

## XMC4000 – Advanced Microcontrollers for Industrial Solutions

32-bit Microcontroller Family based on ARM<sup>®</sup> Cortex<sup>™</sup>-M4



The XMC4000 family marks a cornerstone in microcontroller design for real-time critical systems. It is the result of Infineon's world-leading microcontroller know-how now coupled with all the benefits of a standard CPU core. Featuring Infineon's powerful peripheral set, configurable to specific application requirements, XMC4000 is the ultimate choice for today's industrial control solutions. This family is designed to tackle the imminent challenges of improving energy efficiency, supporting advanced communication protocols, and reducing time-to-market. Family members operate even in high-temperature environments of up to 125 °C, granting you access to their exceptional performance in all corners of your system.

### XMC4000 Building Blocks

ARM® Cortex™-M4 & Floating Point Unit		DEBUG	Real Time Clock
		System Timer	DMA
Communication	Timer & Actuator Control	Analog & Mixed Signal	Proven Quality
Ethernet	CCU4	ADC	Data Protection Through ECC/Parity
USB	CCU8	DAC	CRC & Random Pattern Generation
External Memory I/F	High Resolution PWM	HMI	
SD/MMC Card I/F	Position Interface	Capacitive Touch	
CAN	$\Delta\Sigma$ Demodulator	LED Matrix	
UART/SPI/I <sup>2</sup> C/I <sup>2</sup> S		Ports	
			Infineon Innovation <span style="color: #0056b3;">■</span> Infineon State-of-the-Art <span style="color: #c0c0c0;">■</span> Standard <span style="color: #000000;">■</span>

# One microcontroller platform. Countless solutions.

## XMC4000 Family Features

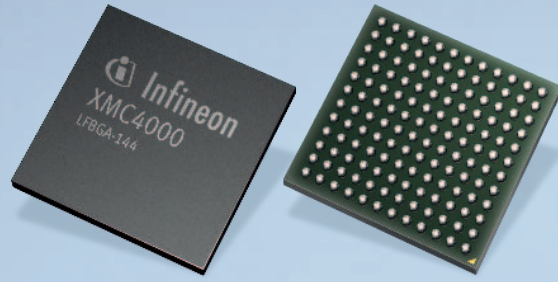
XMC4000 benefits from the real-time control and signal-processing capabilities of the ARM® Cortex™-M4 CPU, coupled with Infineon's fast embedded Flash and an industry-tailored peripheral set which is optimized for real-time control. Flexible timers and pulse generators combined with ultra-fast ADCs and DACs allow accurate sensor-actor control schemes. In addition a set of modern communication interfaces such as Ethernet and USB plus HMI peripherals make up a power pack for industrial applications.

- ARM® Cortex™-M4 with Floating Point Unit (FPU), single-cycle DSP MAC, 80-180 MHz CPU frequency
- Up to 2.5 MB embedded Flash with 22 ns access time and error correction unit
- 16-channel DMA (XMC4500 with 12-channel DMA)
- Comprehensive set of timers, Delta-sigma Demodulator, Position Interface, PWM with emergency shutdown and ADC trigger, Quadrature Encoder Interface
- 4-channel high-resolution PWM (150 ps)
- Up to 4x 12-bit ADC with 70 ns sample time
- 2x 12-bit DAC
- Up to 2x IEEE 1588 compliant Ethernet MAC with switch capability (XMC4700)
- USB 2.0 full-speed device & on-the-go, USB high-speed MAC on selected products
- Up to 6 multi-functional serial interface modules configurable to SPI, I<sup>2</sup>C, I<sup>2</sup>S, UART
- Up to 512 kB embedded RAM
- CAN
- External bus interface supporting SDRAM, SRAM, NOR-/NAND-Flash and memory-mapped IO devices (e.g. LCD)
- SD/MMC interface
- Touch interface & LED Matrix
- Battery-backed real-time clock with calendar function and time-based or external wake-up capabilities
- Extended temperature range up to 125 °C ambient temperature

XMC4000 Family Members Feature Table

		low-end <span style="float: right;">high-end</span>				
		XMC4100	XMC4200	XMC4400	XMC4500	XMC4700*
System Performance	Core	AMR® Cortex™-M4				
	CPU frequency (at 125 °C)	80 MHz	80 MHz	120 MHz	120 MHz	180 MHz
Timers	Co-proc	Floating Point Unit				
	Flash size	128 kB	256 kB	512 kB	1 MB	2.5 MB
	RAM size	20 kB	40 kB	80 kB	160 kB	512 kB
	Cache	4 kB	4 kB	4 kB	4 kB	6 kB
	POSIF	1x	1x	2x	2x	2x
Signal Processing	CCU4 (4ch)	2x	2x	4x	4x	4x
	CCU8 (4ch)	1x	1x	2x	2x	2x
	High-resolution PWM (150 ps) channels	4x	4x	4x		
Communication	ADC 12-bit	2x	2x	4x	4x	4x
	Delta-sigma demodulator			4x	4x	4x
	DAC	2x	2x	2x	2x	2x
	IEEE 1588 Ethernet MAC			1x	1x	2x
	USB	FS DEV	FS DEV	FS OTG	FS OTG	HS OTG
	SD/MMC				✓	✓
	Serial channels (URAT, SPI, I <sup>2</sup> C, I <sup>2</sup> S)	4x	4x	4x	6x	6x
	Ext. memory I/F				✓	✓
CAN	2x	2x	2x	3x	3x	
Touch button	✓	✓	✓	✓	✓	

\* under definition

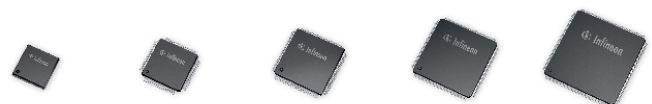


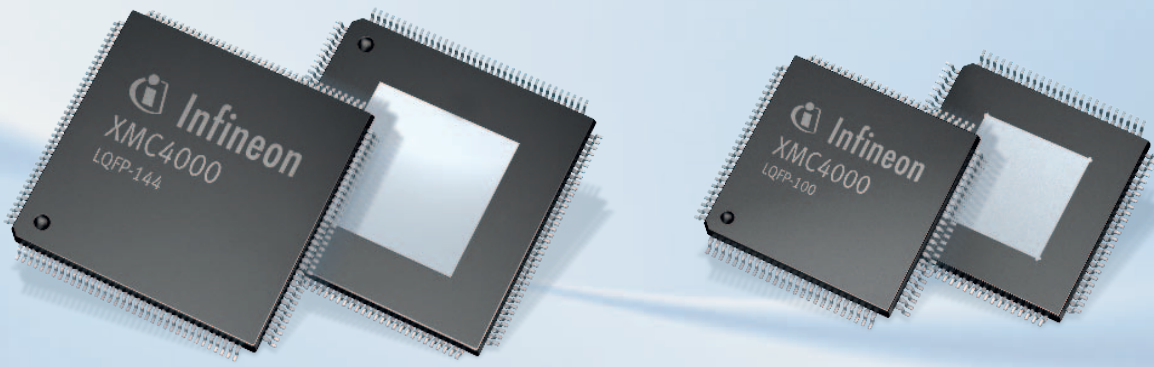
## XMC4000 Portfolio and Roadmap

All microcontrollers of the XMC4000 family offer a number of options with respect to CPU frequency, memory density, peripheral functions and number of I/Os. They span a portfolio of compatible devices at well defined feature/cost ratios, allowing selection of the perfect solution for the different requirements in your system. The 5 series XMC4700, XMC4500, XMC4400, XMC4200, and XMC4100 allow re-use of software within the family and an easy interchange of hardware with certain pin-compatible packages.

### XMC4000 Portfolio

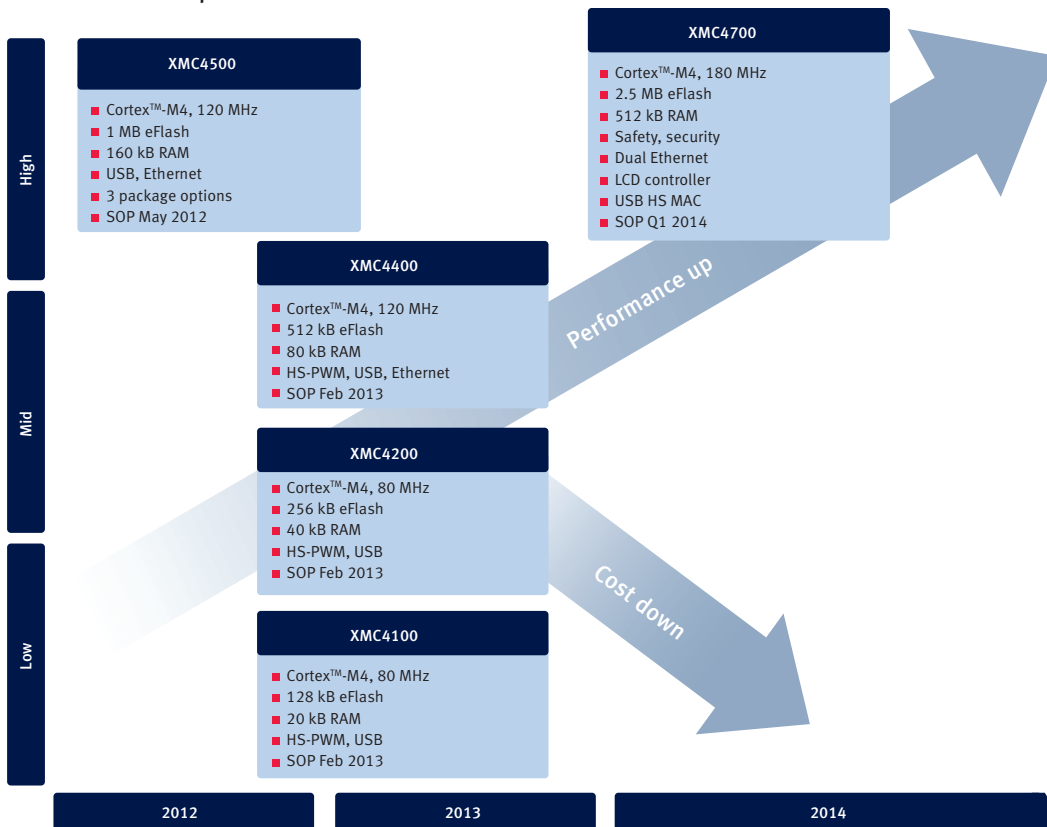
CPU Frequency @ 125 °C	Flash	SRAM								
180	2.5 MB	512 kB							XMC4700 (in def.)	XMC4700 (in def.)
120	1 MB	160 kB						XMC4500	XMC4500	
120	768 kB	160 kB						XMC4500		
120	512 kB	80 kB						XMC4400		
80/120	256 kB	40/80 kB			XMC4200	XMC4400				
80	128 kB	20 kB		XMC4200	XMC4100					
80	64 kB	20 kB		XMC4100						
				VQFN48 (7x7)	LQFP64 (12x12) LFBGA64 (in def.) (5x5)	LQFP64 (12x12)	LQFP100 (16x16)	LQFP144 (22x22)	LFBGA144 (10x10)	LQFP176 (26x26) LFBGA225 (13x13)





Going forward XMC4000 will address the need for higher performance and feature enhancements and at the same time constantly strive to lower costs.

### XMC4000 Roadmap





## XMC4000 Target Markets & Applications

XMC4000 is the ideal solution to enable sophisticated algorithms in applications like advanced motor control and power conversion control. Innovative products powered by XMC4000 serve market segments like renewable energy, logistics, factory and building automation, transportation and any others where leading-edge real-time and signal-processing capabilities are needed, even in 'hot environments' e.g. in proximity to a motor.

### Target Markets

- Renewable Energy
- Logistics
- Factory Automation
- Building Automation
- Transportation

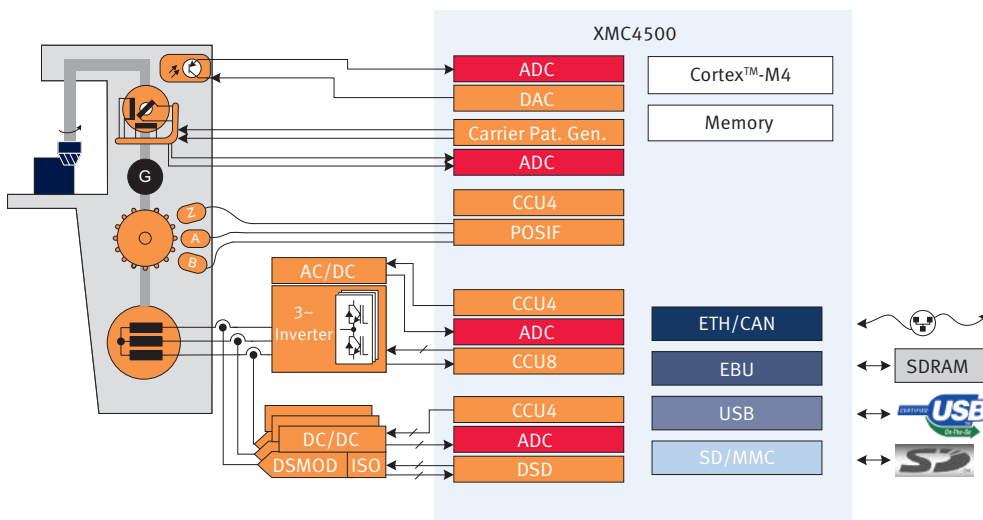
### Target Applications

- Motor Control
- Position Detection
- IO Devices
- HMI
- Solar Inverters
- SMPS
- Sense & Control
- PLC
- UPS
- Light Networks

## Application Example: CNC Machine

Infineon XMC4500 is best suited for supporting high-end motor control applications such as servo drives for CNC machines. The XMC4500 offers the computing performance to run several hard real-time tasks in parallel to heavy communication stacks. With 1 MB embedded flash, 160 kB RAM and a rich peripheral set, it is possible to tailor the application's specific requirements. Ready-to-start software support is given via DAVE™ 3 IDE and code generation engine with low level drivers and free software stacks.

### CNC Machine

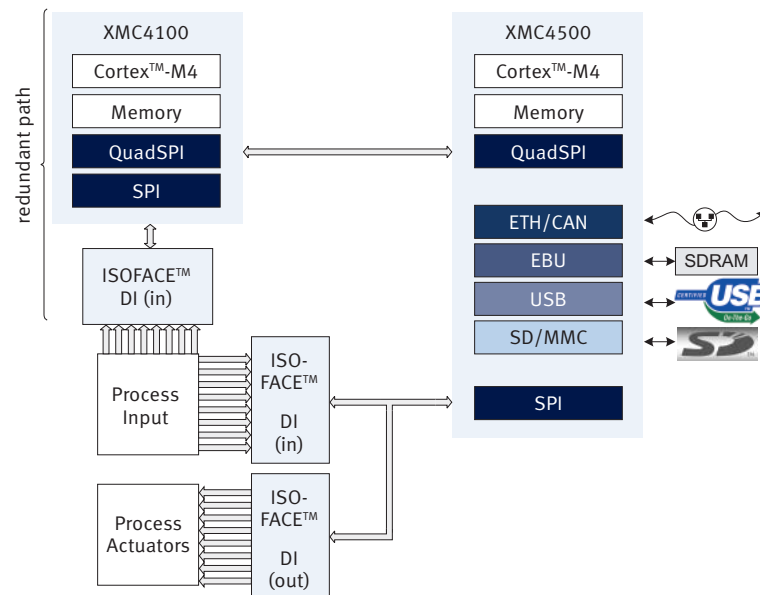


Application Requirement	Used Device Feature
Quadrature Encoder position detection	POSIF interface together with Capture Compare Unit CCU4
Rotary angle detection with Resolver	Carrier pattern generator for primary coil excitation and resolver feedback signal measurement via Analog to Digital Converter (ADC)
Motor control inverter	Capture Compare Unit CCU8
In-phase current measurement via galvanic isolated Delta Sigma Modulator	Delta Sigma Demodulator (DSD)
Main and auxiliary power supply generation with Power Factor Correction (PFC)	Pulse generation via Capture Compare Unit CCU4 and current/voltage measurement via Analog to Digital Converter (ADC)
Sensor calibration, offset and gain adjustment	Digital to Analog Converter (DAC)
Fieldbus interface	Via Ethernet MAC with IEEE1588 timestamping and/or CAN
External memory extension for process data image and code	External Bus Unit EBU supporting synchronous and asynchronous protocols for e. g. SDRAM and NAND- or NOR-flash
Service access via plug and play interface	USB 2.0 OTG interface
User access for machine configuration	SD/MMC interface

## Application Example: Field I/O Device

Industrial field I/O devices must safely control process inputs and outputs. These can be e. g. switches or relays for process actuators, digital sensors for supervision or light curtains for protection. Infineon's ISOFACE™ family is specifically designed for this purpose. Together with XMC4000 devices a complete system solution is possible. A safe path can be accomplished by using a redundant chipset of ISOFACE™ or XMC4000.

### Field I/O Device



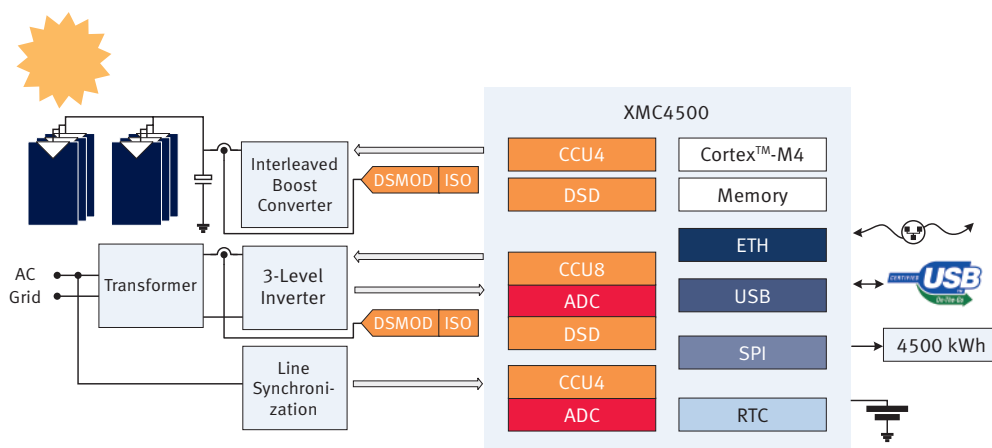
Application Requirement	Used Device Feature
ISOFACE™ input/output communication	Fast SPI interface (up to 20 MBaud) with individual chipselect generation for each ISOFACE™
Redundant path with secondary chipset	Fast QuadSPI interface (up to 80 MBaud)
External memory extension for process data image and code	External Bus Unit EBU supporting synchronous and asynchronous protocols for e. g. SDRAM and NAND- or NOR-flash
Fieldbus interface	Via Ethernet MAC with IEEE1588 timestamping and/or CAN
External memory extension for process data image and code	External Bus Unit EBU supporting synchronous and asynchronous protocols for e. g. SDRAM and NAND- or NOR-flash
Service access via plug and play interface	USB 2.0 OTG interface
User access for machine configuration	SD/MMC interface



## Application Example: Solar String Inverter

In today's solar inverter applications the goal is to achieve the last percentage of efficiency. This is only possible by using optimized inverter topologies with best-in-class power switches. The control of these topologies requires sophisticated pulse generation with symmetric, asymmetric, periodic and aperiodic shapes. In order to operate the solar module in its maximum power point, a fast and accurate simultaneous measurement of current and voltage is necessary. Low load conditions have to be managed in the same way as overloads and safe switch off. Furthermore today's solar inverters are connected to the internet for remote control and data acquisition. The intelligent peripheral set of the XMC4500 offloads the CPU to safe enough headroom for computing both the hard real-time tasks and the heavy software communication stacks.

### Solar String Inverter



Application Requirement	Used Device Feature
Solar inverter (3-level)	Pulse generation via Capture Compare Unit CCU8
In-phase current and hot voltage measurement via galvanic isolated Delta Sigma Modulator	Delta Sigma Demodulator (DSD)
Interleaved buck/boost converter with Power Factor Correction (PFC)	Pulse generation via Capture Compare Unit CCU4
Line synchronization	Time measurement via Capture Compare Unit CCU4
Internet access for remote control and data acquisition	Ethernet MAC
Display	Fast SPI (up to 20 MBaud)
Service access via plug and play interface	USB 2.0 OTG interface
Battery buffered Realtime Clock	RTC

# Development Tools and Software

## DAVE™ 3 – The next generation of DAVE™

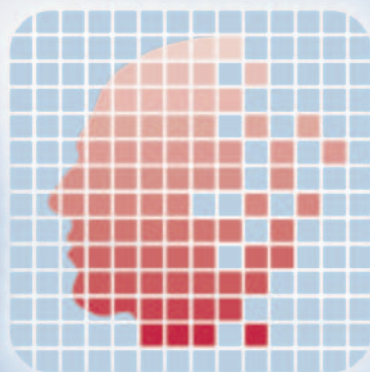
To allow you to fully benefit from XMC4000's flexible architecture, Infineon is offering the DAVE™ 3 infrastructure, a revolution in assisted software development.

Eclipse-based DAVE™ 3 is a free toolset that makes it easy to develop application software-based on predefined and tested software components called DAVE™ Apps. DAVE™ Apps cover a wider range of use cases: from peripheral drivers, like PWM, SPI, CAN or ADC Apps, middle ware components like TCP/IP, USB, File system or GUI, application abstractions for motor control or automation up to complete configurable embedded applications.

DAVE™ 3 comes with a set of completely free development tools like the GNU compiler, free debugger and Flash loader. Other Eclipse-compliant tool suites can be incorporated easily.

The heart of DAVE™ 3 is the DAVE™ Apps Manager used to download and configure the DAVE™ Apps from the web and the DAVE™ Code Engine to generate the application software including conflict-free hardware initialization and pin assignment. The generated code can be compiled with a free ARM® GNU compiler, and an integrated HLL debugger allows downloading and debugging the application software. A data monitoring plugin can visualize application data and allows specific software control from a dash board. Also commercial tools and software can be connected or included in the new DAVE™ 3. With DAVE™ 3, embedded software development has never been easier or faster.

DAVE™ 3 toolset can be downloaded free-of-charge from [www.infineon.com/dave](http://www.infineon.com/dave).



## DAVE™ 3

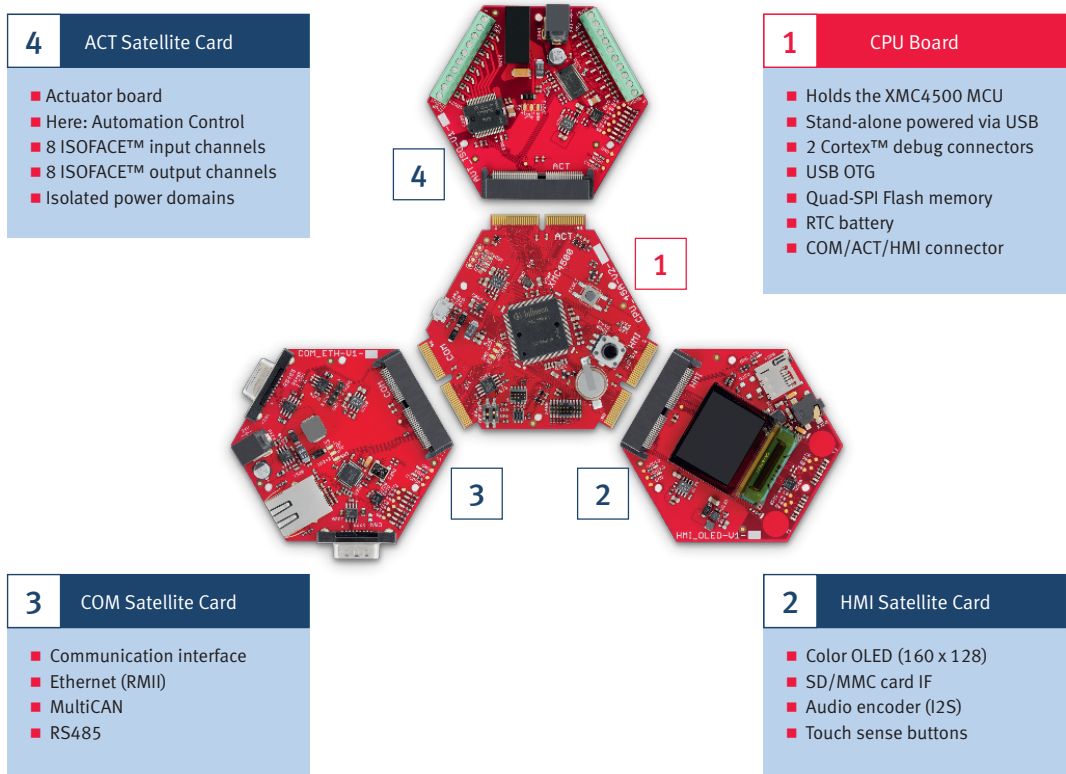
Component based  
programming with  
DAVE™ Apps



## Hexagon Application Kit

The Hexagon Development Kit System is a modular, expandable application board platform for the XMC4000 family. A number of satellite cards connected to the central CPU board will enable fast prototyping of specific applications such as motor control with resolver/encoder circuitry, industrial automation via Infineon’s ISOFACE™ chipset or any kind of power conversion like solar inverters.

An HMI satellite card provides SD/MMC, audio and touch sense functionality along with an OLED display. Ethernet, CAN and RS485 functions can be added via the COMMUNICATION satellite card. The ACTUATOR satellite cards are targeted for motor control, industrial automation and power conversion applications.



The CPU board and satellite cards can be ordered as pre-defined bundles – so-called ‘editions’– or individually depending on your specific needs.

	CPU Board	Debugger	Satellite Cards
Basic Edition	X		
Enterprise Edition	X	X	
Application Edition	X	X	X

## Ask Infineon. Get connected with the answers.

Where you need it. When you need it.

Infineon offers its toll-free 0800/4001 service hotline as one central number, available 24/7 in English, Mandarin and German.

Our global connection service goes way beyond standard switchboard services by offering qualified support on the phone. Call us!

- Germany ..... 0800 951 951 951 (German/English)
- China, mainland ..... 4001 200 951 (Mandarin/English)
- India ..... 000 800 4402 951 (English)
- USA ..... 1-866 951 9519 (English/German)
- Other countries ..... 00\* 800 951 951 951 (English/German)
- Direct access ..... +49 89 234-0 (interconnection fee, German/English)

\* Please note: Some countries may require you to dial a code other than "00" to access this international number, please visit [www.infineon.com/service](http://www.infineon.com/service) for your country!

## Where to Buy

### Infineon Distribution Partners and Sales Offices

Please use our location finder to get in contact with your nearest Infineon distributor or sales office.

[www.infineon.com/WhereToBuy](http://www.infineon.com/WhereToBuy)

Infineon Technologies – innovative semiconductor solutions for energy efficiency, mobility and security.



Published by  
Infineon Technologies AG  
85579 Neubiberg, Germany

© 2012 Infineon Technologies AG.  
All Rights Reserved.

Visit us:  
[www.infineon.com](http://www.infineon.com)

Order Number: B158-H9691-X-X-7600  
Date: 02 / 2012

#### ATTENTION PLEASE!

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie"). With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

#### INFORMATION

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com)).

#### WARNINGS

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies Office. Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.