XMC – Infineon Cortex-M MCU

The Industrial and Multimarket MCU

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Agenda

1. What is XMC™
2. XMC – Major Applications
3. XMC – Ecosystem
4. Introduction to Micrium uC/Probe ™ XMC™
5. Micrium uC/Probe ™ Demo
6. Reference

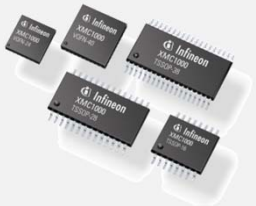
What is XMC™

One microcontroller platform
Countless Solutions

- **XMC™ - Industrial & Multimarket Microcontroller based on ARM® Cortex® M**
- **XMC™ - Application / Segment specific Microcontrollers**

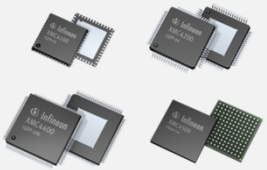
XMC™ comprises of 2 major families

XMC1000



- Cortex® M0 based
- Up to 200kB Flash
- Applications:
  - Low cost motor control
  - Lighting
  - Power conversion

XMC4000



- Cortex® M4 based
- Up to 2MB Flash
- Applications:
  - Automation (Industrial Drives, PLC, I/O)
  - Power conversion

XMC – Basic Facts

XMC1000

System
- ARM® Cortex™-M0, 48MHz
- 8KB to 200KB Flash
- 16kB RAM
- up to 64pin packages

Highlights
- **96MHz MATH Co-processor** for advanced control loops (CORDIC / DIVIDE)
- Advanced PWM and Timers
- Rich serial communication including SPI, UART and I2C
- LED color control engine for automatic RGB mixing and flicker free dimming
- Position Interface for motor control applications

Operating Conditions
- Temperature: up to 105°C
- Voltage: 1.8 to **5.5V**

XMC4000

System
- ARM® Cortex™-M4, up to 144MHz
- DSP and Floating Point Unit (FPU)
- Up to 2 MB Flash with ECC
- Up to 356kB RAM and 8kB Cache
- FPU and up to 12ch DMA
- up to 196pin packages

Highlights
- Advanced PWM, Timers and four 12-bit ADC with 3.5Msps for efficient drives
- High-resolution PWM and control logic for digital power applications
- ΔΣ-Demodulator to save an ASIC
- Real-time optimized and powerful peripherals working autonomously
- Complete set of industrial standard connectivity peripherals including Ethernet, USB, SD/MMC, CAN, SPI, UART, I^2C,EtherCAT

Operating Conditions
- Temperature: **up to 125°C**

Product Portfolio XMC™

ARM® Cortex®-M0

- Core up to 48MHz / Peripherals up to 96MHz
- Capture Compare Units (CCU4, CCU8)
- Serial Channels
- 12Bit ADC
- TA = -40C to 105C

>70 % Performance Increase

XMC1400
up to 200kB Flash
40 – 64 pins

XMC1300
up to 200kB Flash
16 – 40 pins
- 2x CAN
- 2x CCU8
- up to 4 Serial Channels

XMC1200
up to 200kB Flash
16 – 40 pins
- Math Co-Processor
- CCU8 PWM Timer
- Hall & Encoder I/F

XMC1100
up to 64kB Flash
16 – 40 pins
- 9ch LED Control (BCCU)
- 3x Analog Comparators

High Volume Production

TSSOP 16/28/38 – VQFN24/40/64 – TQFP64

Wide Supply Voltage Range 1.8V to 5.5V

Secure Boot Loader – ensure IP protection

Application Specific Peripherals

MATH co-processor	Event Request Unit (ERU)	High-performance analog comparators	PWM Timer for Motor Control (CCU8)	LED Brightness Color Control Unit

XMC1400 Series

70%+ Performance*

SYSTEM

ARM® Cortex®-M0 48MHz	96MHz MATH Co-Processor	On-chip Oscillator	RTC
	SysTick	Clock Input 4-20 MHz	Clock Input 32.768 kHz
	Programmable Interconnect Matrix	Secure Bootloader*	PRNG
	Temperature Sensor	VREG	WDT

TIMER / PWM

8 independent PWM Timers (CCU4) 16-64Bit 4ch, 96MHz	8 independent PWM Timers (CCU8) 16-64Bit 8ch, 96MHz + Dead-Time

COMMUNICATION

2xCAN 32 Message Objects	USIC 4ch [Quad SPI, SCI/UART, I²C, I²S]

ANALOG

12-bit ADC 2x S&H, 12 ch	Analog Comp 4x

MEMORY

FLASH 200KB ECC, Prefetch	RAM 16KB

APPLICATION SPECIFIC

2x Hall & Encoder I/F (POSIF)	Cap. Touch 24 ch	LED control 9 ch	LED Matrix 3 x 64 segments

Description

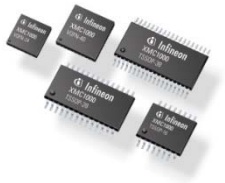
Application / Target Markets

- Motor Control / Digital Power / LED Lighting
- I/O Modules
- Small combustion engines

Key Features

- Designed for best in-class performance: **MATH Co-processor** featuring CORDIC, **96MHz PWM** timer dedicated to motor or engine control w/ dead time and **Hall & Encoder I/F**
- **On-chip connectivity** of peripherals offloads CPU and improves real time performance
- **1MS ADC** with add. internal reference multiple signal processing features
- Peripheral for **LED dimming & color control**, flicker-free, easy to use
- Extended **2.0 – 5.5V** Supply Range
- **IEC 60730 class B** compliant LIB
- 2 **CAN** nodes control

Package



LQFP64
VQFN40
VQFN48
VQFN64

...get more information...

XMC4000 MCUs powered by ARM® Cortex®-M4 One Microcontroller Platform. Countless Solutions.

ARM® Cortex®-M4 (with FPU)
- CPU Frequency up to 144MHz
- **High Performance Flash technology**
- Timers CCU4, CCU8, POSIF
- USB / Up to 3x CAN / Up to 6x Serial Channels
- Up to 4x 12Bit ADC / 2x DAC

XMC4100 / 4200
Up to 256kB Flash / 40kB RAM
48-64pins

XMC4400
Up to 512kB Flash / 80kB RAM
64-100pins
- 120MHz Core
- **Ethernet**
- ΔΣ Demodulator

XMC4500
Up to 1MB Flash / 160kB RAM
100 – 144pins
- EBU
- SD Card

XMC4700
Up to 2MB Flash / 352kB RAM
100 – 196pins
- 144MHz Core
- 6ch CAN

XMC4800
Up to 2MB Flash / 352kB RAM
100 – 196pins
- EtherCAT

XMC4300
256kB Flash / 128kB RAM
100 pin

High Volume Production

QFN 48 – 64-144 LQFP – 196 BGA

Long Product Life Cycle (min. 2027)

Extended Temperature Range – up to Ta 125°C + continues up time of 20years@Tj 110C

Application Specific Peripherals

High Resolution PWM	Event Request Unit (ERU)	High-speed analog compara-tors + Slope generation	Timer for Inverter Control (CCU8)	Delta Sigma demodulator

XMC4800 with EtherCAT®

System Performance

ARM® Cortex®-M4 @144MHz	FPU	Programmable Interconnect Matrix	RTC
	DMA 12ch	SysTick	CRC Engine
	FLASH (ECC) up to 2MB	RAM up to 352kB	CACHE 8kB

Timers / PWM

4x PWM Timers (CCU4) 16-64Bit 4ch	2x PWM Timers (CCU8) 16-64Bit 8ch + Dead-Time	2x POSIF (Position Interface)

Communication

6x CAN 256 MO	USIC 6ch [SPI/Dual SPI/Quad SPI, SCI/UART, I²C, I²S]	EtherCAT®
10/100 Ethernet MAC (/w IEEE 1588)	USB (FS OTG)	SDIO/SD/MMC Interface
External Memory Interface (EBU)		

Analog

4x 8ch-12bit ADC / 4Msps	2x 12Bit DAC	4x ΔΣ Demodulator

Application / Target Markets

- Medium to higher-end industrial control
- Industrial communication
- Transportation

Key Features

- ARM® Cortex®-M4 at 144MHz
- EtherCAT®
- Large on-chip memories 2MB Flash, 352kB RAM
- 6 CAN nodes with 256 message objects
- Rich industrial and external media connectivity
- Safety package supporting SIL-2/3
- 125°C extended temperature range
- Long-term availability with >15 years
- IEC 60730 class B compliant LIB
- Free DAVE™ IDE and DAVE Apps

Packages

- LQFP-100, LQFP-144, LFBGA-196

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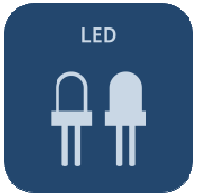
XMC – Major Applications

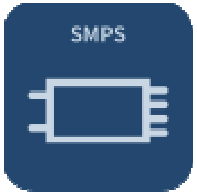
Home & Professional	Building Automation	Power & Energy	Transportation	Factory Automation
				
Applications				
› Home Appliance › AIRCON › Power Tools	› LED Lighting › Motor Control (Shutters, Door Opener,..)	› Server Supply › Solar Inverter › SMPS › Battery Management	› CAV › E-bike › LEV	› Industrial Drives › Pumps / Fans › I/O Modules › Micro PLC
Care abouts				
› Form factor, size and weight › Family concept › Copy protection › Fast ramp-up	› Up-time › Connectivity › Reliability & Quality › Lifetime › Safety & Security	› Energy efficiency › Ease of use › Remote monitoring › Appealing design and form factors	› Robustness for harsh environment › Functional safety › Reliability & Quality › Lifetime	› Energy efficiency › Robustness for harsh environment › Up-time

It's all about…

MOTOR CONTROL



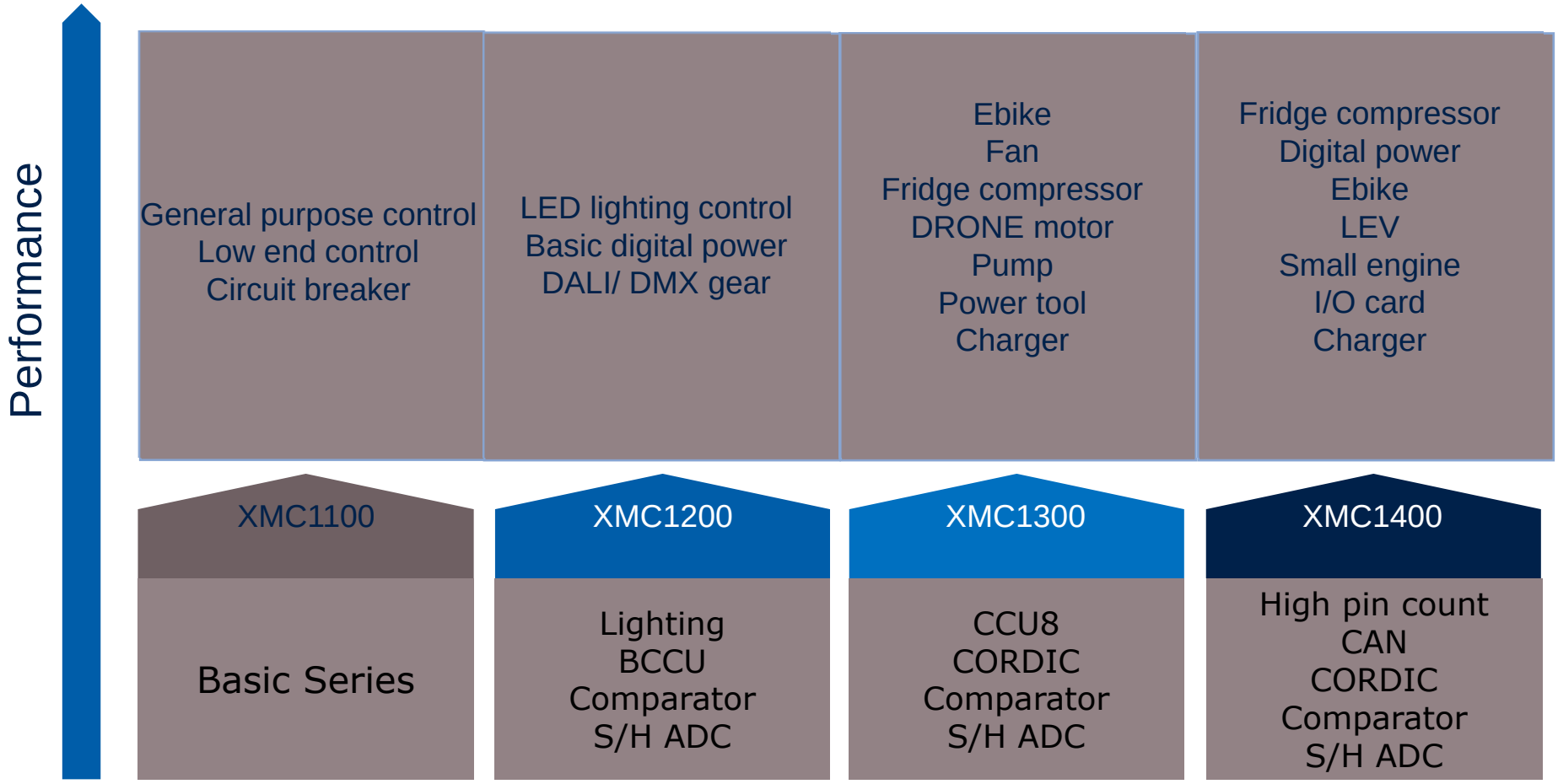
LIGHTING



POWER CONVERSION

COMMUNICATION

XMC1000–Major Application



Application Focus XMC1200
LED Lighting

Energy efficient and state-of-the-art LED lighting combined with connectivity

State-of-the-art LED Lighting:



Brightness and Color Control Unit (BCCU), high speed analog comparators and timers interconnected with ERU for:

- Smooth **automatic color change** (RGB & tunable white)
- Eye-friendly **exponential dimming**
- **Flicker-free** dimming

close to **0 % CPU load**

enough headroom to run wired or wireless protocols or interact with sensors.

XMC1200 implements the most automated LED Control combined with an Cortex®-M0

Application focus XMC1300
Low-end motor control

More efficiency drives the motor control towards brushless DC

All kinds of low-end motors:

Application specific peripherals for Motor Control:

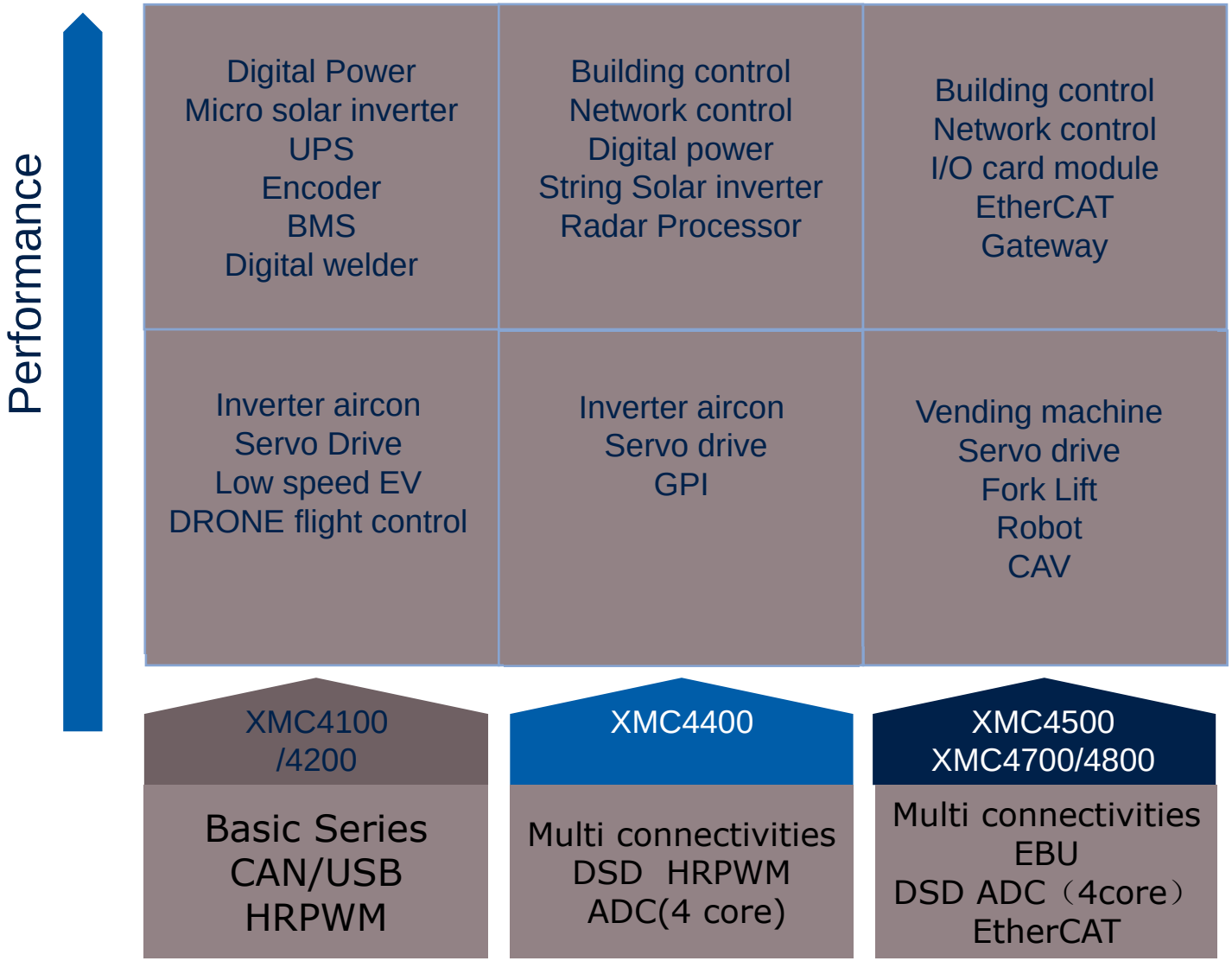
- Dedicated **Inverter PWM** generators (CCU8)
- **Motor Control Position Interface** (POSIF) supporting Hall, linear or quadrature rotary encoders

Performance and real-time enhancements:

- Motor Control specific **MATH Co-processor** (96% Cosine / 84% Division cycle savings)
- **Event Request Unit** (ERU) – enables interconnection between analog, PWM and sensor interface peripherals
- **High-speed peripherals** (2x core clock speed)

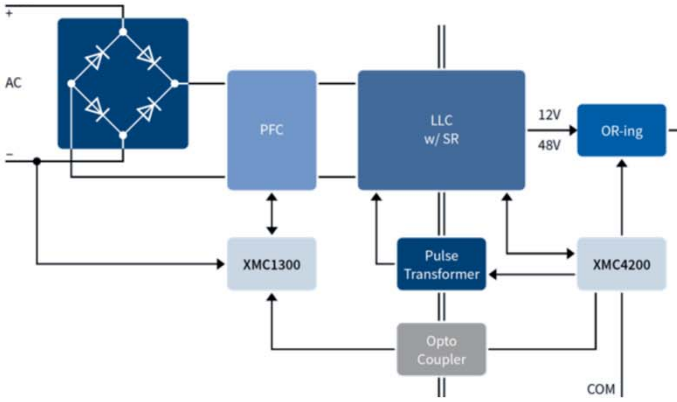
XMC1300 allows most advanced and cost optimized motor control with an Cortex®-M0

XMC4000–Major Application



Application Focus XMC4200 Server Power Supply

More Efficiency and the need to reduce system cost push a move towards Digital Controlled Power Supplies



Highly dedicated peripherals for various control and feedback schemes

- **150ps High Resolution PMW** Timers ensure a precise and stable output voltage at high switching frequencies
- **Easy Peak Current Control** mode (Integrated slope compensation, Blanking, Filtering and Clamping Circuitry)
- **Event Request Unit** (ERU) enables interconnection between analog, PWM and sensor interface peripherals

XMC4200 helps to increase efficiency and reduce system cost

Application Focus XMC4800
Industrial Drives

Real-time performance combined with enhanced connectivity

Optimized peripherals for Industrial Drives

- Dedicated Inverter PWM generators (CCU8)
- Fast and flexible **12-bit ADC**
- **Interfaces** for HALL sensors, encoders and resolvers
- **Event Request Unit (ERU)**

Communication interfaces for system administration and maintenance and for real-time optimized connectivity on control level.

IEEE 1588 | USB | EBU | CAN | SD/MMC | UART, I2C, SPI (quad)

NEW …now available on XMC4800 EtherCAT

XMC4800: a perfect combination for real-time control and industrial connectivity

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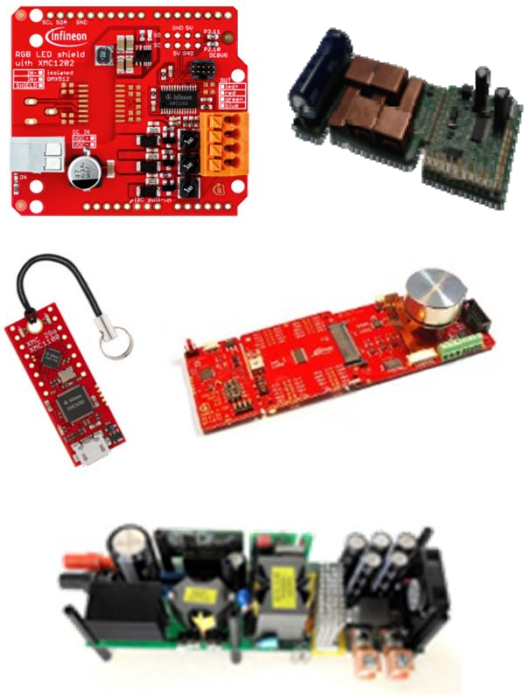
The World around XMC™

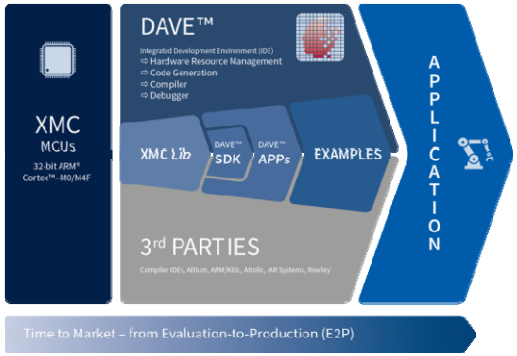
XMC – 32-Bit Industrial Microcontroller Ecosystem



XMC™ KITS and BOARDS

MATLAB&SIMULINK
port
WILLERT.
expresslogic
eTas
HCC
interniche technologies, inc.
SiSy
RTOS
TASKING
Altium
KEIL An ARM® Company
Verifysoft TECHNOLOGY
PARASOFT
GOPEL electronic
Micrium
hitex DEVELOPMENT TOOLS
SEGGER www.segger.com
IAR SYSTEMS
atollic
TheSycon
XELTEK
HI-LO SYSTEMS
CMX SYSTEMS

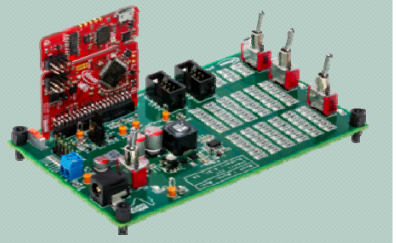
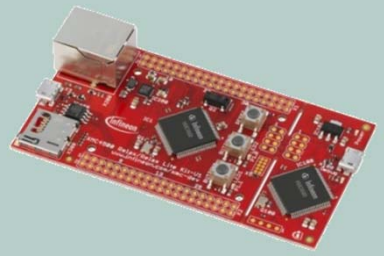
XMC™ SOFTWARE, TOOLS and PARTNERS



DAVE™
Eclipse based IDE makes powerful hardware accessible

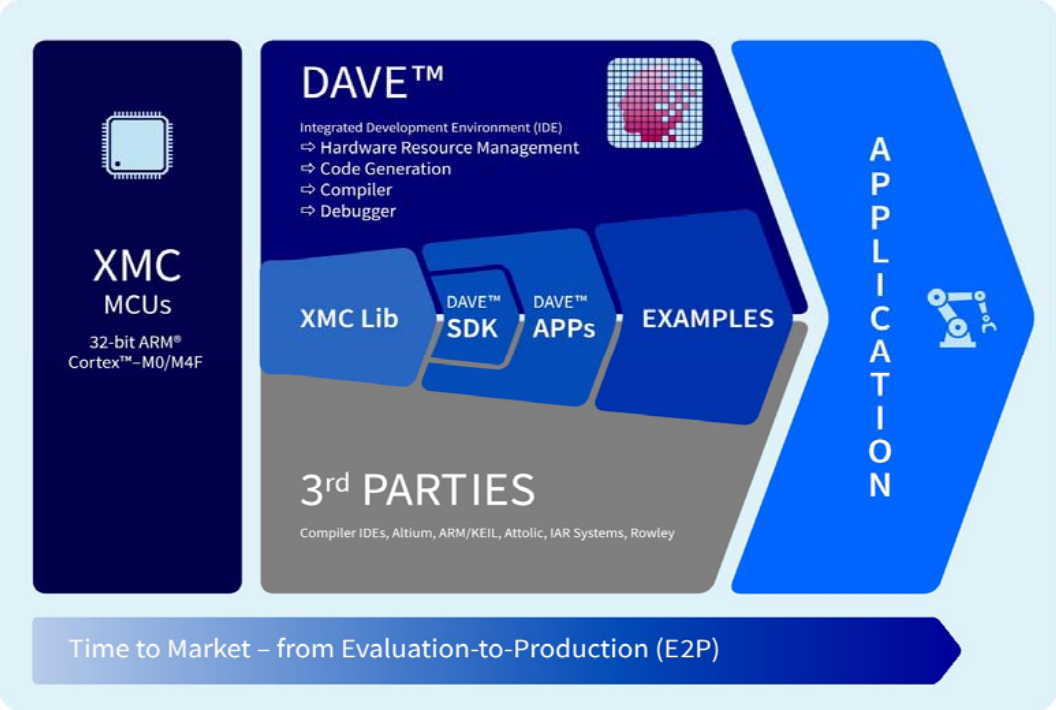
DAVE™ FREE DEVELOPMENT PLATFORM

XMC™ Evaluation Kits – some examples

	GETTING STARTED	APPLICATION SPECIFIC
XMC1000	› XMC1100 Boot Kit › XMC1200 Boot Kit › XMC1300 Boot Kit › **XMC 2Go** 	 **Power Tool KIT** using XMC1302 1kW/20VDC BLDC Motor Control  **Arduino** **RGB Lighting Kit** using XMC1202  **Digital Power** **Explorer Kit** using XMC1300/XMC4200
XMC4000	› XMC4500 Relax Kit › XMC4500 Relax Lite Kit 	 **600W LLC Reference Design** using XMC4200 Achieves TITANIUM efficiency standard  **750W power inverter** with PFC (115VAC to 230VAC) nominal 3A motor current

DAVE™– Digital Application Virtual Engineer

XMC™ Microcontroller - Software development made easy



Highlights

- DAVE™ IDE
- XMC™ Lib
- DAVE™ APPs
- DAVE™ SDK
- DAVE™ EXAMPLES
- DAVE™ 3rd PARTIES
- DAVE™ APPLICATION

Goto DAVE™– www.infineon.com/dave

DAVE™ makes powerful hardware accessible

Software complexity in embedded systems grows faster than Moore's law

DAVE™ IDE – Eclipse based integrated development environment with hardware resource management, code generation, compiler, and debugger.

DAVE™ includes:

- DAVE™ is **easy to use** and **free**
- DAVE™ generates the code tailored to the application
- DAVE™ **Apps and LLDs** (Low Level Driver) make it easy to fully utilize flexible peripherals and interconnectivity with a GUI based application library
- Integrated **resource solver** ensures conflict free mapping of chip resources.
- **DAVE™ SDK** – Development environment for DAVE™ APPs
- **3rd PARTIES support –** LLDs and Dave™ Apps are fully tested with Altium, Atollic, ARM/KEIL, IAR, Rowley

XMC™ Link

KIT_XMC_LINK_SEGGER_V1

Description:

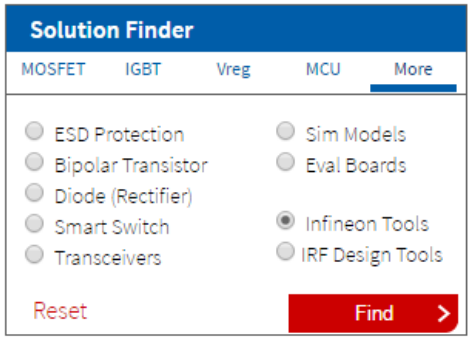
XMC™ Link

Functional Isolated Debug Probe, Based on SEGGER J-Link Technology

XMC™ Link is an Isolated Debug Probe for all XMC™ Microcontrollers. The debug probe is based on SEGGER J-Link debug firmware, which enables use with DAVE™ and all common third-party compiler/IDEs (Altium Limited, Atollic, ARM/KEIL, IAR Systems, iSystem, Rowley Associates) known from the wide ARM® ecosystem.

Buy Online

Order Nr: KIT_XMC_LINK_SEGGER_V1



Summary of Features:

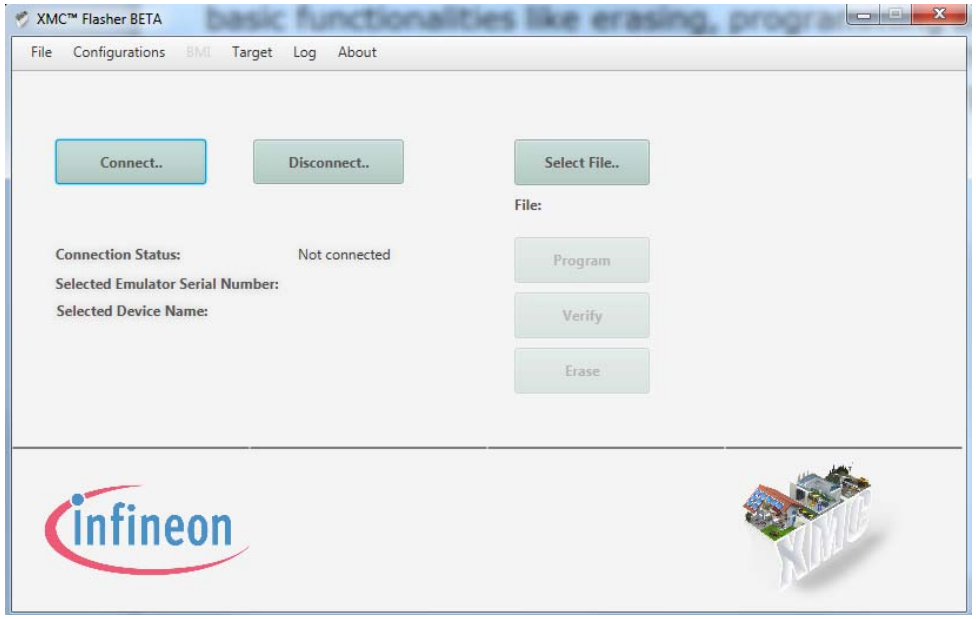
- 1kV DC functional isolation
- Debug protocols
  - JTAG
  - Serial Wire Debug (SWD)
  - Serial Wire Viewer/Output (SWV/SWO)
  - Infineon's Single Pin Debug (SPD)
- Virtual COM Port (UART-to-USB Bridge)

Target connectors:

- 10-pin Cortex® debug connector
- 8-pin XMC™ MCU debug connector
- 2.5V to 5.5V target voltage operation

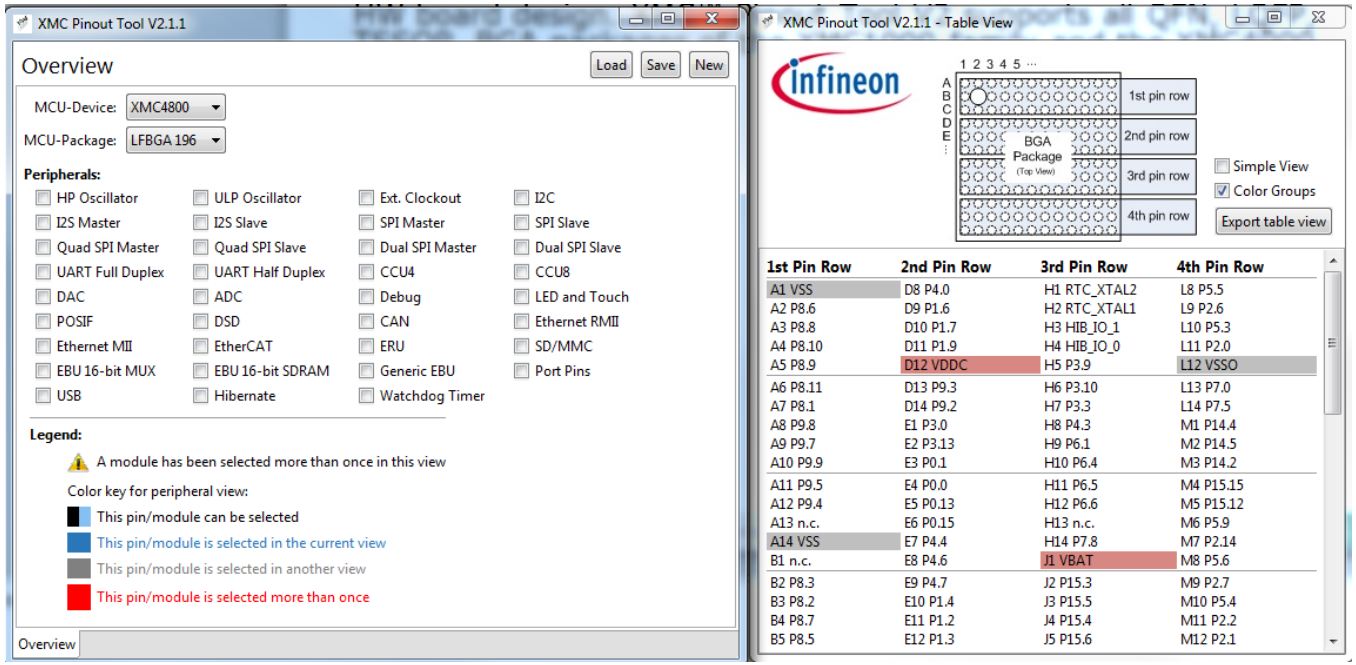
XMC™ Flasher

- XMC™ Flasher is a tiny, free of charge programming tool for on-chip flash programming. It is written **in Java** and it supports basic functionalities like erasing, programming and verification (.hex and .srec), plus BMI handling. XMC™ Flasher requires a J-Link compatible debug-HW to connect to the target (integrated on most of the XMC™ kits or XMC™ Link).



XMC™ Pinout Tool

- The XMC™ Pinout Tool V2 helps to select the required pins and modules of a peripheral. The tool identifies double assignments of pins and supports you to solve these problems. The result is a table of assigned pins and used peripheral. This table can be used as input for the manual pin assignment in DAVE™ and as input for the HW board design. XMC™ Pinout Tool V2 supports all QFN, LQFP, TSSOP, BGA packages of the XMC1000 family and the XMC4000 family.



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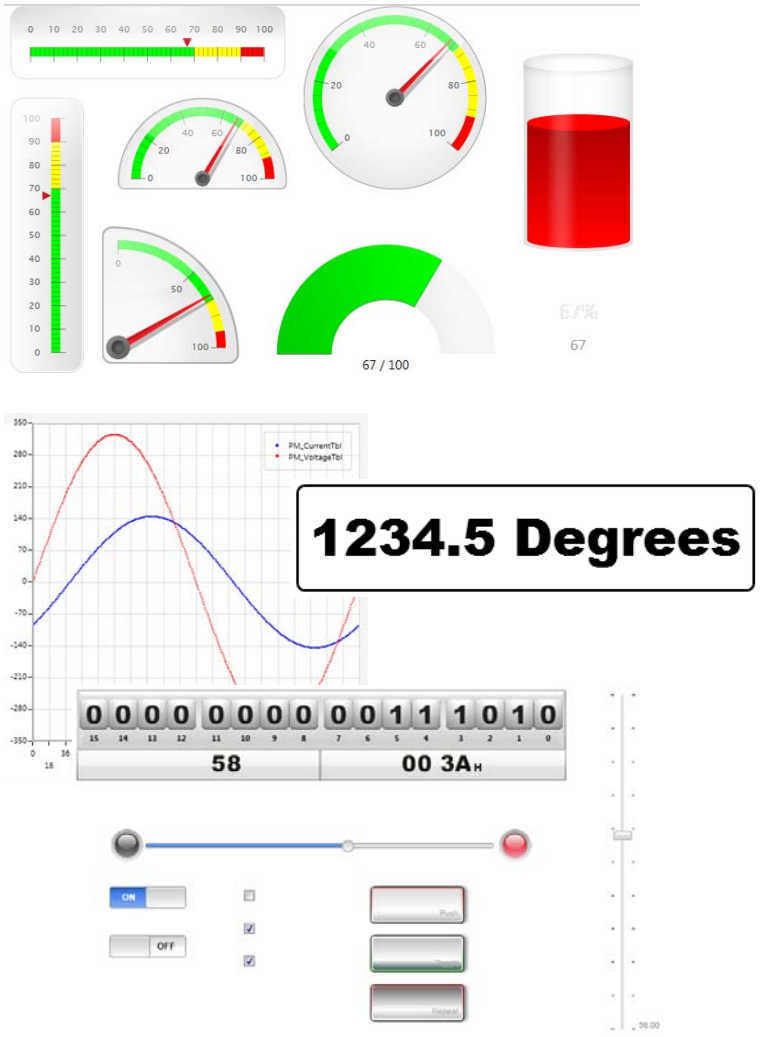
µC Probe: What is it?

Micriμm

- A universal, standalone, run-time embedded system monitoring tool that can display & change target data at run-time
  - Commercial tool
- Connection to the MCU target devices via the debug interface
  - Using the debug HW to acquire and change data on the MCU target (almost no intrusive)
  - Other connection options also supported
- Elf File interface to define the data to be monitored / modified while the system is running
- Flexible creation of a graphical monitoring dash board to visualize data and modify data
- Project file to store and re-open the dashboards

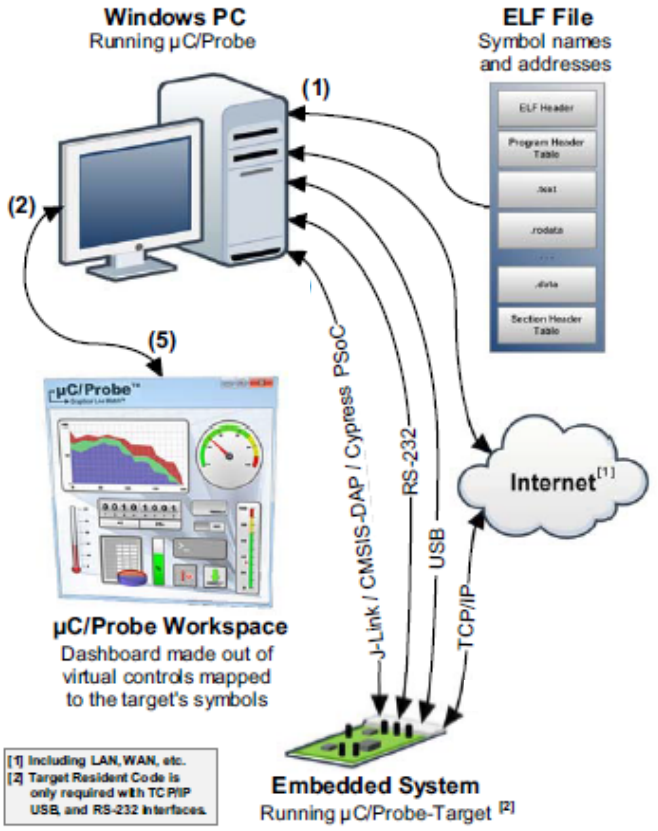
µC Probe: Features support



- Connection to the target via J-Link, CMSIS DAP
  - Data acquisition in kHz range (no target code instrumentation)
- Large set of widgets to visualize data
- Graphs to plot lines, curves, etc
- Drag-and-Drop graphical objects onto a data screen (dashboards) and assign variables to it
  - Retrieved from elf file
- Flexible writeable controls
- C like scripting
- Spread sheets can be added in data screen of µC/Probe
  - Uses all benefits of excel

Introduction to Micrium uC/Probe™ XMC™

- How it works?
  1. Load ELF file
     - uC/Probe™ XMC™ obtains the address of the variables from application ELF file.
  2. Configure the communication interface
  3. Design your dash board by dragging and dropping widgets
  4. Associate a variable to each of the widgets
  5. Start uC/Probe™ XMC™
     - uC/Probe makes requests to read the value of all variables used in the dashboard



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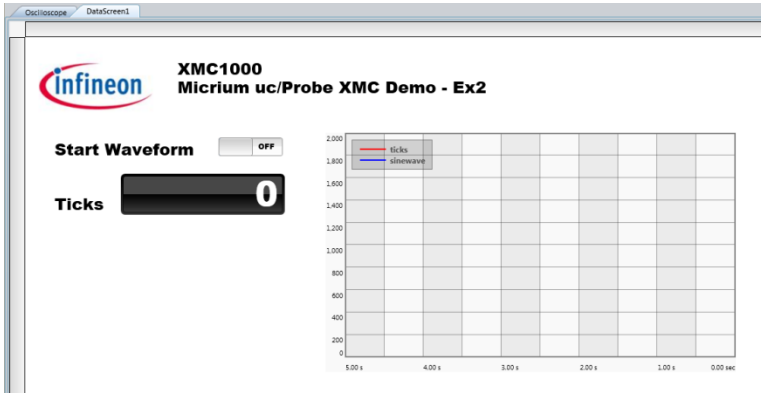
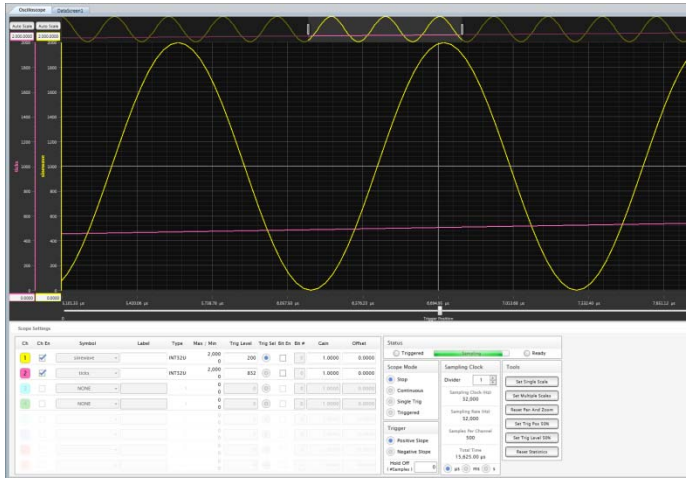
Objective of this Demo

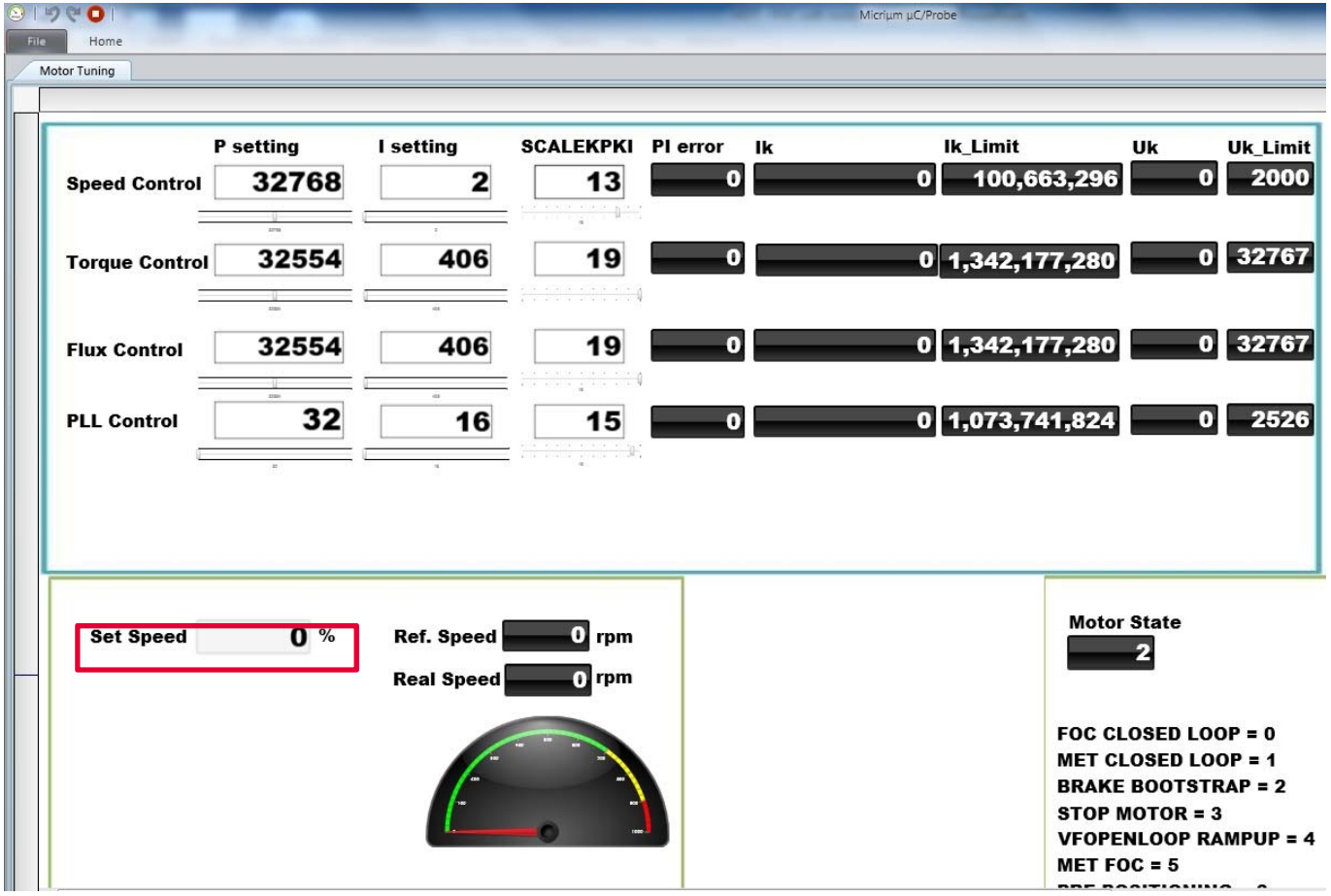
1. Download provided example application to your board
   - Using DAVE™ 4 integrated debugger
   - Using XMC™ Flasher tool
2. Control and monitor your application using the Micrium uC/Probe™ XMC™ dash board
3. Monitor variables using the Micrium uC/Probe™ XMC™ oscilloscope control





Another Demo - Micrium uC/Probe™ XMC™

- Monitoring some parameters and variables for motor control application code.



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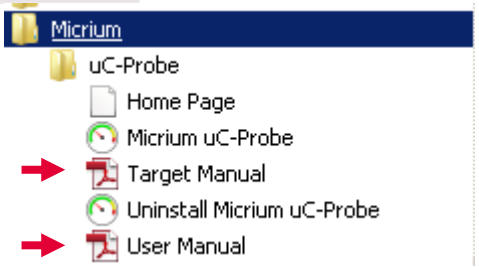

- **Micrium uC/Probe™ XMC™ documentation**
  - **Accessible in the Start menu of Windows**
  - **Or in the File tab of the application**

- **Micrium uC/Probe XMC features**

  https://www.micrium.com/tools/ucprobe/features/

- **uC/Probe Oscilloscope Feature: BLDC Design Case Study**

  https://www.micrium.com/new-%C2%B5cprobe-features-simplify-bldc-design/

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