Wolfspeed SpeedVal Kit™ Expands Control Options With NXP Cards

Designers working with Silicon Carbide (SiC) evaluation kits, often built around just one SiC device, find themselves constrained to a narrow set of components for testing. Wolfspeed's SpeedVal Kit takes a modular approach instead to offer designers the flexibility and customizability, and rapid, painless evaluation of multiple devices at the system level.

The kit's building blocks form an ecosystem of Wolfspeed Silicon Carbide power daughter cards, partner gate driver and controller cards, as well as other accessories that engineers can easily switch on the motherboard. The card-edge connections mean devices can be tested and changed quickly without soldering.

SpeedVal Kit: Engineers can test all aspects of a power converter design with the kit, resulting in a significant reduction in risk and time when moving from evaluation to development.

Digital Control Optimizes Power Conversion

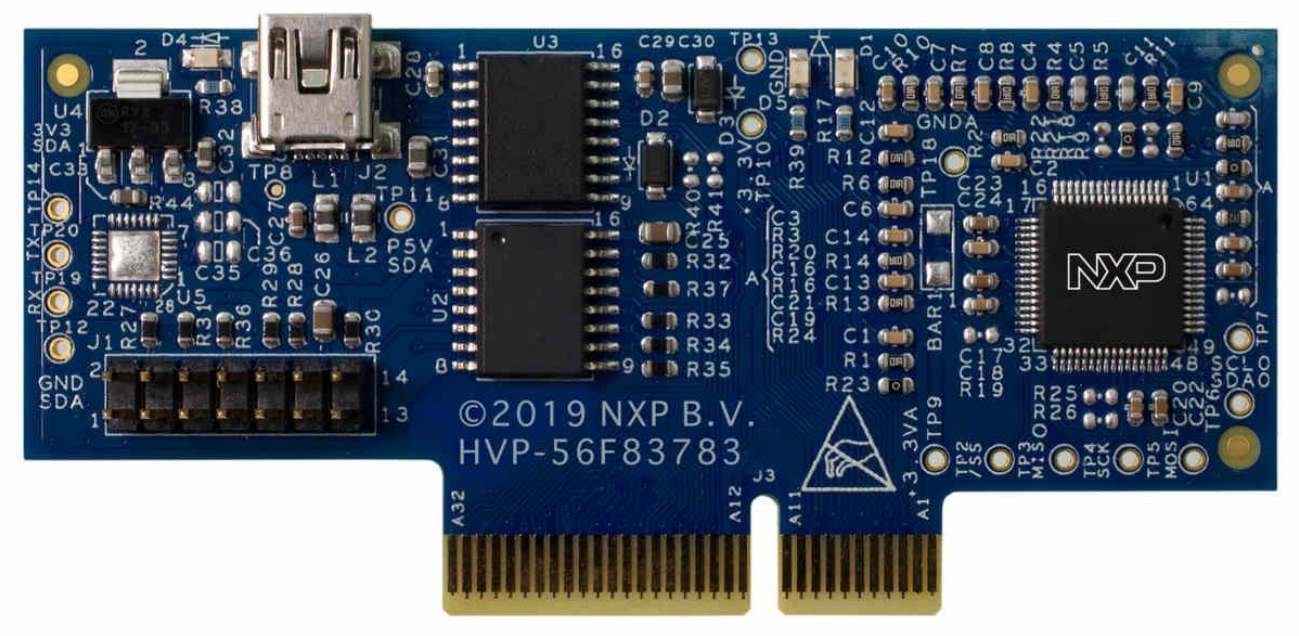
Among the SpeedVal Kit's selection of daughter cards are NXP's HVP-56F83783 and HVP-56F81768 high-voltage development cards, featuring NXP's 32-bit digital signal controllers (https://nxp.com/dsc). While these control cards are optional for using the SpeedVal Kit, they can help the engineer not only test the SiC and gate driver behavior in this system, they also provide an ideal environment to begin firmware development for their own design.

The first benefit to using an NXP control card in conjunction with the PC based user interface for SpeedVal Kit is that it comes with pre-tested firmware for operating the system as a buck or boost converter, or to apply gating signals for Double Pulse Testing (DPT) to investigate switching behavior. This can simplify the evaluation process by eliminating the need for an external function generator to drive the PWM signals, and incorporating some basic safety features and feedback signals to the user interface.

To take things to the next level, customers can extend the existing or develop their own firmware for the controllers. This allows the engineer to develop and test portions of the firmware that they will use in their own eventual design without having to develop any new hardware initially. Using this approach, firmware

can be started months earlier in the development cycle and be validated on known-good hardware early in the design cycle.

Compared with analog controllers, digital controllers offer the benefits of programmable configuration and thus flexibility in design and non-linear control. Consider for instance the high-voltage converter functionality required by applications ranging from server power supplies to grid-tied solar farms and their storage systems to EV fast chargers and onboard chargers to industrial motor drives. Here topologies such as



NXP HVP-56F83783: The High-Voltage-Development Platform is a hardware and software rapid prototyping toolset for evaluating high-voltage motor control and power conversion designs and algorithms.

a totem pole power factor correction (PFC) circuit offers regulation on the harmonic content while providing extremely high system efficiency by leveraging Silicon Carbide's low switching losses and minimal reverse recovery. Through digital control, the PWM signals can be optimally tuned to minimize zero-crossing distortion providing nearly ideal current waveforms on the line.

Adding flexible, configurable control

The two controller cards offered as options with the SpeedVal Kit, host as the workhorse NXP's leading 32-bit digital signal controllers (DSCs). The DSCs are based on a 32-bit 56800EX Hawk V3 core that offers 50 MHz normal-mode and 100 MHz fast-mode core frequency. The core's modified dual Harvard architecture delivers DSP and MCU functionality in a unified, C-efficient architecture. It has 3 internal address buses and 4 internal data buses; flies though up to 100 MIPS in the fast mode; integrates an FIR filter 6X faster than the ARM Cortex-M3; offers fractional arithmetic; has superfast interrupt supported by software subroutine and interrupt stack; and allows priority-level setting for interrupts. The core engine includes JTAG/Enhanced On-Chip Emulation (OnCE) for real-time debugging independent of processor speed.

The HVP-56F83783 accommodates the MC56F83783VLH Digital Signal Controller (DSC) and the HVP-56F81768, MC56F81xxx. Their onboard analog comparator (ACMP) DACs allow inductor current and output voltage measurement for current-mode and voltage-mode control. A flexible eFlexPWM with multi-modes offers 312 ps resolution, synchronization to other PWM, multiple output trigger events, and independent top and bottom deadtime insertion. Both cards also offer basic safety features of over-voltage, over-current, and over-temperature protection.

The controller cards, the DSCs they accommodate, and therefore their capabilities do vary in terms memories, eFlexPWM and timer channels, communication interfaces, and clocks.

The MC56F83783 offers the CAN FD (flexible data rate) interface, is AEC-Q100 qualified, and supports the Production Part Approval Process (PPAP), which implies that NXP understands customer designs and manufactures parts consistently to meet their requirements.

	Core	System	Memories	Timers	Analog	Communications	Clocks
MC56F83xxx	- 32-bit 100MHz 56800EX DSP core - JTAG/EOnCE debug controller	- Inter-module crossbar - Event Generator - 4-ch eDMA - CRC - MRP - Watchdog - LVI/POR/Brownout	- Flash w/ ECC up to 256 KB - SRAM up to 64 KB - Boot ROM 32 KB	- eFlexPWM 16-ch - NanoEdge Placer* - Quad Timer 8-ch - 2x PITs	- 2x 12-bit ADC w/ PGA - 2x 12-bit DAC - 4x ACMP w/ 8-bit DAC	- 2x I²C/SMBus - 2x SPI - 3x UART - USB FS OTG w/ PHY - CAN FD	- PLL - Crystal - 48 MHz OSC - 200 kHz OSC
MC56F81xxx	- 32-bit 100MHz 56800EX DSP core - JTAG/EOnCE debug controller - Digital Signature Algorithm Security Subsystem (DSASS)*	- Inter-module crossbar - Event Generator - 4-ch eDMA - CRC - MRP - Watchdog - LVI/POR/Brownout	- Flash w/ ECC up to 128 KB - SRAM up to 20 KB - Boot ROM 64 KB	- eFlexPWM 8-ch - NanoEdge Placer* - Quad Timer 4-ch - 2x PITs - Quadrature Decoder	- 2x 12-bit ADC w/ PGA - 1x 12-bit DAC - 4x ACMP w/ 8-bit DAC - 2x Opamp	- 2x I²C/PMBus - 1x SPI - 2x UART	- PLL - Crystal - 8 MHz OSC - 200 kHz OSC

NXP MC56F83 vs MC56F81: Text in red highlights differences between the auto-grade, high-performance MC56F83xxx and the entry-level MC56F81xxx. Features with an asterisk (*) are optional within the series.

The MC56F81xxx, on the other hand, offers optional trust provision with the Digital Signature Algorithm Security Subsystem (DSASS) — the hardware realization of ECC-based digital signature authentication, SHA256, and true random number generator (TRNG).

Between the two, the HVP-56F81768 and HVP-56F83783 support many applications, including PFC, industrial motor control, large home appliances, solar inverters, and switched-mode power supplies. The higher performance HVP-56F83783 is particularly well-suited to automotive applications, such as HVAC.

Firmware environment eases customization

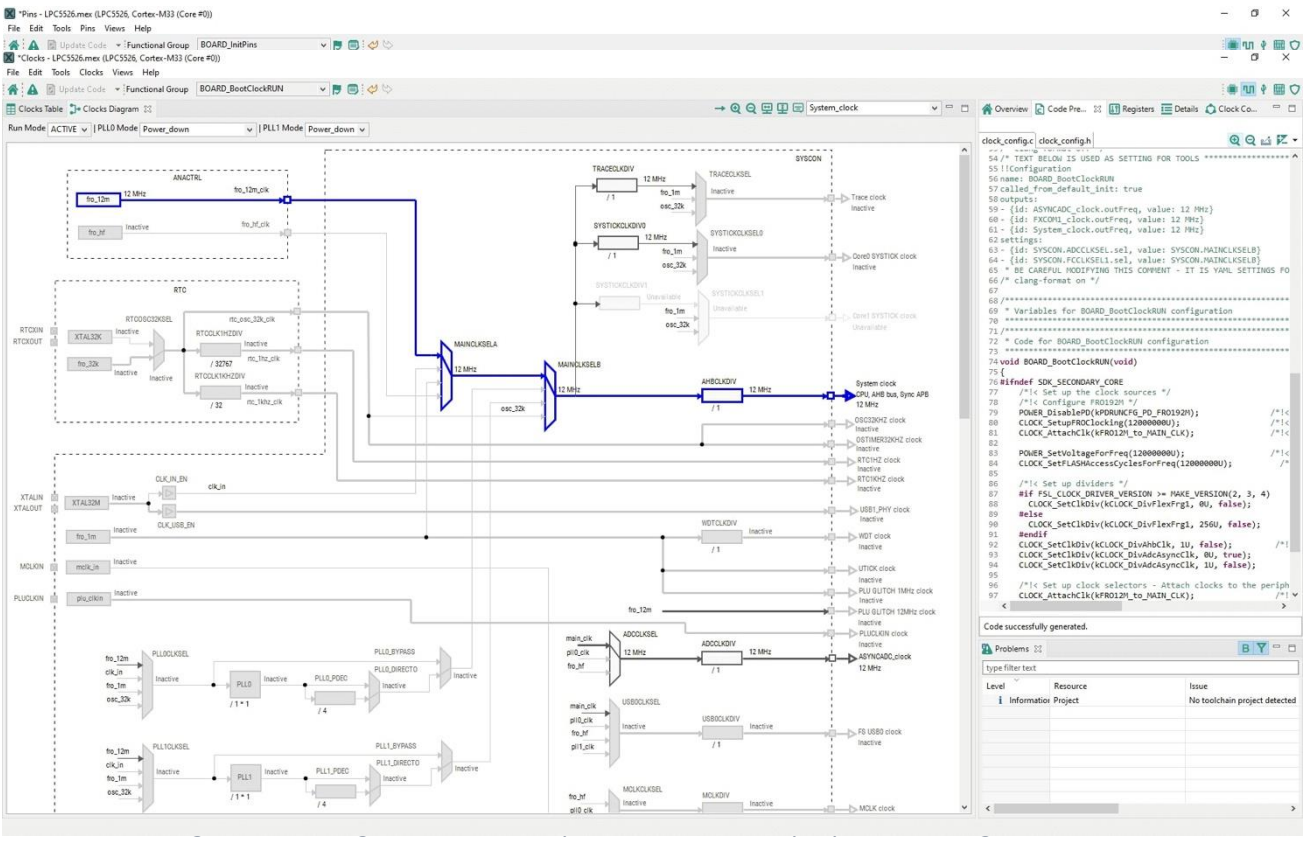
The controller card flexibility and programmability are supported by NXP's extensive firmware development support. The cards can be simply plugged into a computer via USB for designers to start configuring them with their installed tools.

NXP DSCs come with a free license for the CodeWarrior IDE, which runs on most operating systems, including Windows, Solaris, and Linux. The IDE allows designers to choose from multiple programming languages, such as C, C++, and Java, as well as in-line assemblers for most processors.

NXP also provides the MCUXpresso ecosystem, including a software development kit (SDK), as well as a suite of Configuration Tools. Designers can use the Config Toolsuite to shorten time to market by helping to set pins, clocks, and peripherals and generate initialization C code or register values for custom board support. It includes:

- Pins Tool provides pin settings for pin routing, signal muxing, electrical properties and I/O conflict resolution options, and run-time configurations.
- Clocks Tool allows easy configuration of system clock initialization (core, system, bus, peripheral clocks), offering visual inspection of the configured clock paths. It validates clock settings, provides calculations

of the resulting clock frequencies, and delivers automatic clock setup capability and functionality for automatic adjustment of pin output parameters.



Clocks Tool: Its graphical and tabular representations of the MCU clock tree system are further empowered by interactive user controls and automatic clock setup and error checking.

- Peripherals Tool generates MCUXpresso SDK driver initialization code and register settings for specialized peripherals
- Project Cloning Tool creates a standalone SDK project based on an example application available within the SDK.
- Project Updater works with existing SDK-based IDE projects with generated pins, clocks, and peripheral source files.
- Device Configuration Tool allows sequence configuration of device configuration data commands for pre-initialization at boot time. It generates the binary files for MCUXpresso secure provisioning tools.

NXP's tools and runtime software are complimentary, and assembly and C source code are provided under open-source licensing.

Growing ecosystem advantage

The NXP HVP-56F81768 and HVP-56F83783 controller cards are part of Wolfspeed's growing ecosystem supporting the SpeedVal Kit evaluation platform offering multi-supplier solutions. Serving as the starting point for all Silicon Carbide designs with bill of materials, design and simulation files, and expert support. This ecosystem approach allows customers to evaluate and develop all facets of a SiC power converter quickly and easily to help accelerate their product development and achieve first-pass design success. Learn more about the SpeedVal Kit at Wolfspeed.com/SpeedValKit and the NXP controller card options at NXP.com/dsc.