RN0085
Release note

STM32 PMSM single/dual FOC SDK Release 4.3

Introduction

This release note provides important information about the STM32 PMSM FOC SDK motor control software design kit composed by PMSM FOC FW library and ST MC Workbench (reference: STSW-STM32100).

This release note is updated periodically in order to keep you abreast of evolutions of the package and any problems or limitations found. Check the ST microcontroller support website at www.st.com to ensure that this is the latest version of this release note.

Customer support

For more information or help concerning STM32 PMSM FOC SDK, please contact the nearest sales office. For a complete list of ST offices and distributors, please refer to www.st.com.

Software updates

You can download software updates and all the latest documentation from the ST microcontroller support site at www.st.com.

Microcontrollers supported

- STM32F030C6/C8/K6/R8
- STM32F051C6/C8/K6/K8/R6/R8
- STM32F072x
- STM32F100, STM32F103
- STM32F2 Series
- STM32F302xB/C, STM32F303xB/C, STM32F302x6/x8
- STM32F405xx, STM32F407xx, STM32F415xx, STM32F417xx, STM32F446xC, STM32F446xE.
- STM32F301C6/C8/K6/K8/R6/R8

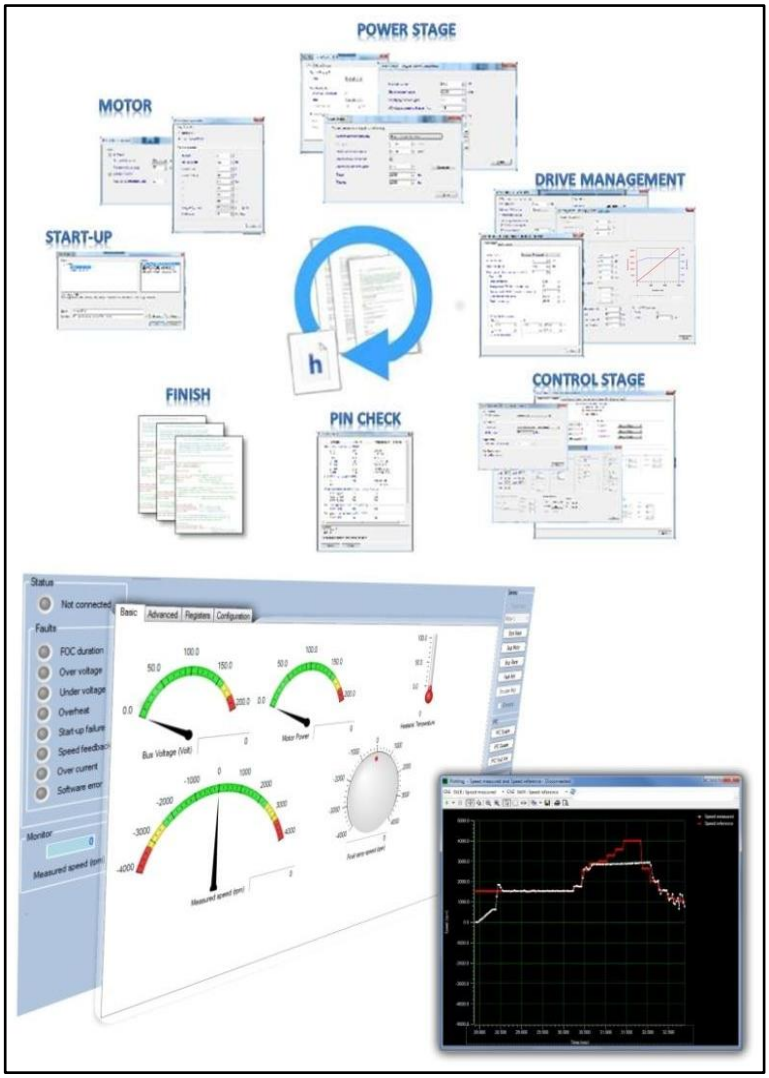
Contents

1 Description

ST's STM32 offers the performance of the industry-standard ARM® Cortex®-M core at the service of vector (or field-oriented) control (FOC) algorithms, widely used in high-performance drives. The STM32 PMSM FOC SDK (STSW-STM32100), which includes the PMSM FOC FW library and ST MC Workbench, allows the user to evaluate the STM32 performance in applications driving single or dual field oriented control of 3-phase permanent magnet motors (PMSM, BLDC).

ST MC Workbench is a PC software that reduces the design effort and time in the STM32 PMSM FOC firmware library configuration. The user, through a graphical user interface (GUI), generates all parameter header files which configure the library according to the application needs and can in real time monitor and change some variables of the algorithm.

Figure 1: Work process and monitor of ST MC Workbench



2 ST Motor Control Workbench

2.1 What's new

- Motor profiler (new version):
  - Dedicated windows and graphics
  - Supported board management
  - Play mode
- Digital PFC:
  - Topology: single-stage boost DC-DC converter
  - Microcontroller supported: STM32F103xC, STM32F103xD, STM32F103xE, STM32F103xF and STM32F103xG; STM32F303xB and STM32F303xC.
- Extended support to STM32F07x and STM32F446x microcontrollers
- Three shunt current sensing algorithm is now available for STM32F0xx microcontrollers

2.2 Program features

- Configuration of all the parameters required by 'STM32 PMSM FOC firmware library' supported
- Generation of all the header files (.h) required by 'STM32 PMSM FOC firmware library' supported
- Support for single and dual motor control
- Communication with motor control application
- High frequency injection sensorless (HFI)
- Motor profiler support
- New project creation starting from the board
- On-the-fly sensorless startup
- Digital power factor corrector (PFC)
- Three shunt current sensing with a ADC algorithm

2.3 Supported ST MC Platform

STM32 PMSM FOC v4.3

2.4 Supported STM32 microcontrollers

- STM32F030C6/C8/K6/R8
- STM32F051C6/C8/K6/K8/R6/R8
- STM32F072x
- STM32F100, STM32F103
- STM32F103
- STM32F2 series
- STM32F302xB/C, STM32F303xB/C, STM32F302x6/x8
- STM32F405xx, STM32F407xx, STM32F415xx, STM32F417xx, STM32F446xC, STM32F446xE.
- STM32F301C6/C8/K6/K8/R6/R8

2.5 Release information

2.5.1 About release 4.3

- Motor profiler (new version)
- Digital power factor correction:
  - Topology: single-stage boost DC-DC converter
  - Microcontroller supported: STM32F103xC, STM32F103xD, STM32F103xE, STM32F103xF and STM32F103xG; STM32F303xB and STM32F303xC
- Extended support to STM32F07x and STM32F446x microcontrollers
- Three shunt current sensing algorithm is now available for STM32F0xx microcontrollers
- Free RTOS support extended to STM32F3 and STM32F4 families
- added AC6 workspace
- Minor bug fixes

2.5.2 About release 4.2

- Support for STM32F302x6/x8
- Support for STM32F301x6/x8
- Minor bug fixes

2.5.3 About release 4.1

- Motor
  - Added motor profiler support
- Power stage
  - Changed “Bus voltage sensing” management
- Drive management
  - Added support for on-the-fly sensorless startup
- Control stage
  - Changed “Bus voltage feedback” management
- Program feature
  - New project creation starting from the board
  - Changed "Output Folder" option
  - The “.stmc” extension format has been changed into “.stmcx”
  - Updated documentation
- Minor bug fixes

2.5.4 About release 4.0.0

- Drive management
  - Added HFI sensorless management
  - Improved start-up parameters (start-up rump plotting)
  - Added AC input selection
- Power stage
  - Improved driving signal polarity: added the possibility to set the same values for all U, V, W drivers simultaneously.
- Program features:
  - Adding compact/extend mode: showing/hiding advanced features
- Minor bug fixes

2.5.5 About major previous releases

Release 3.0.4

- Added unit measure for "Torque&Flux - Cut-off frequency"
- Changed behavior of bus voltage sensing inverting input
- Improved conversion from STM32F05xx of WB 2.1 to STM32F051x of WB 3.0
- Removed read-only for OPAMP inverting pins if shared resource is enabled and OPAMP gain is external in dual motor configuration
- Removed read-only for COMP output pins
- Improved start-up time
- Minor bug fixes

Release 3.0.2

- Minor bug fixes

Release 3.0.1

- Added alternate function information for comparators
- Pin management in change target library
- External protection and no protection available also for STM32F3x
- Added managing of the ADC sampling for phase current feedback (clock frequency, minimum, divider)
- Allowed internal/external or vice-versa gain type in shared resource configuration
- Minor bug fixes

Release 3.0.0

- Support for single and dual STM32F3x
- Extended support for STM32F0xx (STM32F030x, STM32F050x, STM32F051x)
- Example project list
- Recent project list
- Export for logs
- Support for embedded OPAMP
- Support for embedded COMP
- PFC support
- Extended DAC functionality
- Added amplification network gain form and export into HTML format
- Minor bug fixes

2.6 Host PC system requirements

PC running on Microsoft Windows operating systems: Win 7

The software requires Microsoft .NET Framework 3.5 SP1 or higher

System administration rights are required for setup.

3 STM32 PMSM FOC FW library

3.1 New features

Version v4.3

- Motor profiler (new version)
- Digital power factor correction:
  - Topology: single-stage boost DC-DC converter
  - Microcontroller supported: STM32F103xC, STM32F103xD, STM32F103xE, STM32F103xF and STM32F103xG; STM32F303xB and STM32F303xC
- Extended support to STM32F07x and STM32F446x microcontrollers
- Three shunt current sensing algorithm is now available for STM32F0xx microcontrollers
- Added 64 MHz support with internal oscillator for STM32F301/302
- Free RTOS support extended to STM32F3 and STM32F4 families
- Added AC6 workspace

Version v4.2

- STM32F302x6/x8 microcontroller support
- Three-shunt algorithm using only one ADC for STM32F302x6/x8 MCUs
- Native support (project configuration) for P-NUCLEO-IHM001 kit
- Motor profiler improvement (hysteretic control of current to speed up the procedure)
- One touch tuning (hysteretic control to speed up the procedure, start-up ramp set according to the load set in WB)

Version v4.1

- Motor profiler (only for STM32F30x and STM32F4xx)
- One touch tuning (only for STM32F30x and STM32F4xx)
- On-the-fly sensorless startup

Version v4.0

- Sensorless (high frequency injection HFI plus B-EMF state observer, PLL rotor speed/angle computation from B-EMF, only for STM32F30x or STM32F4xx)
- Support to ARM® Keil® µVision® and IAR Embedded Workbench® IDEs
- Simplify the MC SDK with a self-explaining approach
- Ready to use application examples
- Fast unidirectional serial communication
- Simplified LCD user interface

Version v3.4

- Added support of the STM32F30x microcontroller families
- Support of STM32F3 enhanced set of peripherals including comparators, PGAs, DACs, high-speed ADCs and CCMRAM.
- Support of the STM32F0x family enlarged, now comprising STM32F030x, STM32F050x, STM32F051x.
- HardFault handler now used for error signaling and application safety.
- The STM3210B-EVAL new LCD MB895/S (HX8347D) is now supported by LCD FW.
- Support of L6230 enable pins.

- Default variables can be configured and displayed using the DAC functionality.
- In dual motor control mode, the same bus voltage measurement can be used for both motor controls.

Version v3.3

- Added support of the STM32F05xx microcontroller families
- Added support of inrush current limiter
- Added general purpose ramp generation class

3.2 Known problems and limitations

3.2.1 Known limitations in v4.3

- Sampling time not taken into account to determine if sampling in the middle of period is possible (affects STM32F3).
- Dual sensor-ed configuration is not working (is not possible to enable both HALL as primary speed sensor and encoder as auxiliary sensor, or vice versa)
- Error in compilation using UART4 and UART5 in STM32F3 projects
- Negative slope of Temperature sensing is not supported
- Dual motor drive with 1-shunt and Hall sensors without resource conflict
- Conflict with TIM4 not indicated when using one shunt STM32F1
- ENCODER speed sensor function: one input capture pin of the selected timer must be grounded, according to the remapping in use and this rationale:
  – IC4 in case of TIM2
  – IC4 in case of TIM3
  – IC3 in case of TIM4
  – IC4 in case of TIM5.
- Hall / Encoder modules: GPIO configuration is not locked

3.2.2 Known problems/limitations in v4.2 fixed in v4.3

- Out of order I/O init sequence leading to power stage damage
- R3_2_F30x and R3_4_F30x Repetition counter setting issue to be fixed
- Dual single shunt for STM32F3x doesn't work
- MCU_SUPLY_VOLTAGE wrongly propagated in the FOC lib
- Incorrect OCP - 1 shunt with STM32F0 microcontroller
- Minor bug fixing

3.2.3 Known limitations in v4.2

- Start/stop button management not implemented in the FW
- HW dead time not used even if selected, SW used instead
- Sampling time not taken into consideration to determine if sampling in the middle of period is possible (affects STM32F3).
- Dual sensor-ed configuration is not working (it is not possible to enable both HALL as primary speed sensor and Encoder as auxiliary sensor, or vice-versa)
- STEVAL-IHM022V1 using free RTOS project not working in dual drive
- ENCODER speed sensor function: one input capture pin of the selected timer must be grounded, according to the remapping in use and this rationale:
  – IC4 in case of TIM2
  – IC4 in case of TIM3
  – IC3 in case of TIM4
  – IC4 in case of TIM5.
- AF function for TIM3, TIM4, etc used by sensor feedback is not set properly

- Hall / Encoder modules: GPIO configuration is not locked
- False spike in the DAC variable related to measured current during calibration phase
- LCD user interface: when the “start both motors” button is pushed, a new value of target speed set before is not taken into account
- The linker file (IAR) for MC project (STM32F2 and STM32F4 microcontrollers) doesn’t take into account the Flash and RAM memory reserved for the LCD Project
- DAC functionality: TIM3 remap not configurable when working with STM32F103 with Flash memory density lower than or equal to 128 kBytes.
- Serial Com user interface: MCI_StartMotor and MCI_StopMotor, return value not checked.

3.2.4 Known problems/limitations in v4.1 fixed in v4.2

- Hardfault occurring when enabling MTPA in confidential or web distribution
- Motor speed not reset in idle state (sensorless configuration)

3.2.5 Known problems/limitations in v4.0 fixed in v4.1

- Error: “TIM8_BRK_IRQHandler already defined" compiling a single drive project for STM32F3 using TIM8
- Ramp manager class and SpeednTorqCtrl class internal overflow for long ramp duration
- When enabling fast unidirectional serial communication the firmware gets stuck in the USART interruption
- If BKIN input is active while MCboot not completed MemFault exception is raised
- WB example for STEVAL-IFN003V1 - Enabling signals not checked
- Unidirectional serial generates only one channel even if two are selected in WB
- Keil® project - inrush current limiter not included in the MC Lib (ICL)
- Wrong LCD FW for STEVAL-IHM039V1 for dual drive
- Wrong clock configuration for USART in STM32F3 projects (STM32F303x8, STM32F302x8, STM32F301x8)

3.2.6 Known limitations in v4.1

- Start/stop button management not implemented in the FW
- HW dead time not used even if selected, SW used instead
- AF function for TIM3, TIM4, etc used by sensor feedback is not set properly
- Sampling time not taken into consideration to determine if sampling in the middle of period is possible (affects STM32F3).
- Dual sensor-ed configuration is not working (it is not possible to enable both HALL as primary speed sensor and Encoder as auxiliary sensor, or vice-versa)
- STEVAL-IHM022V1 using Free RTOS project not working in dual drive
- ENCODER speed sensor function: one input capture pin of the selected timer must be grounded, according to the remapping in use and this rationale:
  - IC4 in case of TIM2
  - IC4 in case of TIM3
  - IC3 in case of TIM4
  - IC4 in case of TIM5
- Hall / Encoder modules: GPIO configuration is not locked.
- False spike in the DAC variable related to measured current during calibration phase
- LCD user interface: when the “start both motors” button is pushed, a new value of target speed set before is not taken into account.
- The linker file (IAR) for MC project (STM32F2 and STM32F4 microcontrollers) doesn’t take into account the Flash and RAM memory reserved for the LCD Project.

- DAC functionality: TIM3 remap not configurable when working with STM32F103 with Flash memory density lower than or equal to 128 kBytes.
- Serial Com user interface: MCI_StartMotor and MCI_StopMotor, return value not checked.

3.2.7 Known problems/limitations in v3.4 fixed in v4.0

- Current reading error for STM32F3x due to wrong computation of sampling time in NS done in the parameter conversion
- Wrong encoder alignment is performed
  - when set alignment angle is different from 90 degrees or
  - when motor pole pairs are different from 2.
- - If HALL sensor is used then an error (division by 0) occurs when the timer pre-scaler becomes 0.

3.2.8 Known limitations in v4.0

- STEVAL-IHM022V1 Dual Drive - Free RTOS - Hard fault driving both motors.
- Sampling time is not taken into consideration to determine if sampling in the middle of period is possible (affects STM32F3).
- ENCODER speed sensor function: one input capture pin of the selected timer must be grounded, according to the remapping in use and this rationale:
  - IC4 in case of TIM2
  - IC4 in case of TIM3
  - IC3 in case of TIM4
  - IC4 in case of TIM5.
- Hall / Encoder modules: GPIO configuration is not locked.
- False spike in the DAC variable related to measured current during calibration phase.
- LCD User Interface: when the “start both motor” button is pushed, a new value of target speed settled before is not taken into account.
- The linker file (IAR) for MC project (STM32F2 and STM32F4 microcontrollers) doesn’t take in account the Flash and RAM memory reserved for the LCD Project
- DAC functionality: TIM3 remap not configurable when working with STM32F103 with Flash memory density lower than or equal to 128 kBytes.
- Serial Com user interface: MCI_StartMotor and MCI_StopMotor, return value not checked

3.2.9 Known problems/limitations in v3.3 fixed in v3.4

- An issue in the state observer (speed and position sensor) has been solved; the malfunctioning was pointed out in v3.3, when optimizing execution speed on STM32F0.
- In Timebase.c counters declared as 8 bit now corrected as 16 bit variables.
- RampMngr class compliancy with MISRA rule.
- InrushCurrentLimiter class compliancy with MISRA rules fixed.
- In 3-shunt and ICS current reading class, function SwitchOnPWM now waits the timer update before activating driving signals
- In 3-shunt current reading class, phase C calibration now done correctly using only one ADC peripheral
- The linker file (IAR) for MC project (F2 and F4) didn’t take into account the Flash and RAM memory reserved for LCD Project.
- Added support for the LCD marked MB895/S C-03 of STM3210B-EVAL and STEVAL-IHM022v1.
- Added support for the LCD marked MB895/P C-03 of STM3210E-EVAL.

3.2.10 Known limitations in v3.4

- ENCODER speed sensor function: one input capture pin of the selected timer must be grounded, according to the remapping in use and this rationale:
  - IC4 in case of TIM2
  - IC4 in case of TIM3
  - IC3 in case of TIM4
  - IC4 in case of TIM5
- Hall/Encoder modules: GPIO configuration is not locked
- False spike in the DAC variable related to measured current during calibration phase
- LCD User Interface: when the “start both motor” button is pushed, a new value of target speed settled before is not taken into account
- The linker file (IAR) for MC project (STM32F2 and STM32F4 microcontrollers) doesn’t take into account the Flash and RAM memory reserved for the LCD Project.
- DAC functionality: TIM3 remap not configurable when working with STM32F103MD.
- Serial Com User Interface: MCI_StartMotor and MCI_StopMotor, return value not checked.

3.2.11 Known problems/limitations in v3.2 fixed in v3.3

- The issue that stuck the LCD firmware when the DAC function was not enabled has been fixed.
- The generation of wrong PWM frequencies in the STM32F1xx configuration for TIM_CLOCK_DIVIDER not equal to one has been fixed.
- The generation of wrong dead times in the STM32F1xx configuration for TIM_CLOCK_DIVIDER not equal to one has been fixed.
- The integral term of PID objects with MAX integral term instead of zero has been fixed.
- The "Initial Electrical Angle" settled via the STMC workbench did not have any effect in the previous version of the library. The issue has been fixed.
- Cross checks and backward compatibilities with the workbench generated files has been fixed in the LCD project.
- The current measurement for ICS sensors (STM32F103HD, STM32F2xx or STM32F4xx) using the wrong offset has been fixed.
- The switch context algorithm of all dual motor current sensing classes (STM32F103HD, STM32F2xx or STM32F4xx) has been fixed.

3.2.12 Known limitations in v3.3

- ENCODER speed sensor function: one input capture pin of the selected timer must be grounded, according to the remapping in use and this rationale:
  - IC4 in case of TIM2
  - IC4 in case of TIM3
  - IC3 in case of TIM4
  - IC4 in case of TIM5

4 Revision history

Table 1: Document revision history

Date	Version	Changes
14-Nov-2012	1	Initial release.
18-Apr-2014	2	Added Version 3.4.
04-Jun-2014	3	Updated Introduction, Section 1: Description and Section 3.2.5. Added ST MC Workbench release notes in Section 2. Added Version 4.0 of PMSM FOC FW library in Section 3.2.5 and Section 3.2.6.
26-May-2015	4	Added Version 4.1. Updated Microcontrollers supported, Section 2.1: What's new, Section 2.3: Supported ST MC Platform, Section 2.4: Supported STM32 microcontrollers and Section 2.6: Host PC system requirements. Added Section 2.5.1: About release 4.2, Version v4.2 in Section 3.1, Section 3.2.2: Know problems/limitations in v4.0 fixed in v4.1 and Section 3.2.3: Know limitations in v4.2.
03-Sep-2015	5	Added Version 4.2. Updated Microcontrollers supported, Section 2.1: What's new, Section 2.2: Program features, Section 2.3: Supported ST MC Platform, Section 2.4: Supported STM32 microcontrollers and Section 2.6: Host PC system requirements. Added Section 2.5.1: About release 4.2, Version v4.2 in Section 3.1, Section 3.2.1: Know problems/limitations in v4.1 fixed in v4.2 and Section 3.2.3: Know limitations in v4.2.
27-Sep-2016	6	Updated *Section "Microcontrollers supported"*; *Section 2.1: "What's new"*; *Section 2.2: "Program features"*; *Section 2.3: "Supported ST MC Platform"*; *Section 2.4: "Supported STM32 microcontrollers"*: *Section 2.5.2: "About release 4.2"*; *Section 2.6: "Host PC system requirements"* Added *Section 2.5.1: "About release 4.3"*; *Section 3.2.1: "Known limitations in v4.3"*; *Section 3.2.2: "Known problems/limitations in v4.2 fixed in v4.3"*

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