CASE STUDY

NXP Accelerates Software Creation on S32K Automotive Microcontrollers

- NXP® Semiconductors is a provider of 32-bit automotive microcontrollers that offer high levels of integration, comprehensive software, and hardware enablement across a broad range of performance points.
- www.NXP.com

Software in the Driver's Seat

The prominence of software in the automotive market has never been greater, driven in part by consumer expectations for an enhanced in-vehicle experience, which has led to car makers increasing their focus on the software. With the continued growth in both the size and complexity of software, the cost of its creation and maintenance is also rising and extending the time to market. The automotive industry needs solutions for improving software development for successful deployment in the software-defined vehicles (SDV) of the future.

This growth in software is not limited to complex high-performance system-on-chips (SoCs), but must also be developed and deployed in microcontrollers (MCUs). As a result, NXP has stepped up its software

- Seamless software deployment
- Accelerated time-to-market with cost savings through advanced modelling
- Ability to test complex code configurations
- Code re-use across different products
- Maximized performance on automotive microcontrollers

focus, offering software solutions targeting its Arm-based MCUs and SoCs to help these product users accelerate the design and development cycle.

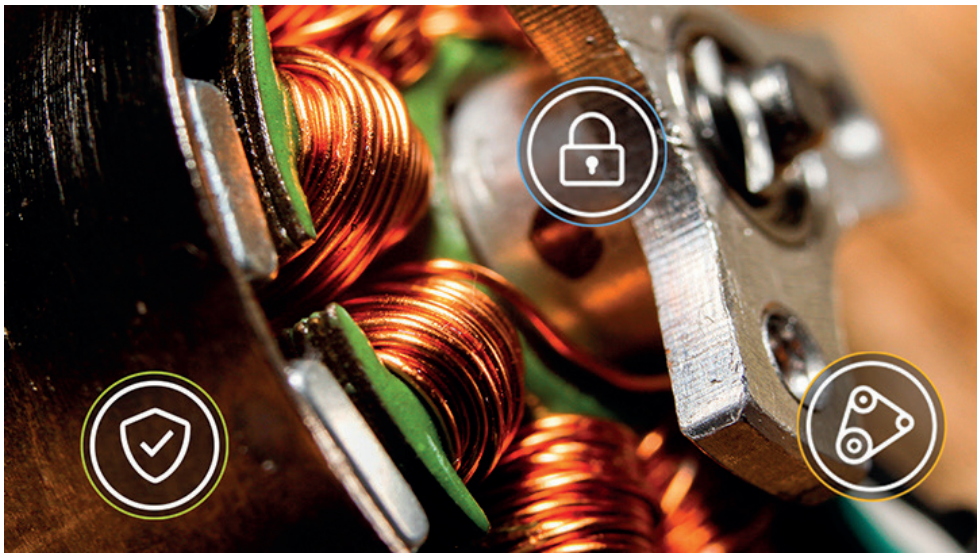

FIG. 1
Brushless direct current motor based on NXP S32K3 Cortex-M MCUs

The use of motors across the vehicle continues to rise and is an example of where it is highly beneficial to simplify the development of control algorithms.

Embedded software engineers rely on in-house motor experts or motor vendors for information on motor properties and characteristics to develop the motor control algorithms. The involvement of diverse groups of engineers may lead to some loss of information, as engineers in different domains have preferences toward specific design environments.

> **"NXP's toolbox of motor control libraries and modeling tools are supporting the seamless development and deployment of motor-control software across our Arm-based microcontrollers. These allow engineers to test complex code configurations for their automotive solutions before the final hardware design, saving them time and costs, and helping to maximize performance."**
>
> *Marius-Lucian Andrei*, Senior Software Engineer at NXP Automotive Processing

In addition to the software integration challenges of application code and device drivers, which is hardware specific, the over reliance on hardware-based testing leads to long iteration cycles for fixing bugs.

NXP offers Model-Based Design Toolbox (MBDT), a collection of tools and libraries, designed to assist customers with prototyping and accelerating the algorithm development on NXP MCUs. Engineers can model complex algorithms in MATLAB® and Simulink®, and generate embedded code compatible with Arm® based MCUs, including NXP's S32K microcontrollers family.

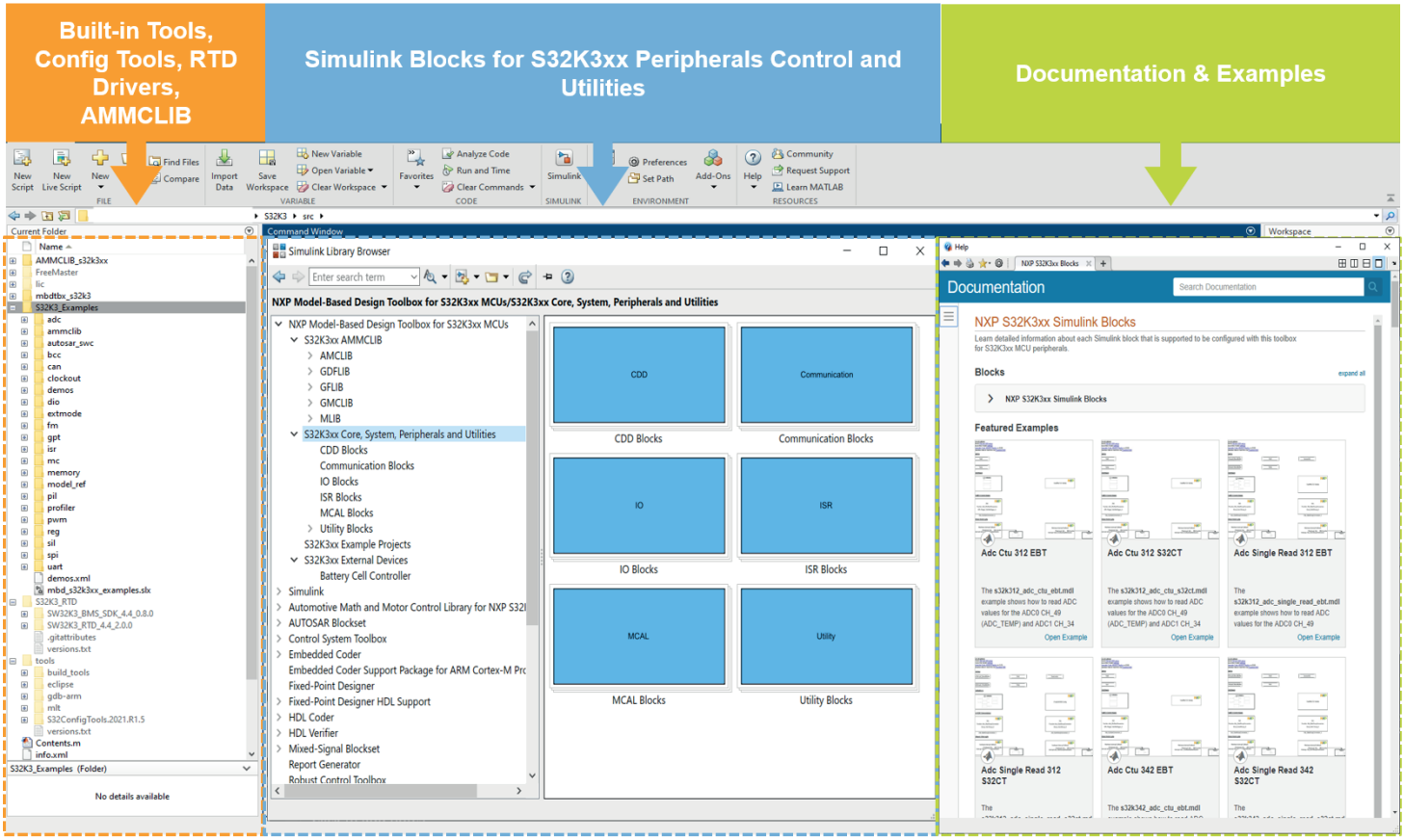

FIG. 2
Model-Based Design Toolbox (MBDT) to ease motor control software development on NXP S32K3 Cortex-M MCUs

By using MBDT, engineers can take advantage of its integrated tools, such as the S32 Configuration Tools for pins, clocks, and peripherals, while the application code is automatically generated, compiled, and deployed on the S32K targets. Once the code is executed on the target, the NXP's FreeMASTER can be used to connect to the running target for tuning or parameter visualization. MBDT also works in conjunction with some additional MathWorks Toolboxes, such as Simscape® for emulating electric motors through Stateflow resulting in easier implementation of finite state machines and application logic - or the Deep Learning Toolbox for running AI algorithms on NXP microcontrollers, and many other products.

MBDT for S32K3xx is fully integrated into MATLAB® and the Simulink® environment, and can be installed directly from the MATLAB Add-Ons or NXP.com. MBDT provides numerous examples alongside documentation for all the blocks it provides, and integrates the following NXP Software products:

- *Toolchain support* through a compiler and code deployment mechanism.
- *S32 Configuration Tools*, which are used for setting the pins, clocks, and peripherals.
- *Real Time Drivers (RTD)*, on top of which the generated code controls the target peripherals.
- The *Automotive Math and Motor Control Library (AMMCLib)* for high-performance arithmetic, trigonometric, digital signal processing, and math functions.
- *FreeMASTER*, which is a real-time debug monitor and data-visualization tool for runtime configuration and tuning.

Support for the MCSPTE1AK344 Development Kit

The MCSPTE1AK344 is a development kit engineered for three-phase brushless direct current (BLDC) motors and permanent magnet synchronous motors (PMSMs).

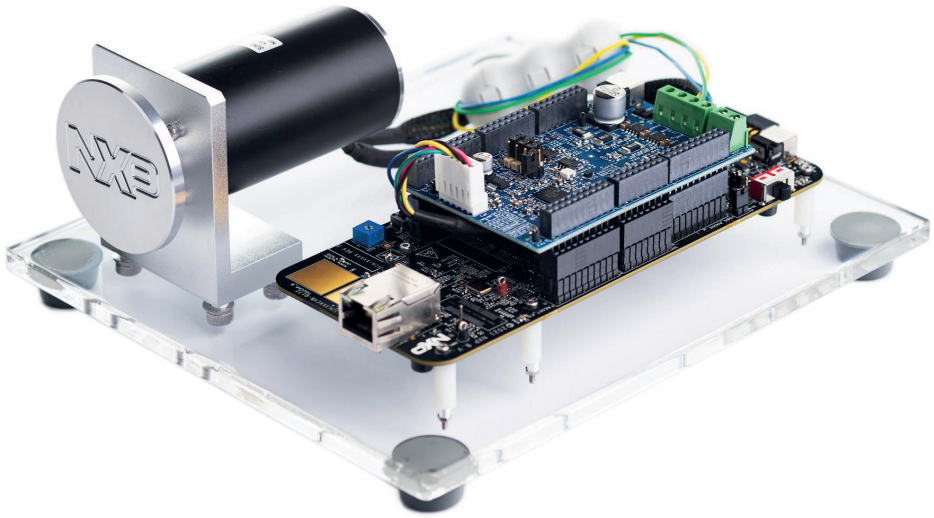

FIG. 3
MCSPTE1AK344 Development Kit

Based on the 32-bit Arm® Cortex®-M7 S32K3 microcontroller and the GD3000 pre-driver, the MCSPTE1AK344 enables rapid prototyping and evaluation of BLDC and PMSM control applications. Besides the Arm® Cortex®–M7 core, the S32K344 microcontroller delivered with the MCSPTE1AK344 provides suitable peripherals for motor-control applications.

MCSPTE1AK344 enables a complete out-of-the-box experience for modeling motor control algorithms through the rapid prototyping and evaluation of BLDC and three-phased PMSM applications. This means engineers do not have to wait for the final hardware design, saving them time and costs.

Useful Links

- Arm Microcontrollers for Automotive - https://www.arm.com/campaigns/automotive-microcontroller
- NXP S32K3 Motor Control Kit – nxp.com/MCSPTE1AK344
- NXP Model-Based Design Toolbox (MBDT)
- NXP Model-Based Design Toolbox Community Space

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