# Dual-Axis Motor Control on a Single SoC FPGA
Superior Performance, Reliability, Safety, Security, and Integration Made Easy

Microsemi's motor control solution is designed specially to meet the challenging industrial requirements of performance, reliability, and safety in an easy-to-use environment. Microsemi offers a modular intellectual property (IP) portfolio, tools, reference designs, kits, and software to control motors such as permanent-magnet synchronous motor (PMSM)/brushless DC (BLDC) and stepper motors.
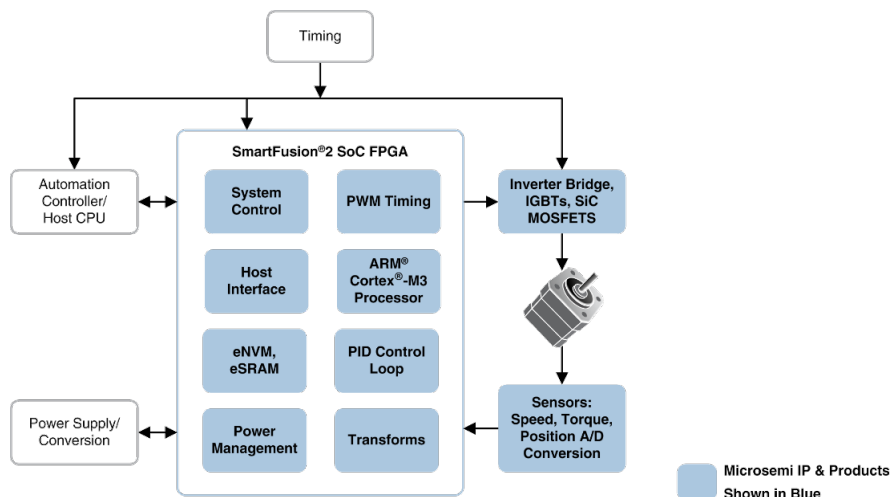
Motor Control Block Diagram
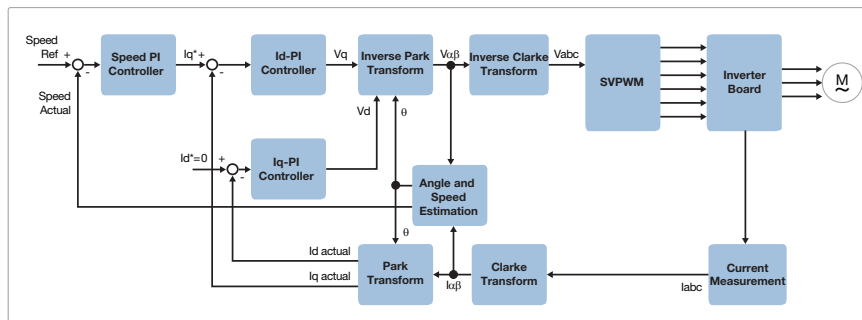
IP Modules

- Space vector modulation (SVM)
- Three-phase PWM
- FOC transformation IPs (Clarke, Park, Inverse Clarke, and Inverse Park)
- PI controller
- Rate limiter
- Position and speed estimator
- Encoder, Hall, and Resolver interface

Solutions for Motor Control Block Diagram

Microsemi IP & Products Shown in Blue

Reference Design Features

- Motor control algorithms implemented in FPGA fabric
- Scalability to a multi-axis motor drive design
- Design flexibility with modular IP suite
- Deterministic, high-precision, low-power, reliable, and secure
- Robust sensorless solution—supports 100K RPM or more
- Integration of system functions to lower total cost of ownership (TCO)
- Low latency of 1 µs for FOC loop from ADC measurement to PWM generation

Motors and Algorithms

Motor	Algorithm
PMSM/BLDC	FOC sensorless
	FOC with HALL
	FOC with encoder
	FOC with resolver
Stepper	Microstepping

Fully Modular IP Suite

- Quick plug-and-play approach to implement algorithms
- Easy porting and customization through block-based approach
- Precise algorithm for angle estimation in sensorless FOC
- PWM with dead time protection and delay time insertion
- IP blocks are coded for efficient use of FPGA resources
- IP blocks tested in simulations and on actual hardware
- IPs available as MATLAB models; VHDL Verilog code for FPGA

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High-Performance, Reliable, and Secured Motor Control Solution

Microsemi's SmartFusion®2 SoC-FPGA-based solution is an ideal reference platform for developing high-performance, reliable, and secured dual-axis motor control applications. The solution has algorithms like sensorless FOC, FOC with HALL, FOC with encoder, and FOC with resolver for PMSM/ BLDC motors. The position control algorithm of the stepper motor supports up to 1024 micro-steps.

The SmartFusion®2 Motor Control GUI allows for the dynamic tuning of parameters, such as reference speed, Kp/Ki gains of PI controllers, and viewing internal signals for debugging. The kit also supports various communication interfaces, including Ethernet, CAN, USB, and others. SmartFusion®2 SoC FPGAs feature stronger design security than other FPGAs and include differential power analysis (DPA) resistant anti-tamper measures using technology licensed from Cryptography Research Incorporated (CRI). The security architecture was designed with a layered approach in mind, building on top of a foundation of secure hardware.

Microsemi offers a one-stop shop with a portfolio of complementary products to meet your motor control needs. Microsemi's product portfolio includes FPGAs, SiC diodes/ MOSFETs, power modules, timing, PoE/Midspans, sensors, and more.
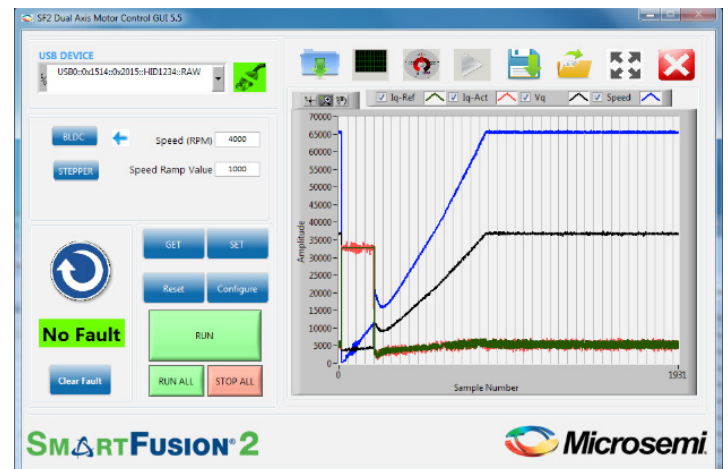
Ordering Information

SmartFusion2 Dual-Axis Motor Control Starter Kit
Part number: SF2-MC-STARTER-KIT

RTL source code for Motor Control IPs
Part number: MCSOLCores-RM

For more information, visit
www.microsemi.com/applications/motor-control

Software GUI for Motor Control

Dual-Axis Motor Control Board

Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for aerospace & defense, communications, data center and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; enterprise storage and communication solutions, security technologies and scalable anti-tamper products; Ethernet solutions; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, California and has approximately 4,800 employees globally. Learn more at www.microsemi.com.