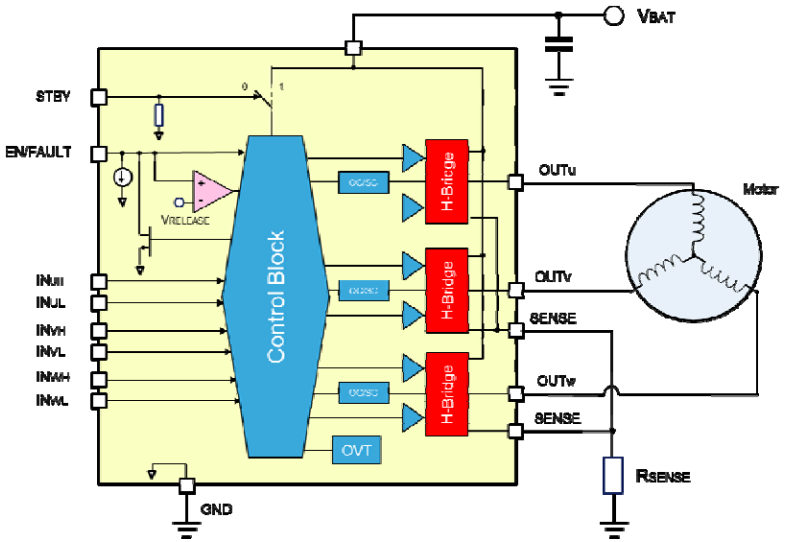


- Supply: 1.8V – 10V
- **Dual Full-bridge:**
  - **1.3A_{rms} (2A peak)**
  - **$R_{DS(ON)}$ = 0.4Ω (HS+LS)**
- Step-clock / direction Inputs
- **Up to 256 micro-step resolution**
- **PWM I control with programmable off-time**
- **Extremely low STBY consumption (<80nA)**
- Fully protected:
  - Non-dissipative OCP
  - Cross conduction protection
  - Thermal shutdown & UVLO
- **Ultra-compact QFN package**

Possible applications

STSPIN 3-Phase Motor Driver

STSPIN230 for sensorless battery-powered BLDC

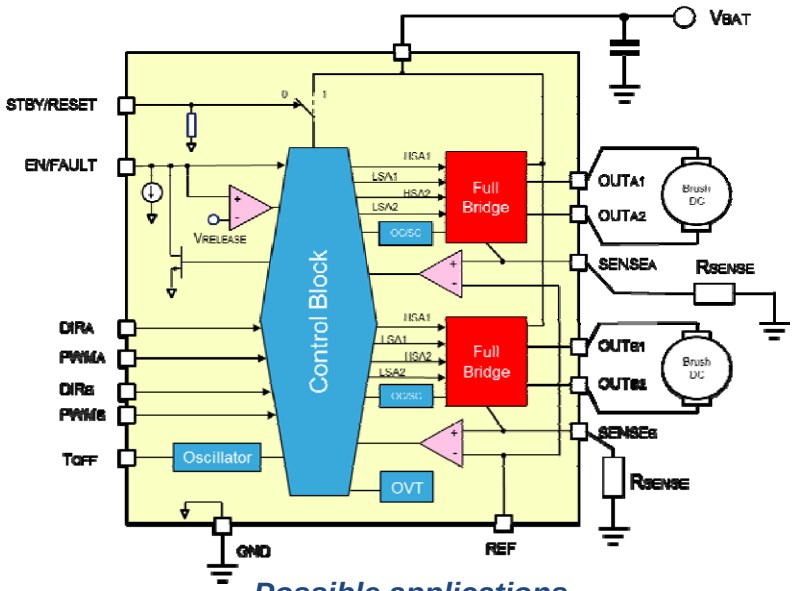


- Supply: 1.8V – 10V
- **3 Half-Bridges:**
  - **1.3A_{rms} (2A peak)**
  - **$R_{DS(ON)}$ = 0.4Ω (HS+LS)**
- Direct Inputs driving
- **I control with programmable off-time**
- **Extremely low STBY consumption (<80nA)**
- **FW support for 1 shunt FOC**
- Fully protected:
  - Non-dissipative OCP
  - Cross conduction protection
  - Thermal shutdown & UVLO
- **Ultra-compact QFN package**

Possible applications

STSPIN 3-Phase Motor Driver

STSPIN240 for battery-powered DC



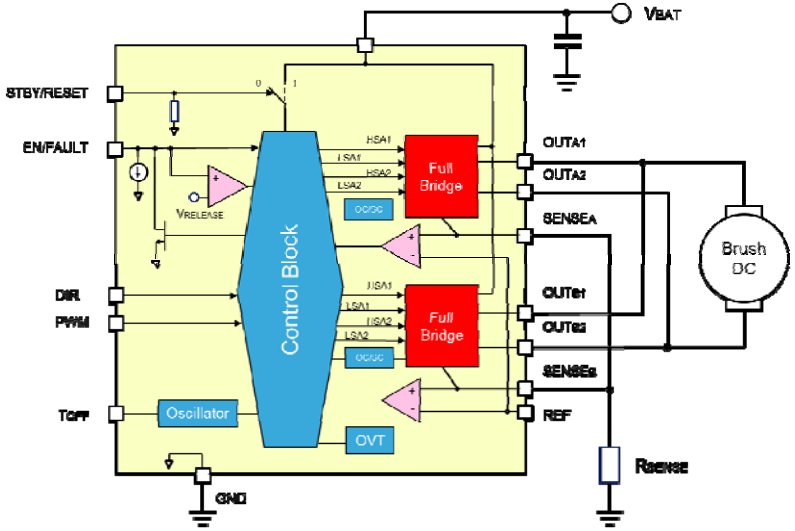
Possible applications

Package
✓ QFN3x3

- Supply: 1.8V – 10V
- **Dual Full-bridge:**
  - **1.3A_{rms} (2A peak)**
  - **$R_{DS(ON)}$ = 0.4Ω (HS+LS)**
- Direct PWM Inputs driving
- **Extremely low STBY consumption (<80nA)**
- Fully protected:
  - Non-dissipative OCP
  - Cross conduction protection
  - Thermal shutdown & UVLO
- **Ultra-compact QFN package**

STSPIN DC Brushed-Motor Driver

STSPIN250 for battery-powered DC

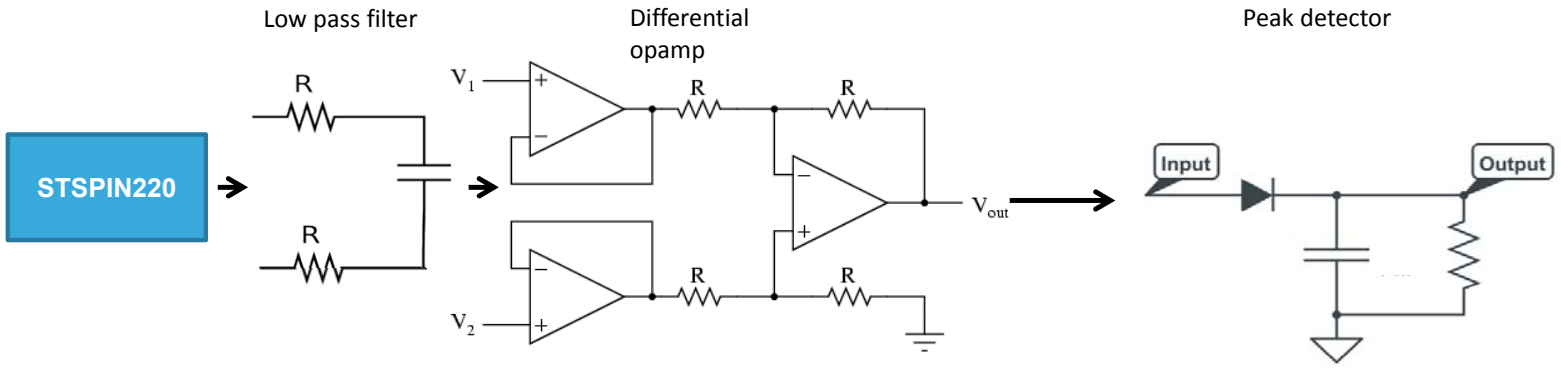


- Supply: 1.8V – 10V
- **Dual Full-bridge for Parallel Outputs;**
- **Higher I & lower R_{DSON}**
  - **2.6A_{rms} (4A peak)**
  - **$R_{DS(ON)}$ = 0.2Ω (HS+LS)**
- Direct PWM Inputs driving
- **Extremely low STBY consumption (<80nA)**
- Fully protected:
  - Non-dissipative OCP
  - Cross conduction protection
  - Thermal shutdown & UVLO
- **Ultra-compact QFN package**

Possible applications

Stall-Detection Circuit

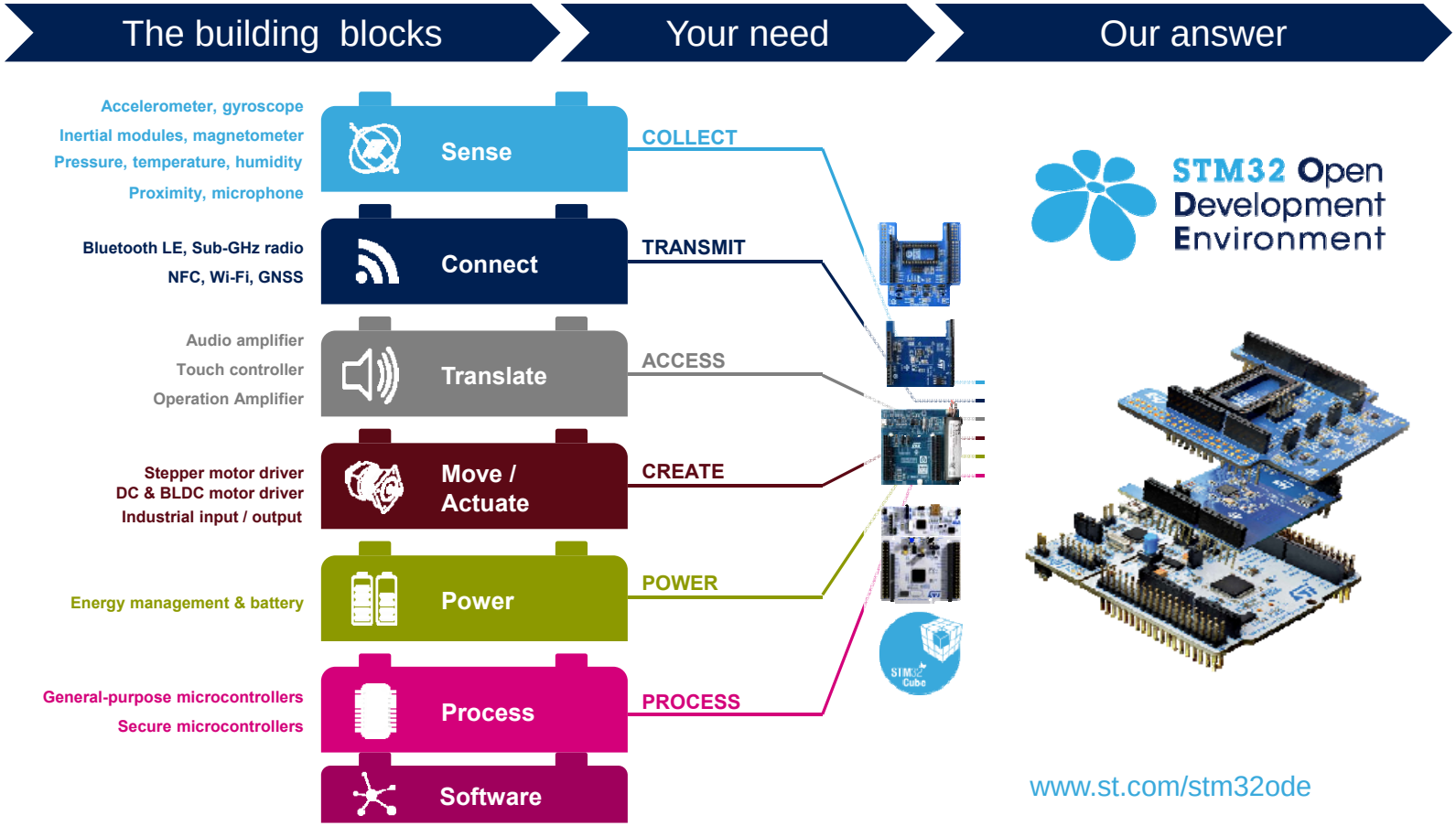
Utilizing the characteristics of the integrated current controller, we know that when a stall occurs, the controller will drastically reduce the applied voltage to keep current under control in the face of the loss of motor back-EMF. Since applied voltage should be much higher at running speeds (under normal conditions) detecting this lower applied voltage (when it should be higher) can signal a stall condition.



STSPIN Setup & Tools

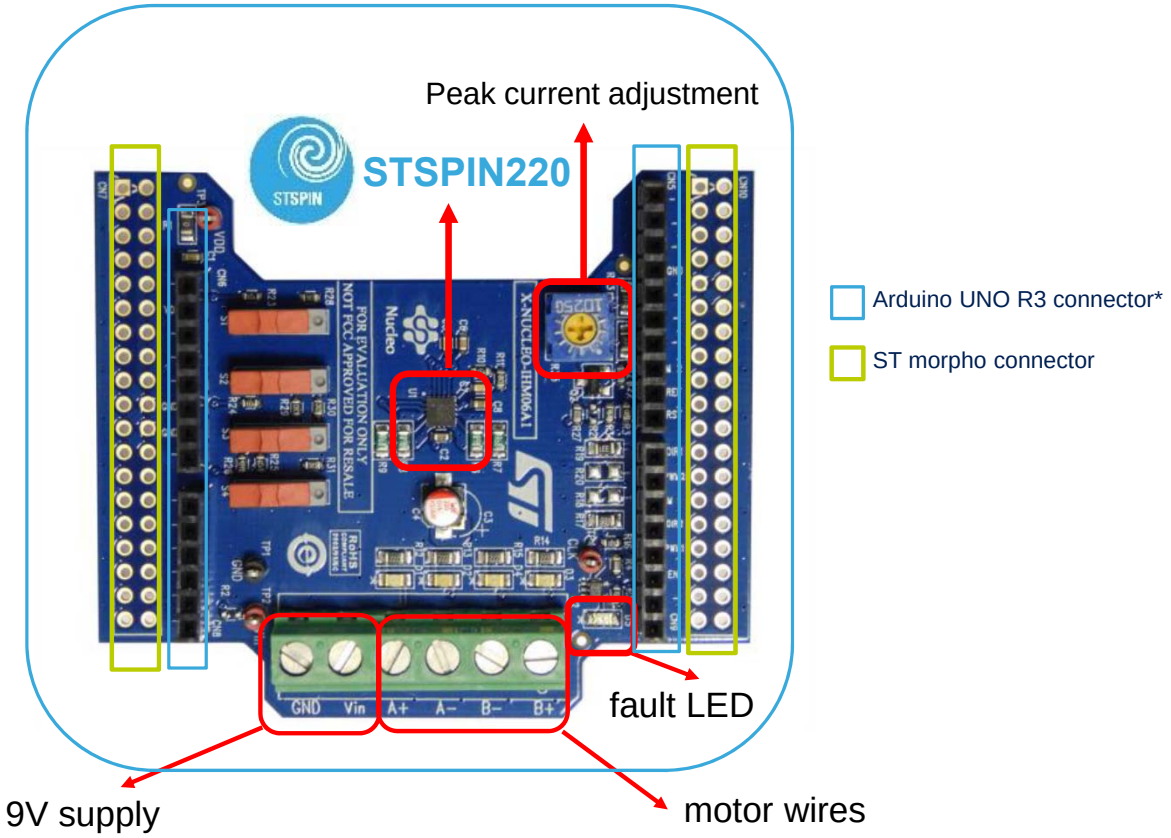
- STM32 Nucleo Shield Board with STSPINxxx
- X-NUCLEO-IHM06A1 for STSPIN220
- X-NUCLEO-IHM11M1 for STSPIN230
- X-NUCLEO-IHM12A1 for STSPIN240
- X-NUCLEO-IHM13A1 for STSPIN250
- STM32 Nucleo Board with STM32F401 with STLink and COM port emulator
- SPINFamily Evaluation Tool v3.2
- Motor Control Workbench
- SW supporting tools e.g. IAR, Keil

STM32 Open Development Environment

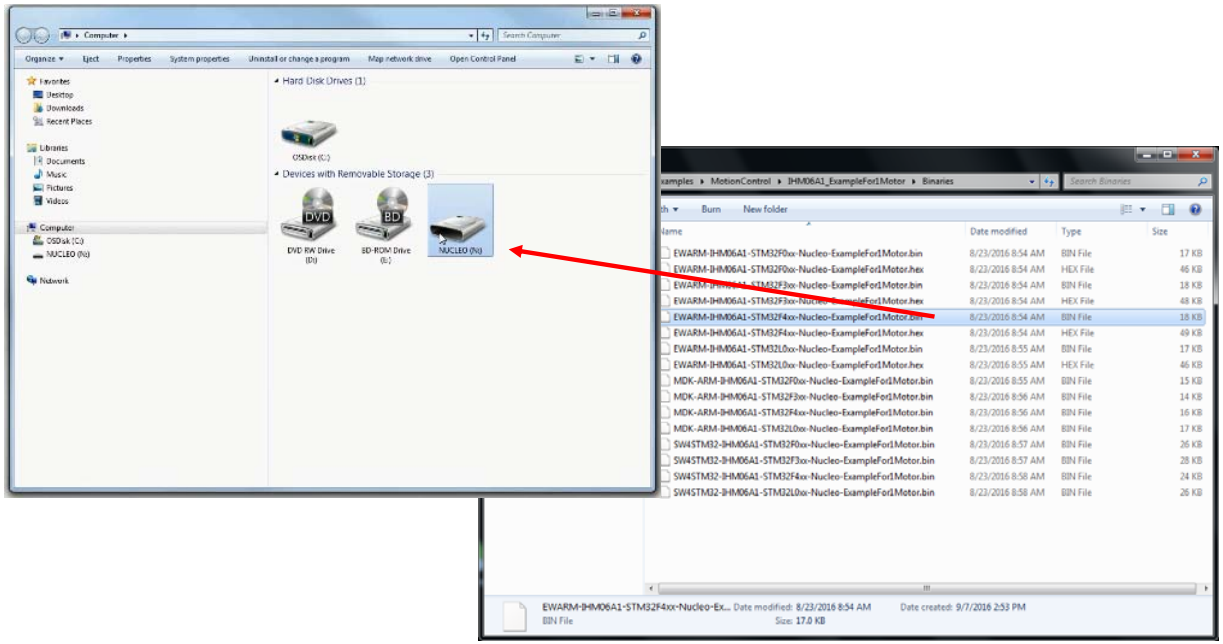


www.st.com/stm32ode

X-NUCLEO-IHM06A1 for STSPIN220

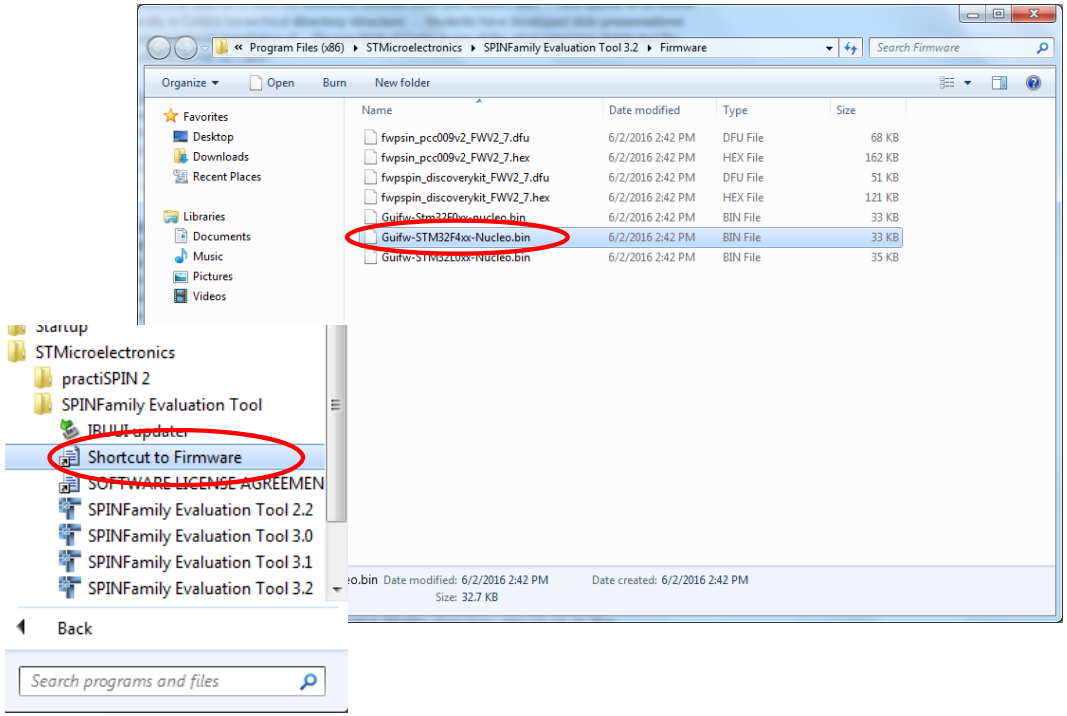


Starting with X-Cube SPN6

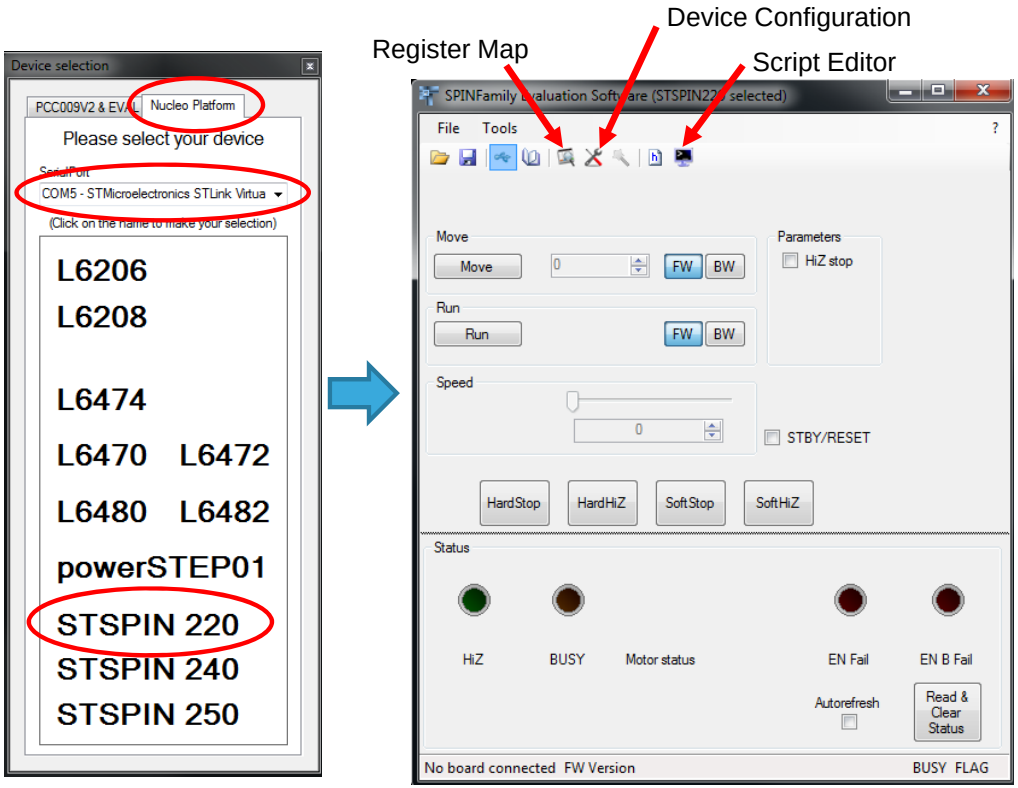


STM32Cube expansion software (X-CUBE) - Expansion software provided free for use with the STM32 Nucleo expansion board and fully compatible with the STM32Cube software framework. It provides abstracted access to expansion board functionality through high-level APIs and sample applications.

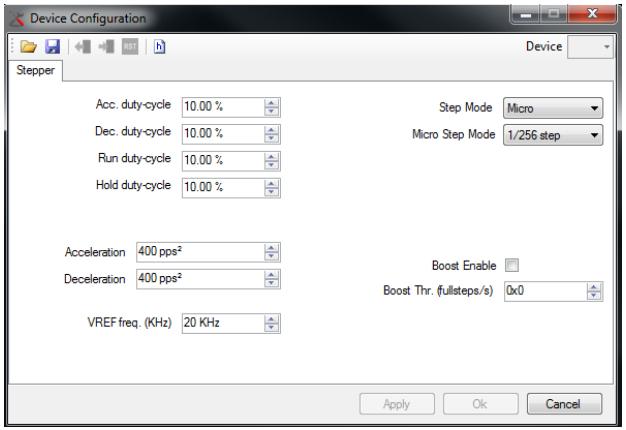
SPINFamily Evaluation Tool 3.2

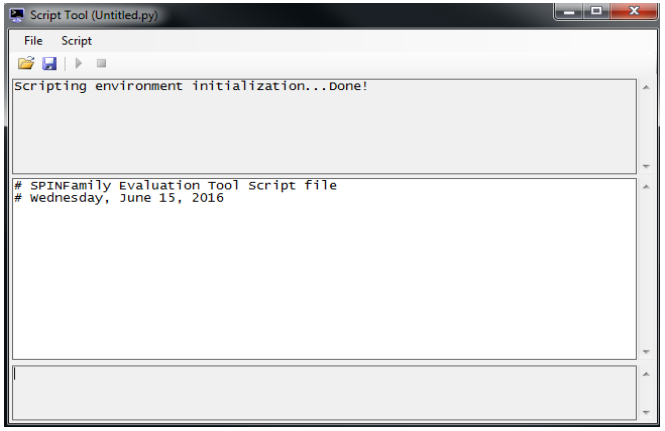


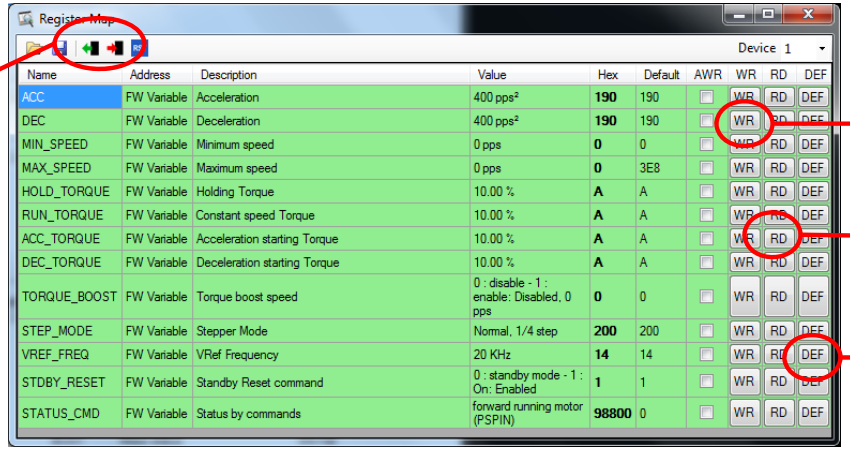
SPINFamily Evaluation Tool 3.2



SPINFamily Evaluation Tool 3.2







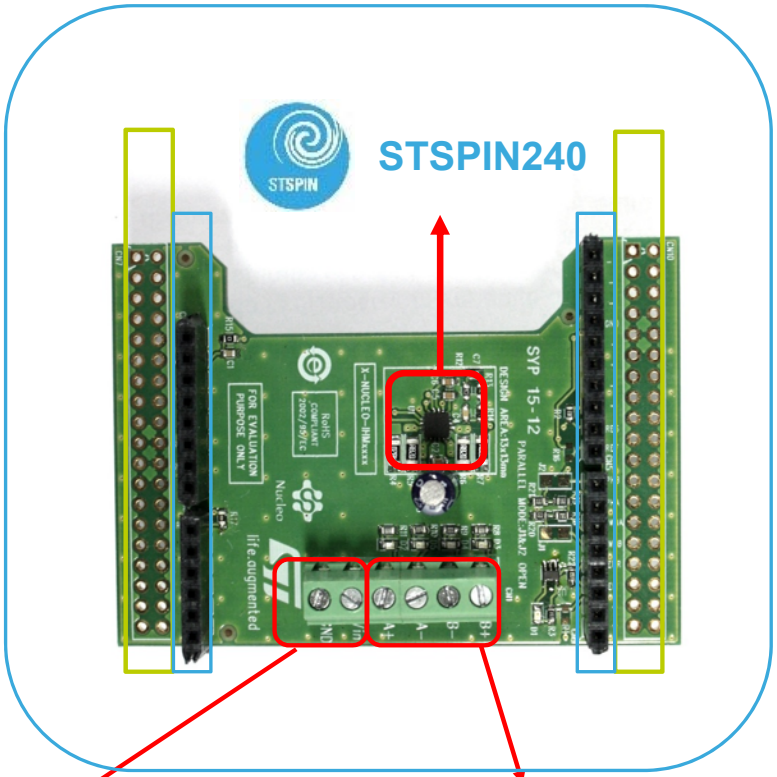
Read/Write icon for all registers

Individual register write

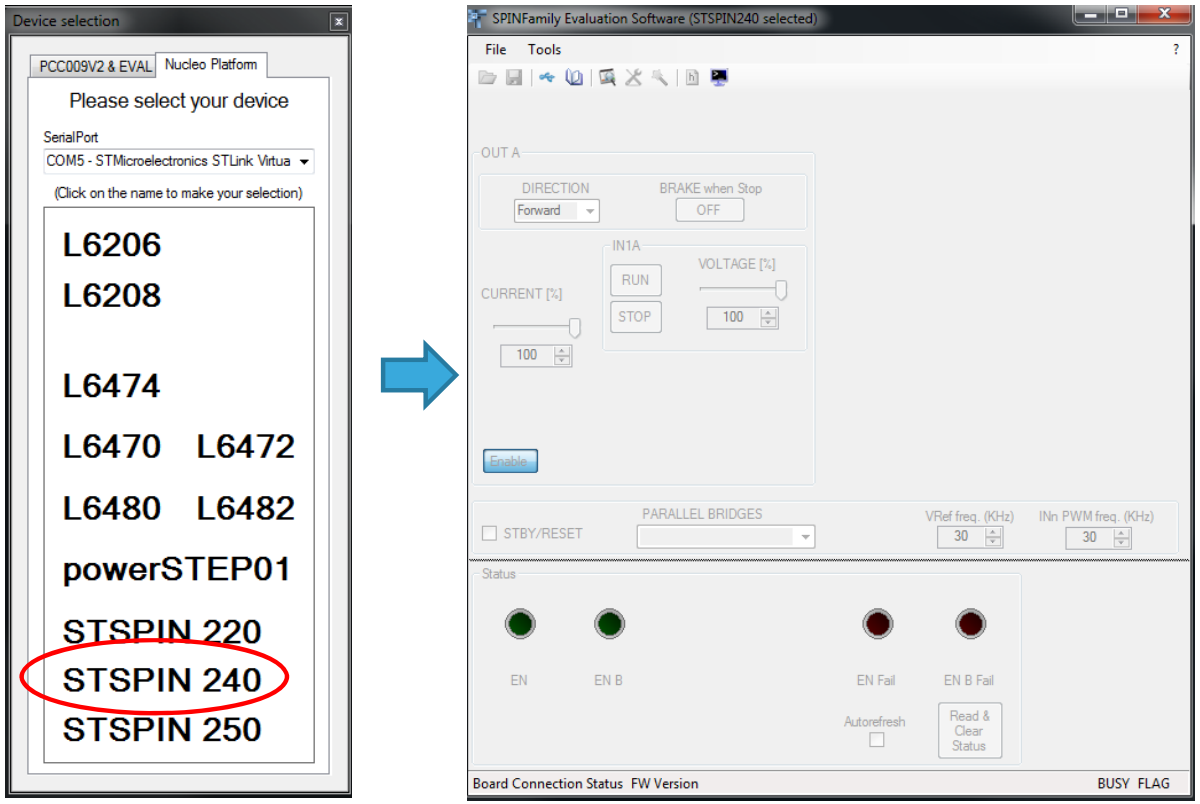
Individual register read

Default setting

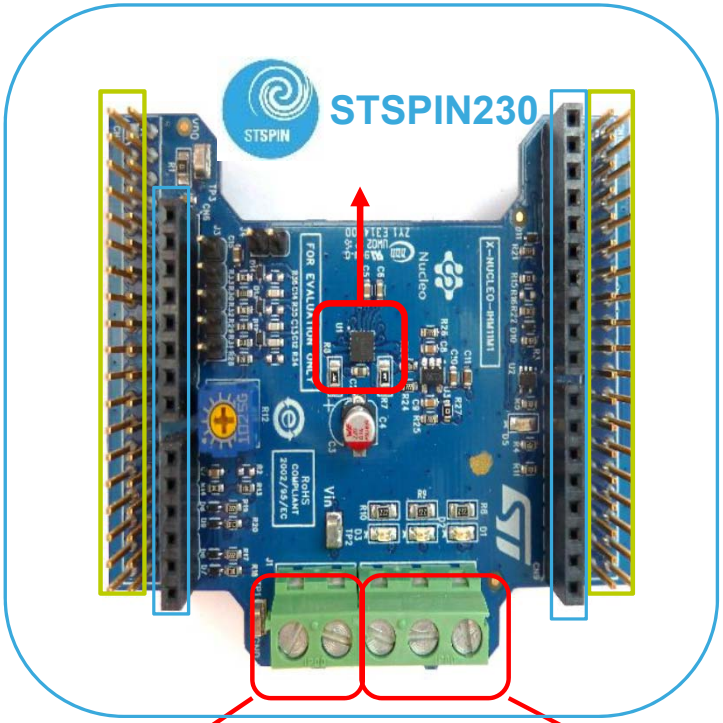
X-NUCLEO-IHM12A1 for STSPIN240



SPINFamily Evaluation Tool 3.2



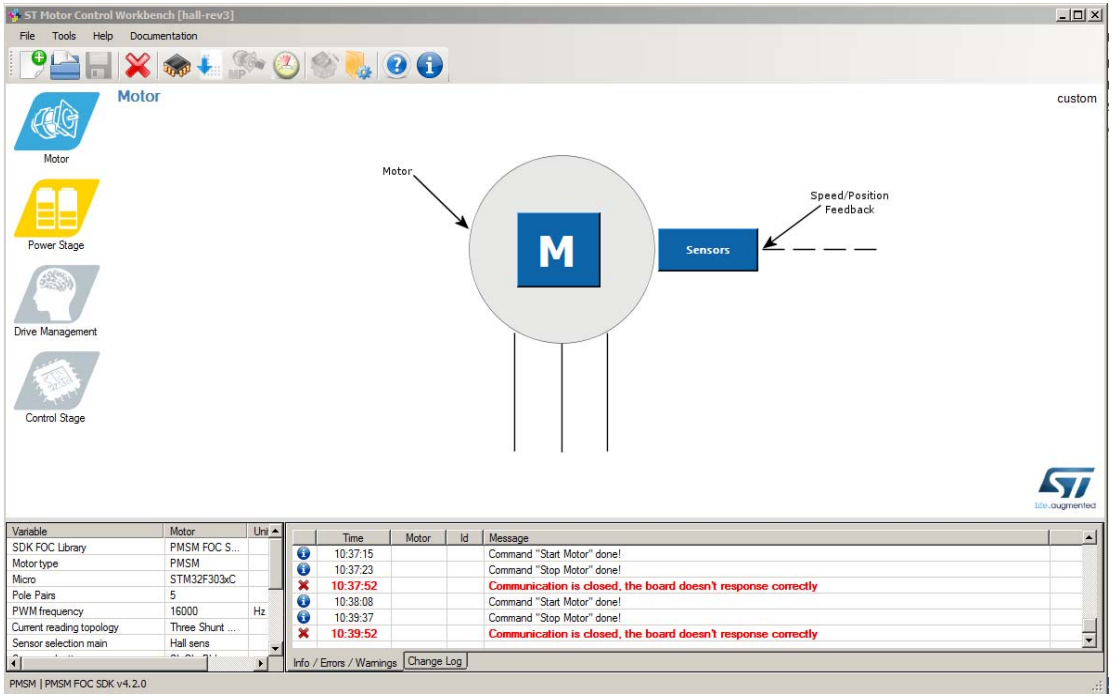
X-NUCLEO-IHM11M1 for STSPIN230



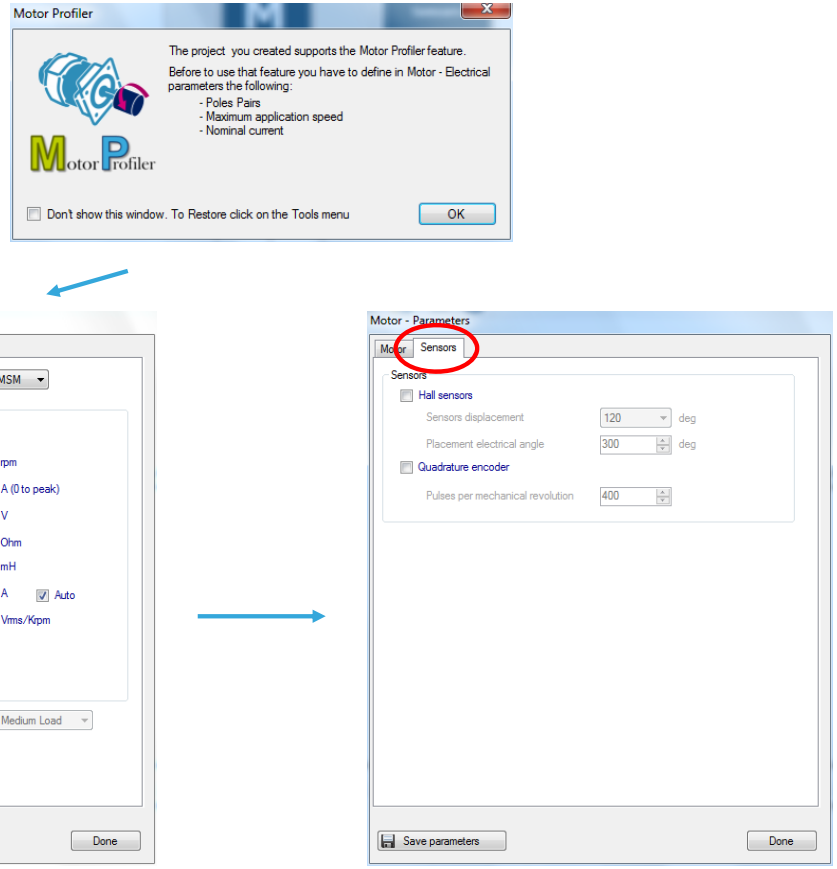
Arduino UNO R3 connector*

ST morpho connector

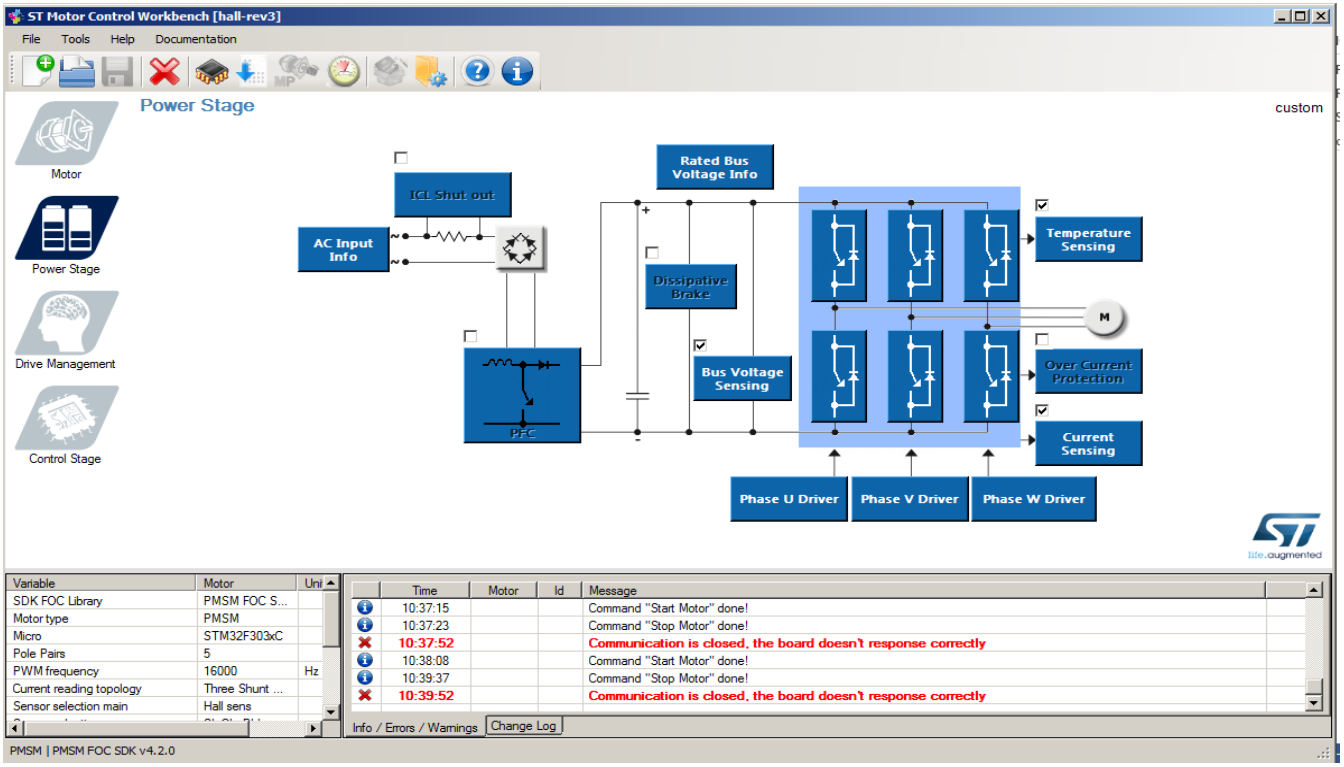
ST Motor-Control Workbench



ST Motor-Control Workbench



ST Motor-Control Workbench



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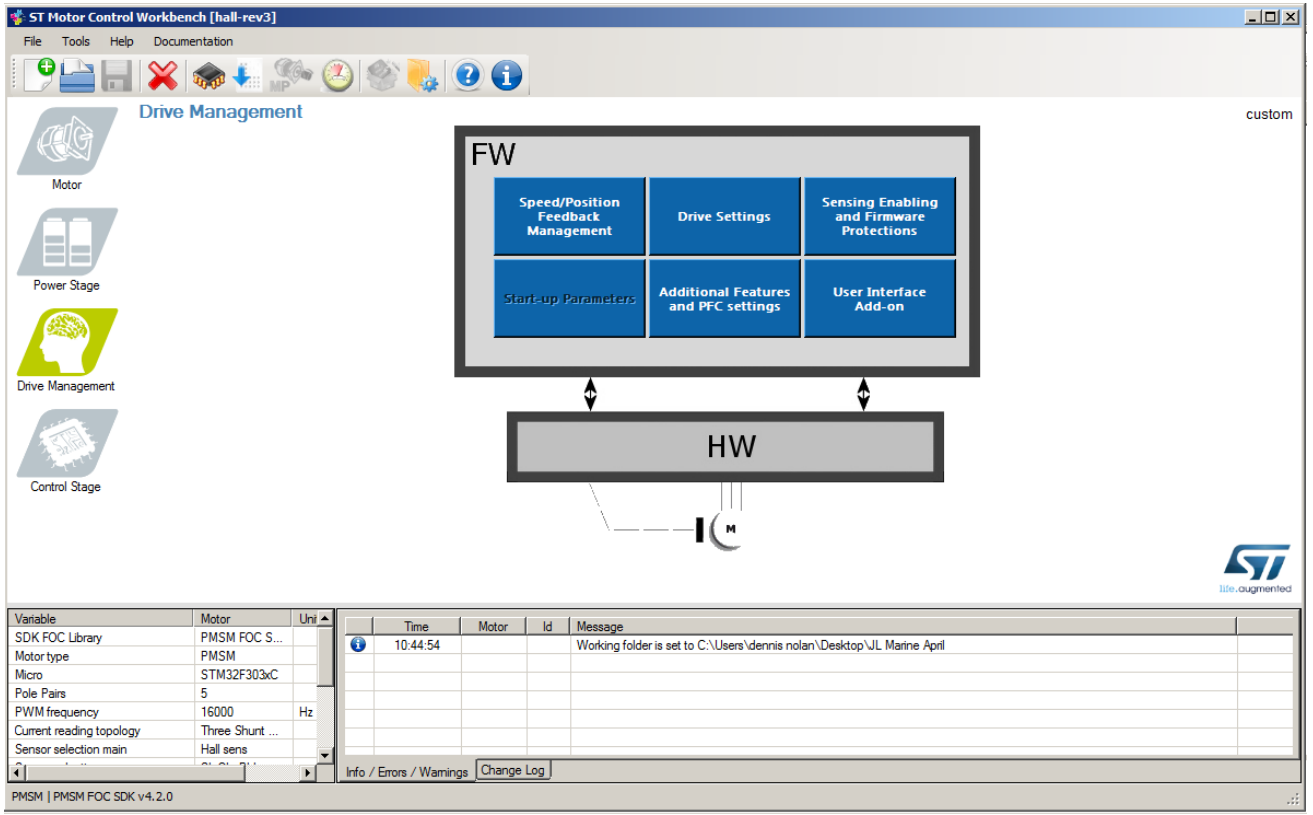
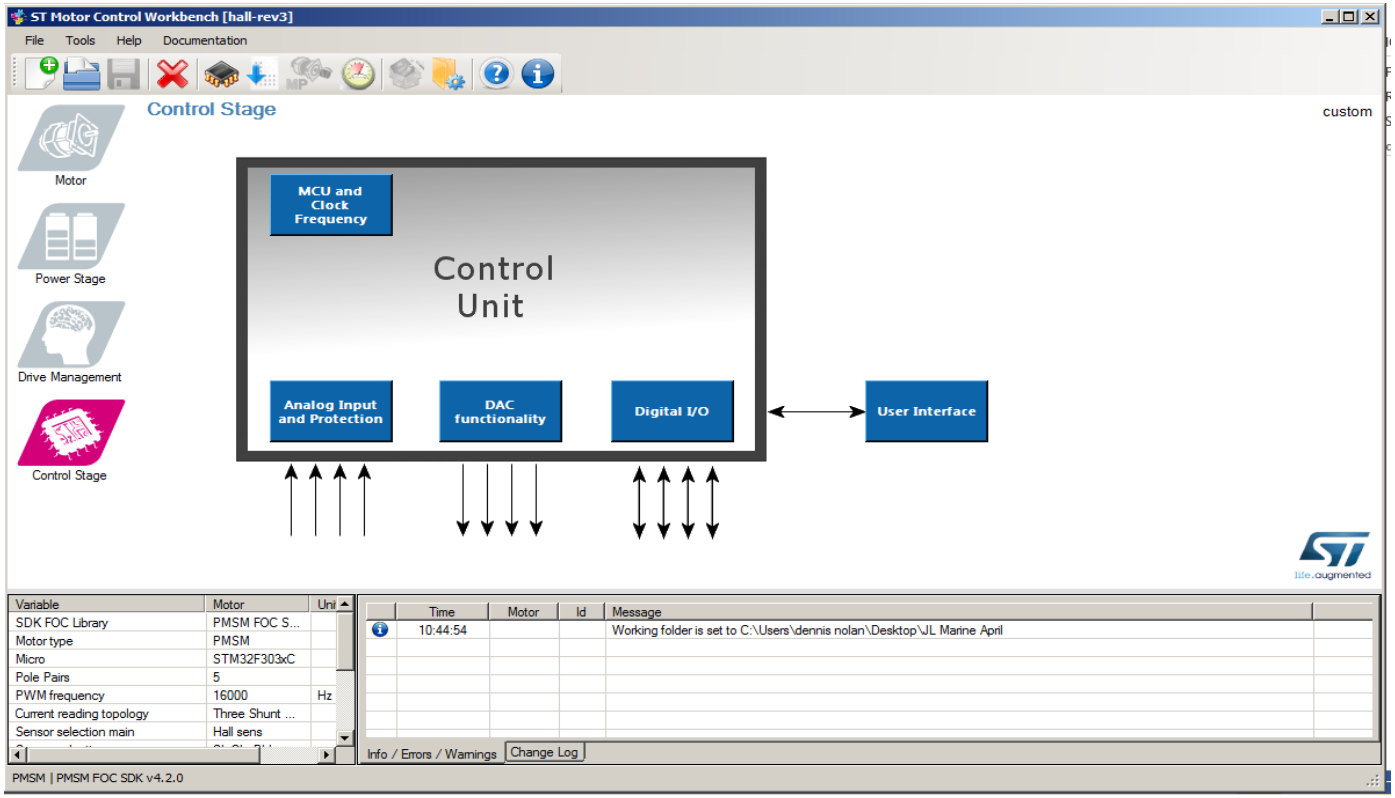


ST Motor-Control Workbench



STSPIN System BOM

- STSPIN220, STSPIN230, STSPIN240, STSPIN250 – for motor control, solenoids, valves
- Battery-charger ICs – for battery management
- LDOs (LD1117, LD3985, LD39050) – for power management
- OPAMPs – for current sensing
- STM32xxx
- MEMS & Sensors – for motion and environmental sensing

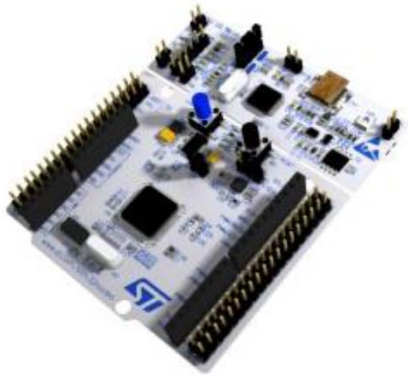
ST Customer Support

- www.st.com – Datasheets, Application Notes, Design Tips, Reference Designs, BOM, Gerber Files
- YouTube Tutorial: https://www.youtube.com/watch?v=OcbkP69t8Yc
- On-line technical support
- Discussion Forum
- eNewsletter
- Motor-Control Engineering Specialists covering East Coast, Midwest, and West Coast
- Dedicated Motor-Control Lab in Schaumburg, Illinois

All You Need to Build a System, in Just a Few Minutes

- 1x STM32 Nucleo development board (Nucleo-F401RE)
- Motor-driver expansion board (X-Nucleo-IHMxxxx)
- 1x USB type A to mini-B USB cable
- Motor (stepper, brushed DC, BLDC)
- An external DC power supply providing 1.8-10V
- 1x Laptop/PC with Windows (XP, Win 7, Win 8)

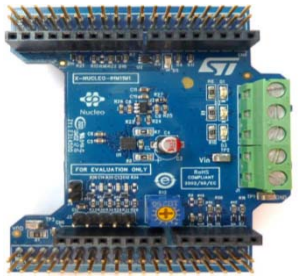
NUCLEO-F401RE



PC with USB cable

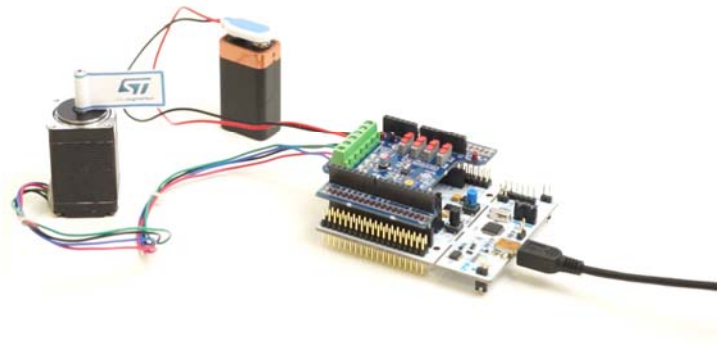
DC motor, BLDC motor, stepper

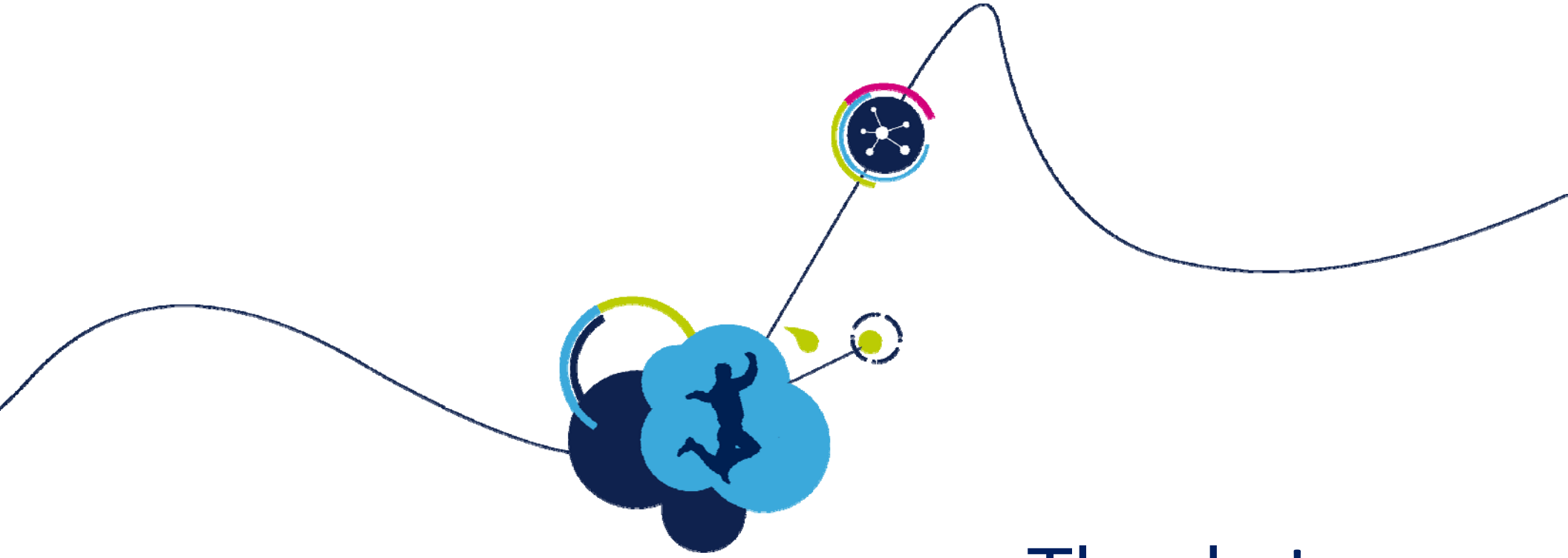
X-Nucleo Motor Shield



You've Learned Today

- ST portfolio of integrated motor control drivers for portable and low voltage applications
- STSPIN electrical performance – 3x3 QFN package, low Rds_{on}, low Iq (< 80nA)
- Easy prototyping with STM32 and Nucleo evaluation boards
- Ideas how to improve system performance – Back-EMF detection
- ST portfolio of evaluation boards, tools and customer support





Thanks!

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