Application Brief

MSP430 + DRV83xx Selection Guide for Power Tools

To effectively spin a Brushless-DC motor in cordless power tools, an appropriate microcontroller (MCU) must be selected to provide a trapezoidal control algorithm, communicate to the gate driver to configure settings and diagnose faults, and consume minimal power to improve battery life. In addition, when using more complex control techniques such as sensorless control, the MCU must be able to calculate real-time motor phase voltages and currents to accurately detect rotor position and measure Back-EMF crossings.

Table 1. MCU + DRV Selection Table Including Required Evaluation Tools and Designs

Application	ABS MAX (V)	MCU	Gate Driver	Required Evaluation Tools and Designs			Sensored or Sensorless Trapezoidal Control Included?
				MCU Evaluation Board	Gate Driver Evaluation Module	Software/GUI/ Design Files	
Power Tool	40	MSP430 General Purpose MCUs ranging from 0.5kB up to 64kB	DRV8304x 40-V max 3-phase smart gate driver with current shunt amplifiers	MSP430F5529 MCU Launchpad	BOOSTXL-DRV8304H	DRV8304 Software + GUI	Both
	65		DRV8320S 65-V max 3-phase smart gate driver with SPI interface		BOOSTXL-DRV8320S	DRV832x Software + GUI	
			DRV8320H 65-V max 3-phase smart gate driver with Hardware interface		BOOSTXL-DRV8320H		
			DRV8323RS 65-V max 3-phase smart gate driver with buck regulator, current shunt amplifiers, and SPI interface		BOOSTXL-DRV8323RS		

Table 1. MCU + DRV Selection Table Including Required Evaluation Tools and Designs (continued)

Application	ABS MAX (V)	MCU	Gate Driver	Required Evaluation Tools and Designs			Sensored or Sensorless Trapezoidal Control Included?
				MCU Evaluation Board	Gate Driver Evaluation Module	Software/GUI/ Design Files	
Power Tool (cont)	65 (cont)	MSP430 General Purpose MCUs ranging from 0.5kB up to 64kB (cont)	DRV8323RH 65-V max 3-phase smart gate driver with buck regulator, current shunt amplifiers, and Hardware interface	MSP430F5529 MCU Launchpad (cont)	BOOSTXL-DRV8323RH	DRV832x Software + GUI (cont)	Both (cont)
Vacuum/ blower/fan			DRV8320x 65-V max 3-phase smart gate driver	TIDA-010031			Sensorless
Garden tool/ Lawn mower	102		DRV8350R 102-V max 3-phase smart gate driver with buck regulator	TIDA-010056			Sensored

Description

For evaluation purposes, MSP430FR2355 FRAM-based MCUs and MSP430F5529 Flash-based are two general purpose MCUs well-suited for motor control applications such as power tools, vacuum cleaners, and garden tools. The MSP430FR2355 MCU integrates 32KB FRAM, 12-bit ADCs, universal asynchronous receiver/ transmitter (UART)/serial peripheral interface (SPI)/inter-integrated circuit (I2C), and four 16-bit timers in a 48-pin LQFP package, and the MSP430F5529 MCU includes 128KB Flash, 12-bit ADCs, UART/SPI/I2C, USB, and four 16-bit timers in an 80-pin LQFP package. These peripherals on both MCUs are capable of providing 6 PWM control signals to the gate driver inputs, SPI to communicate to the gate driver, ADCs for optional motor phase current and phase voltage from the gate driver from the gate driver, and UART or USB compatibility for GUI interface.

Both MCUs are recommended to use with the DRV8304x, DRV832x, and DRV835x 3-phase Smart Gate Driver devices from Texas Instruments. These gate drivers are ideal for Brushless-DC motors in power tool applications, blowers, fans, garden tools, and lawn mowers because they optimize external MOSFET gate switching and power stage design while providing optional integrated Current Shunt Amplifiers for sensored or sensorless control.

To expedite the evaluation process, Texas Instruments provides the BOOSTXL-DRV8304H, BOOSTXL-DRV8320S, BOOSTXL-DRV8320H, BOOSTXL-DRV8323RS, and BOOSTXL-DRV8323RH Evaluation Modules to interface with the MSP-EXP430F5529LP Launchpad Development Kit. Each EVM includes a “Software Files” folder on their product page that includes firmware examples and a GUI. The firmware includes sensored and sensorless projects to use with the BOOSTXL-DRV8304x or BOOSTXL-DRV832x EVM GUIs.

In addition, Texas Instruments provides two reference designs, TIDA-010031 and TIDA-010056, which demonstrate high-speed, high-power, and/or high-efficiency solutions for Brushless-DC motor drives. TIDA-010031 uses a high-speed sensorless trapezoidal to spin motors up to speeds of 180,000 RPM, and TIDA-010056 demonstrates a >99% efficient power stage in a small PCB form factor optimized for driving a three-phase BLDC motor in cordless power tools. Both designs utilize the MSP430FR2355 FRAM-based MCU as the best solution for a cost-effective, smart microcontroller to meet the various end equipment system needs.

No matter the design challenges, Texas Instruments provides solutions to help you through the evaluation process and suit your power tool needs. The breadth of the MSP430 MCU portfolio, as well as the wide offerings of gate driver solutions, allows for the design and development of different classes of power tools from cordless hand-held tools to more robust garden tools.

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