XC164CM series Product Presentation

February 2006

Never stop thinking

Industrial Drives

Consumer Drives

Application examples

High End Printer

Motor Control

Automotive

Infineon Microcontroller Products – Competitive Advantage

Microcontroller Elements	Benefits
Cores C166, XC166	Fast Real-Time Cores with Complex Instruction Set Fewer Instructions needed to accomplish a given task Very high Code Density
Real-Time Bus, Interrupts, DMA	Wide bus access, Cache based systems Fast Interrupt System, Fast Context Switching Direct Transfer of Data without CPU intervention
Quality Flash with ECC 0 ppm target	quality is too valuable to compromise avoiding field returns avoiding later cost penalties
Peripherals Interfaces, PWM, Timer,..	Highly Integrated Complex Peripherals More work done by Peripherals means less work done by CPU and fewer external devices
Tools Starter Kits. Compiler,..	Easy to use and install Starter Kits State of the Art Compiler On chip Debugging solutions

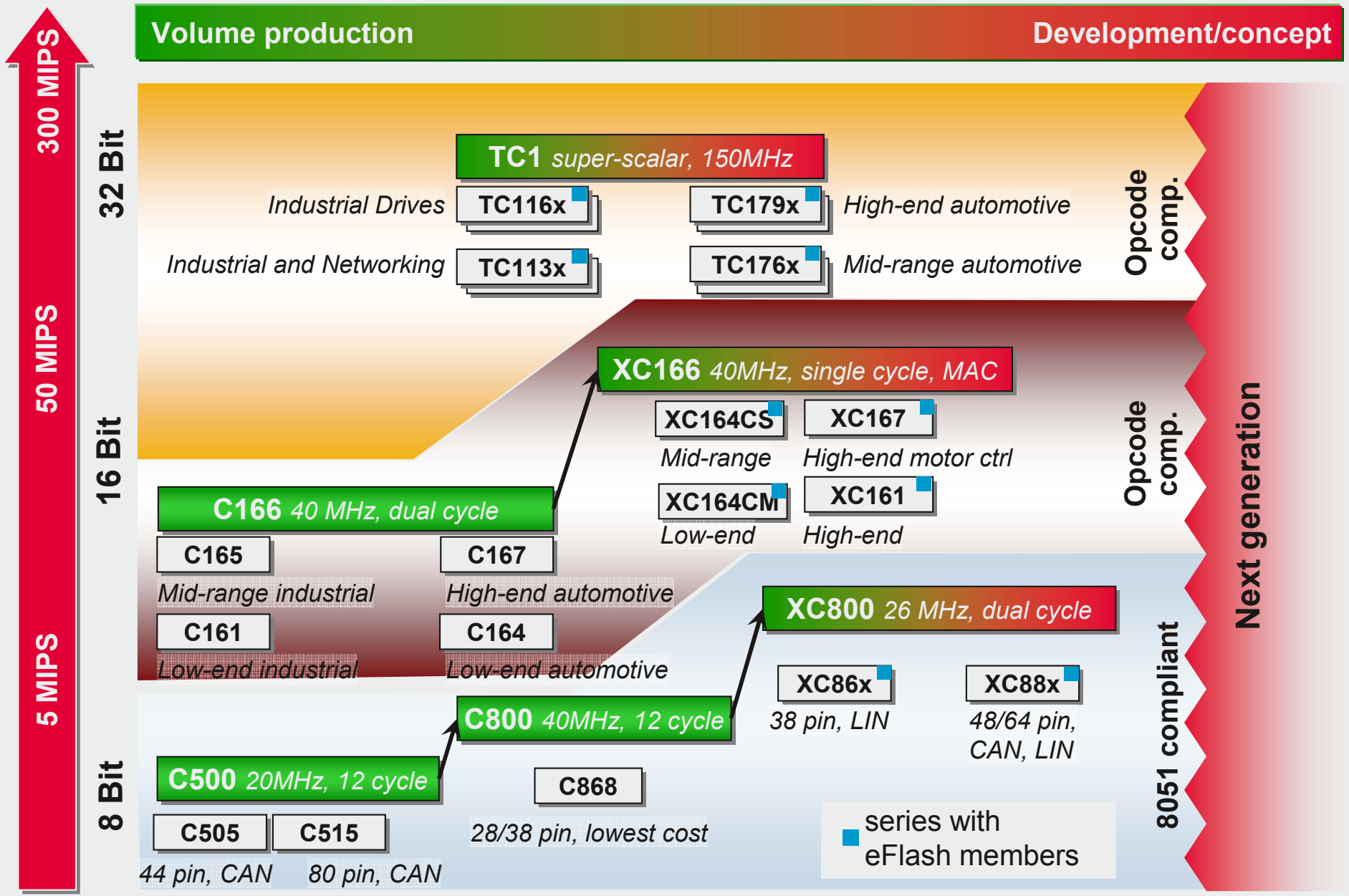
Reduced System Cost

stop thinking Never

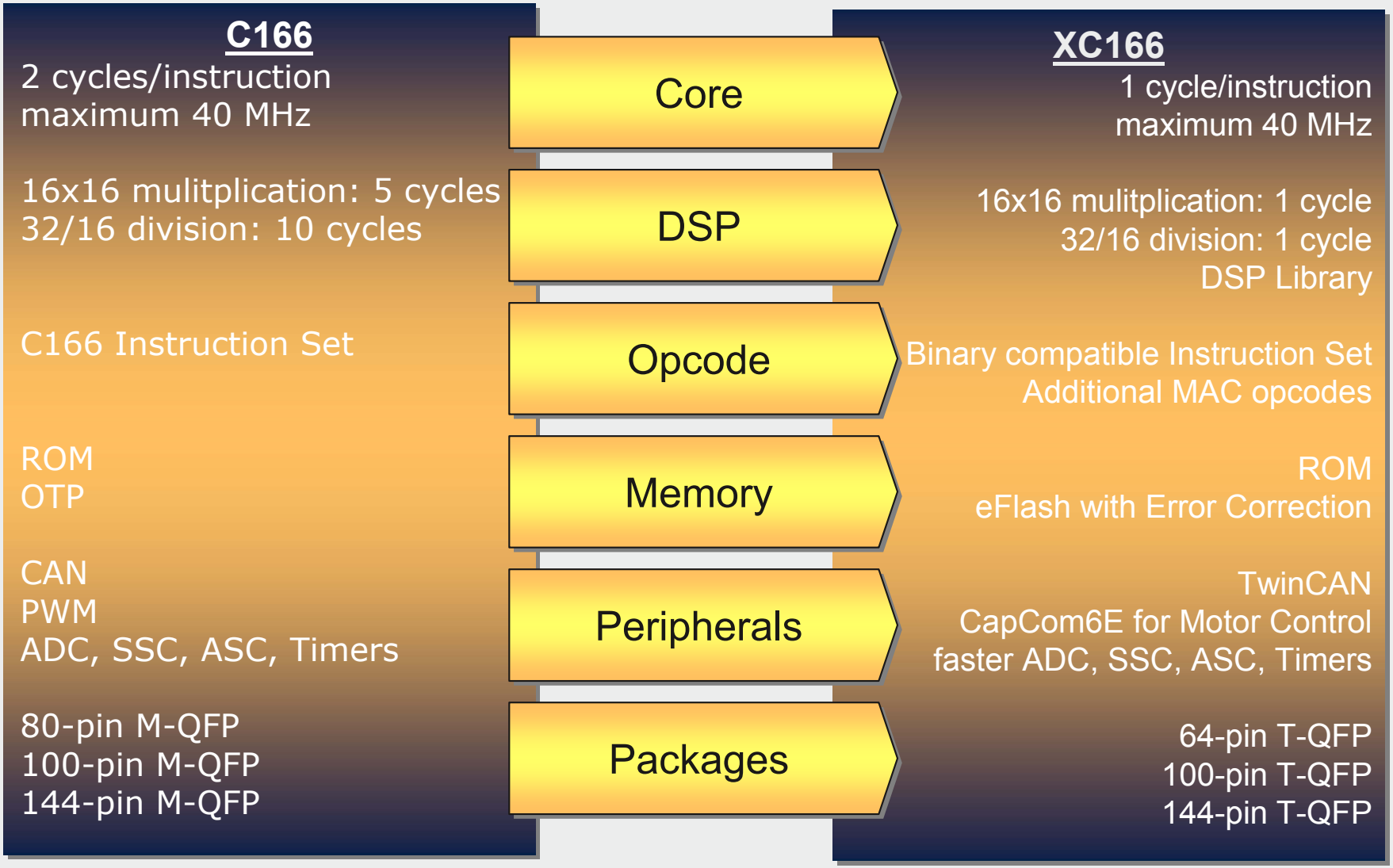
XC164CM series
Features

- Leading 16 Bit Architecture – 200Mpcs+ shipped
- Single cycle instruction execution
- Real time performance – 40 MIPS
- DSP capabilities (MAC unit)
- Enhanced Debugging Concept (OCDS – JTAG)
- Automotive Qualified Embedded Flash with ECC
- Low cost 64 pin PG-TQFP (Green) package
- Rich peripheral set

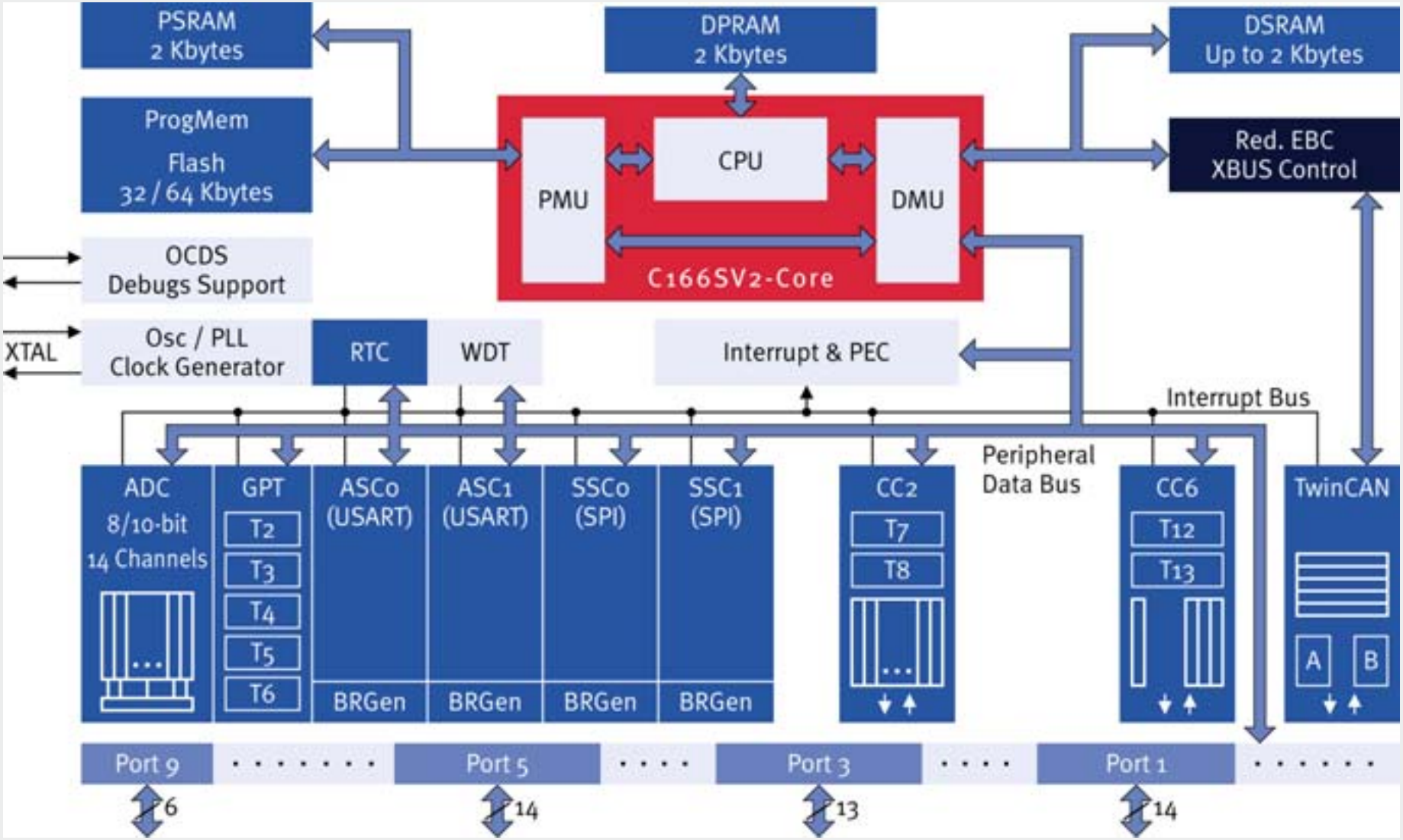
Infineon's microcontrollers: Outstanding real-time performance for a wide range of applications



The Evolution from C166 to XC166



XC164CM series – Block Diagram



New XC166 Architecture Core - C166S V2

Op-Code **compatible to C166** Architecture

- The enhanced C166S V2 based architecture offers **high performance at 16 Bit**
  - Nearly all Instructions executed in **one CPU Clock Cycle**
  - **single cycle instruction** @ 40 MHz CPU clock
  - 25 ns **multiplication** (16 x 16 bit) time @ 40 MHz CPU clock
  - 2-stage **prefetch pipeline,** 5-stage **execution pipeline**
  - **DSP** support with **powerful built in MAC** instructions (16-bit multiplier with 32-bit result generation)
    - Infineon provides **DSP libraries** to utilise the MAC

The enhanced C166S V2 based Architecture offers <u>outstanding Performance</u> at 16 Bit.

XC164CM and XC164CS series

Easy upgrade from low-end to high-end

	CM series						CS series			
	LM	TM	SM	KM	GM	CM	N	S	D	CS
eFlash	32/64	32/64	32/64	32/64	32/64	32/64	64/128/256	64/128/256	64/128/256	64/128/256
RAM	4/6	4/6	4/6	4/6	4/6	4/6	6	6	6	6/12
Pack-age	64	64	64	64	64	64	100	100	100	100
Freq. [MHz]	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40	20/40
CCU6			✓			✓	✓	✓	✓	✓
CAN				✓	✓	✓			✓	✓
ADC		✓	✓		✓	✓		✓		✓

CM and CS series members

- Opcode compatible: easy upgrade/downgrade
- Allowing optimum application feature fit
- Differentiators: eFlash, RAM, pin count, frequency, application specific peripherals

XC164CM series Family of Products

Main application: Automotive

Type	Program Memory	Clock Frequency	Temp. Range	Comments
SAF-XC164CM-8F20F	64K Flash	20MHz	-40 to 85ºC	ADC, CCU6, CAN
SAF-XC164CM-8F40F	64K Flash	40MHz	-40 to 85ºC	ADC, CCU6, CAN
SAF-XC164CM-4F20F	32K Flash	20MHz	-40 to 85ºC	ADC, CCU6, CAN
SAF-XC164CM-4F40F	32K Flash	40MHz	-40 to 85ºC	ADC, CCU6, CAN
SAK-XC164CM-8F20F	64K Flash	40MHz	-40 to 125ºC	ADC, CCU6, CAN
SAK-XC164CM-8F40F	64K Flash	40MHz	-40 to 125ºC	ADC, CCU6, CAN
SAK-XC164CM-4F20F	32K Flash	40MHz	-40 to 125ºC	ADC, CCU6, CAN
SAK-XC164CM-4F40F	32K Flash	40MHz	-40 to 125ºC	ADC, CCU6, CAN

Package is PG-TQFP-64-16

XC164CM series Family of Products

Main application: Industrial Control with CAN

Type	Program Memory	Clock Frequency	Temp. Range	Comments
SAF-XC164GM-8F20F	64K Flash	20MHz	-40 to 85ºC	ADC, CAN
SAF-XC164GM-8F40F	64K Flash	40MHz	-40 to 85ºC	ADC, CAN
SAF-XC164GM-4F20F	32K Flash	20MHz	-40 to 85ºC	ADC, CAN
SAF-XC164GM-4F40F	32K Flash	40MHz	-40 to 85ºC	ADC, CAN

Package is PG-TQFP-64-16

XC164CM series Family of Products

Main application: Industrial Control without CAN

Type	Program Memory	Clock Frequency	Temp. Range	Comments
SAF-XC164SM-8F20F	64K Flash	20MHz	-40 to 85ºC	ADC, CCU6
SAF-XC164SM-8F40F	64K Flash	40MHz	-40 to 85ºC	ADC, CCU6
SAF-XC164SM-4F20F	32K Flash	20MHz	-40 to 85ºC	ADC, CCU6
SAF-XC164SM-4F40F	32K Flash	40MHz	-40 to 85ºC	ADC, CCU6
SAF-XC164TM-8F20F	64K Flash	20MHz	-40 to 85ºC	ADC
SAF-XC164TM-8F40F	64K Flash	40MHz	-40 to 85ºC	ADC
SAF-XC164TM-4F20F	32K Flash	20MHz	-40 to 85ºC	ADC
SAF-XC164TM-4F40F	32K Flash	40MHz	-40 to 85ºC	ADC

Package is P-TQFP-100-16

XC164CM series Family of Products

Main application: Industrial Digital Control with CAN

Type	Program Memory	Clock Frequency	Temp. Range	Comments
SAF-XC164KM-8F20F	64K Flash	20MHz	-40 to 85ºC	CAN
SAF-XC164KM-8F40F	64K Flash	40MHz	-40 to 85ºC	CAN
SAF-XC164KM-4F20F	32K Flash	20MHz	-40 to 85ºC	CAN
SAF-XC164KM-4F40F	32K Flash	40MHz	-40 to 85ºC	CAN

Main application: Industrial Digital Control without CAN

Type	Program Memory	Clock Frequency	Temp. Range	Comments
SAF-XC164LM-8F20F	64K Flash	20MHz	-40 to 85ºC	
SAF-XC164LM-8F40F	64K Flash	40MHz	-40 to 85ºC	
SAF-XC164LM-4F20F	32K Flash	20MHz	-40 to 85ºC	
SAF-XC164LM-4F40F	32K Flash	40MHz	-40 to 85ºC	

Package is PG-TQFP-64-16

XC164CM series
Success Stories

XC164CM: PLC frequency measurement card

Frequency measurement card for PLC

- Used for frequency measurement in water generation motor for Chinese market

Key requirements

- Quick interrupt response time.
- Flexible timer

Key product features for application

- eFlash
- High MIPS/MHz performance.

Key reasons for success

- Reputation for PLC
- Existing business (Eupec)
- Expert support

16 Bit Micro XC164CS in Conveyors

- **Keys to Success**
  - Product with the right features
    - Fast Real-Time CPU
    - Flexible CAN Interface
    - CAPCOM6E and A/D for Motor Control
- Several XC164CS parts control BLDC motors at various points along the conveyor and communicate via the CAN bus

16 Bit Micro C166 / XC166 in High end Printing

- Products: C167CS, XC164CS
- Application: High End Desktop Publishing (Printing)
- Key Features: CAN, A/D, PWM
- There are up to ~6 microcontrollers per printer. They handle communication between various parts of the system and control key system components such as stepper motors.
- Keys to success:
  - On Site CAN training
  - Large Family of 16-bit CAN products offering full range of price/performance
  - Direct technical support

16 Bit Micro C166 in Routers

- Product: C167CR
- Application: Backplane (maintenance) bus for each card/system in a router
- Key Features: CAN, A/D, PWM
- Each card/system in the router (e.g. line card, fabric cards, cooling fan system, etc.) has a C167CR for CAN communication. The CAN bus carries configuration and diagnostic data. The other features of the microcontroller are used selectively when required (e.g. PWM for fan control, A/D for temperature measurement).
- Keys to success:
  - Product Features Fitting to customer requirements
  - In-House CAN expertise
  - Initial direct technical and marketing support

16 Bit Micro C167CR in Copiers

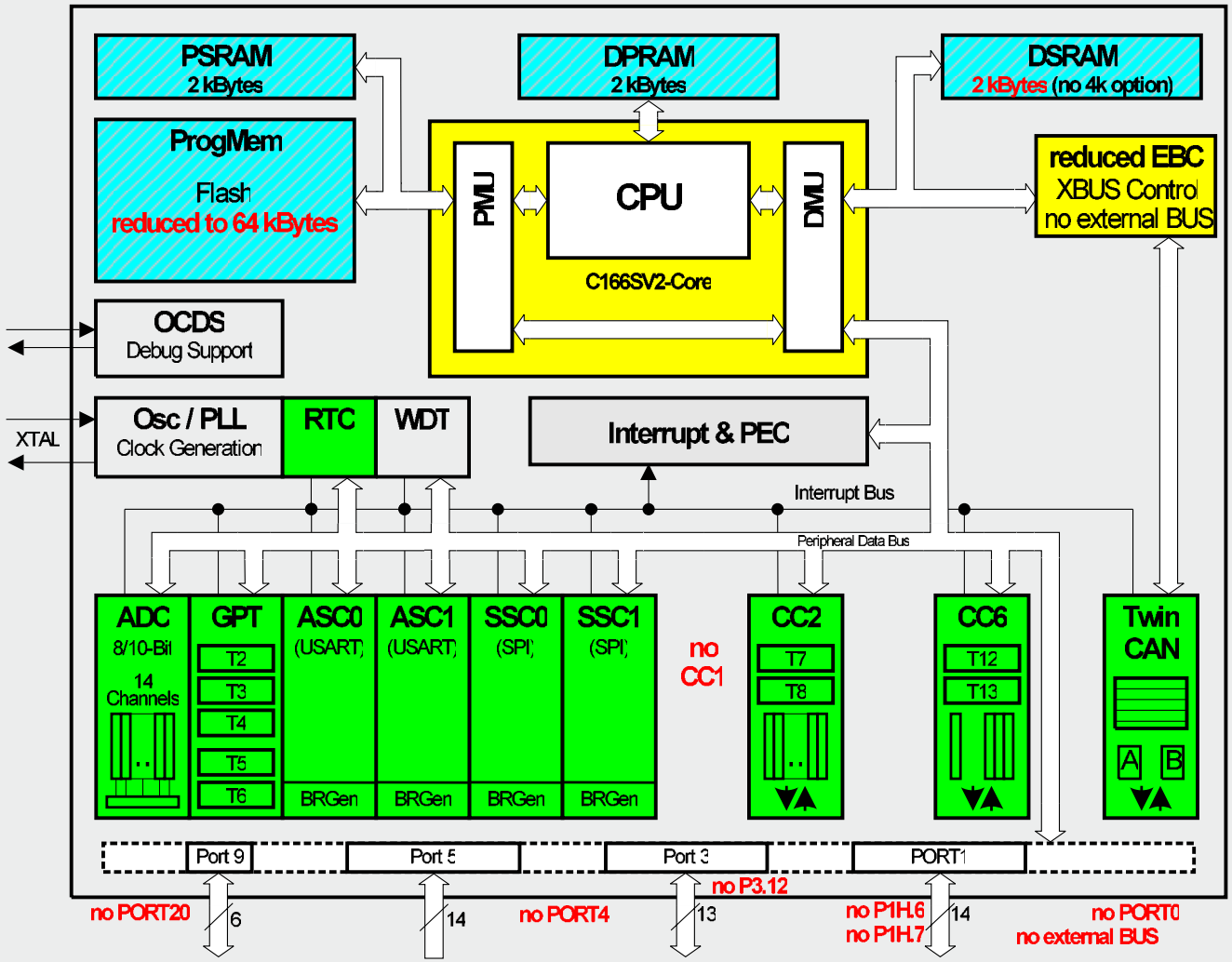
- **Keys to Success**
  - Product with the right features
    - Fast Real-Time CPU
    - Low Interrupt Response Time
    - CAN, A/D & CAPCOM (PWM and Pulse width measurement)
  - Long Lifetime
  - Ruggedness
- The C167CR controls stepper motors and communicates to other modules via the CAN bus

16 Bit Micro C166 in Network Monitors

- Products: C163, C165
- Application: High End Monitor for Networks
- Key Features: Low Cost General Purpose Part with good External Bus Controller (EBC)
- The microcontroller was designed in due to poor delivery from our competitors during the global silicon allocation. The total design time was 3 weeks.
- Keys to success:
  - Good EBC to interface to their external memory
  - Intense Direct Technical and marketing support to help them through their supply issues in record time.

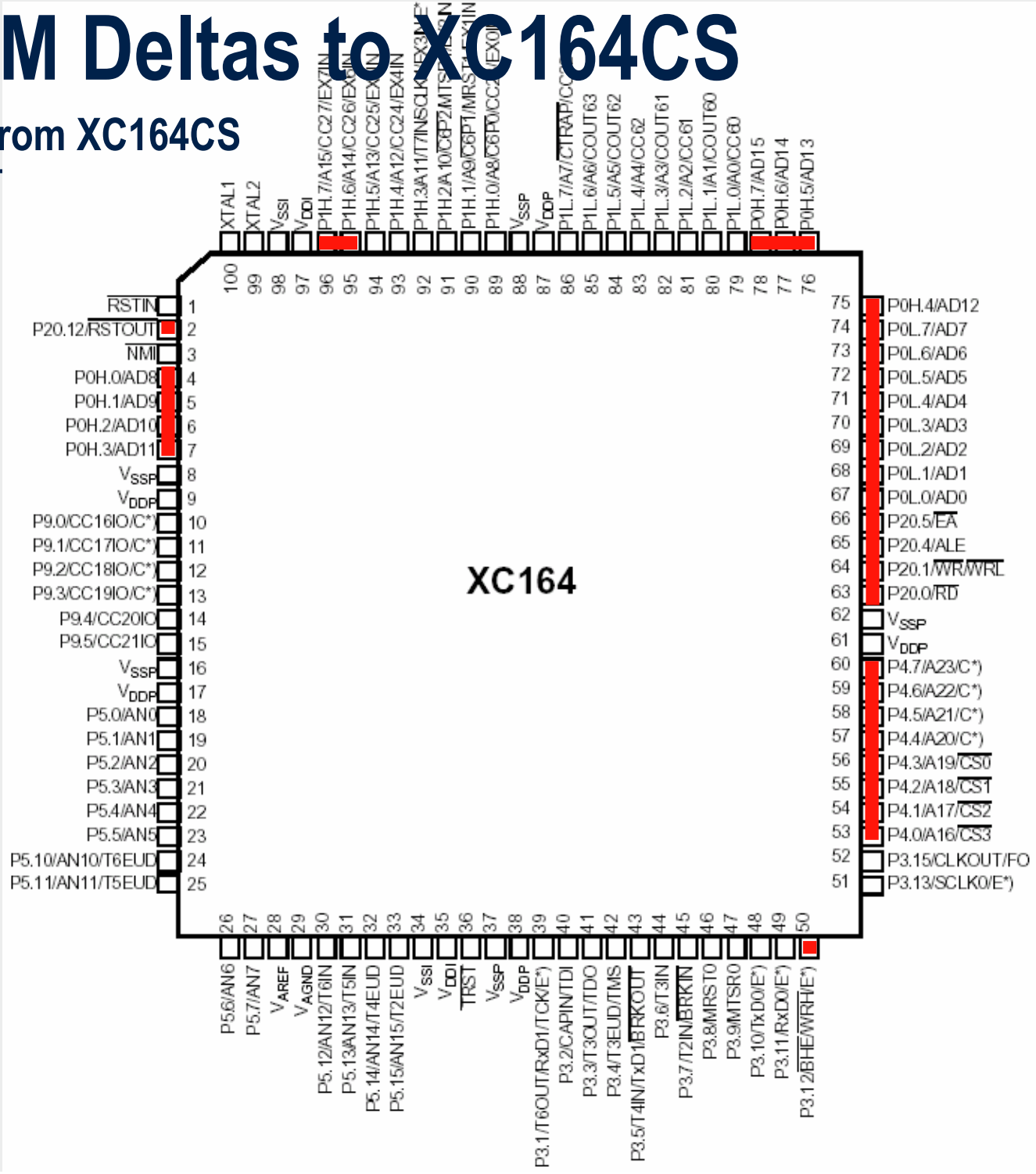
XC164CM series
Compatibility to XC164CS series

XC164CM Deltas to XC164CS



XC164CM Deltas to XC164CS

Pins Removed from XC164CS



XC164CM Reset Configuration

No Port0 and no Port20 => new scheme for setting configuration modes

Feature	XC164CS-16FF	XC164CM-8FF
integrated pull up (PU) /down (PD) during reset	$\overline{EA}$ PU, $\overline{RD}$ PU, ALE PD	P1H5 PU, P1H4 PU P9.5 PU, P9.4 PU
Standard start from internal memory at C00000	$\overline{EA}$=1,$\overline{RD}$=1,ALE=0 default	$\overline{TRST}$=**1** [1)] P1H5=x, P1H4=x P9.5 =1, P9.4=1 default
Bootstrap loader ASC	$\overline{EA}$=1,$\overline{RD}$=**0**, ALE=0 $\overline{EA}$=0, P0.5-2=1011	$\overline{TRST}$ = **1** P1H5=x, P1H4=x P9.5=**0**, P9.4=1
Bootstrap loader CAN	$\overline{EA}$=1,$\overline{RD}$=**0**,ALE=**1** $\overline{EA}$=0, P0.5-2=1001	$\overline{TRST}$ = **1** P1H5=x, P1H4=1 P9.5=1, P9.4=**0**
Adapt mode	$\overline{EA}$=**0** P0.1=**0**	$\overline{TRST}$ = **1** P1H5=1, P1H4=1 P9.5=**0**, P9.4=**0**
Alternate start internal from C10000	$\overline{EA}$=1,$\overline{RD}$=1,ALE=**1**	not supported

1) In XC164CM this mode is used for start from internal memory at C00000 in conjunction with OCDS. Standard start from internal memory at C00000 is always performed if $\overline{TRST}$=0 during reset.

Note: Bold means: to be set with external pull resistor.

XC164CM Reset Configuration

No Port0 and no Port20 => new scheme for setting configuration modes

1.3 Bootstrap Loader, Adapt Mode, and Test Mode Settings XC164CM

All system start up configurations are locked or enabled by $\overline{\text{TRST}}$. If pin $\overline{\text{TRST}}$ is pulled low for all the time, then OCDS (including JTAG) and all non standard system start up configurations are always disabled.
For all applications it is recommended to have $\overline{\text{TRST}}$ pulled low for normal operation.

1.3.1 Enabling Non Standard System Start Up Configurations

If at the end of reset pin $\overline{\text{TRST}}$ is getting high, then pins P1H.5 (pin 6), P1H.4 (5), P9.5 (48), and P9.4 (47) are used to select one of the non standard system start up configurations. This setting is latched with the rising edge of $\overline{\text{RSTIN}}$.

Table 3 Mode Selection Overview

P1H.5	P1H.4	P9.5	P9.4	Selected Mode
x	x	1	1	Start internal: default setting, internal start from address C00000 . To be used for internal start from C00000 with OCDS debuggers (0011, 0111, 1011, 1111)
x	x	0	1	BSL-ASC: Bootstrap loader ASC
1	1	0	0	Adapt Mode: all pins are tristate used for connecting an incircuit emulator

XC164CM series
Product Overview

XC164CM series System features

- Features
  - High performance 16-bit CPU with 5-Stage pipeline
  - 25ns Instruction cycle time @ 40MHz CPU clock
  - Fast Context switching support
  - 1-cycle Multiply and Accumulate (MAC) instructions
  - 16-priority level interrupt system
  - On-chip PLL
  - Peripheral Event Controller (PEC)
  - Programmable Watchdog Timer and Oscillator
  - Power saving modes
  - Package: P-TQFP-64-16 (green)
  - Temperature range: SAF and SAK (-40°C to 85/125°C)

XC164CM series On-chip memory

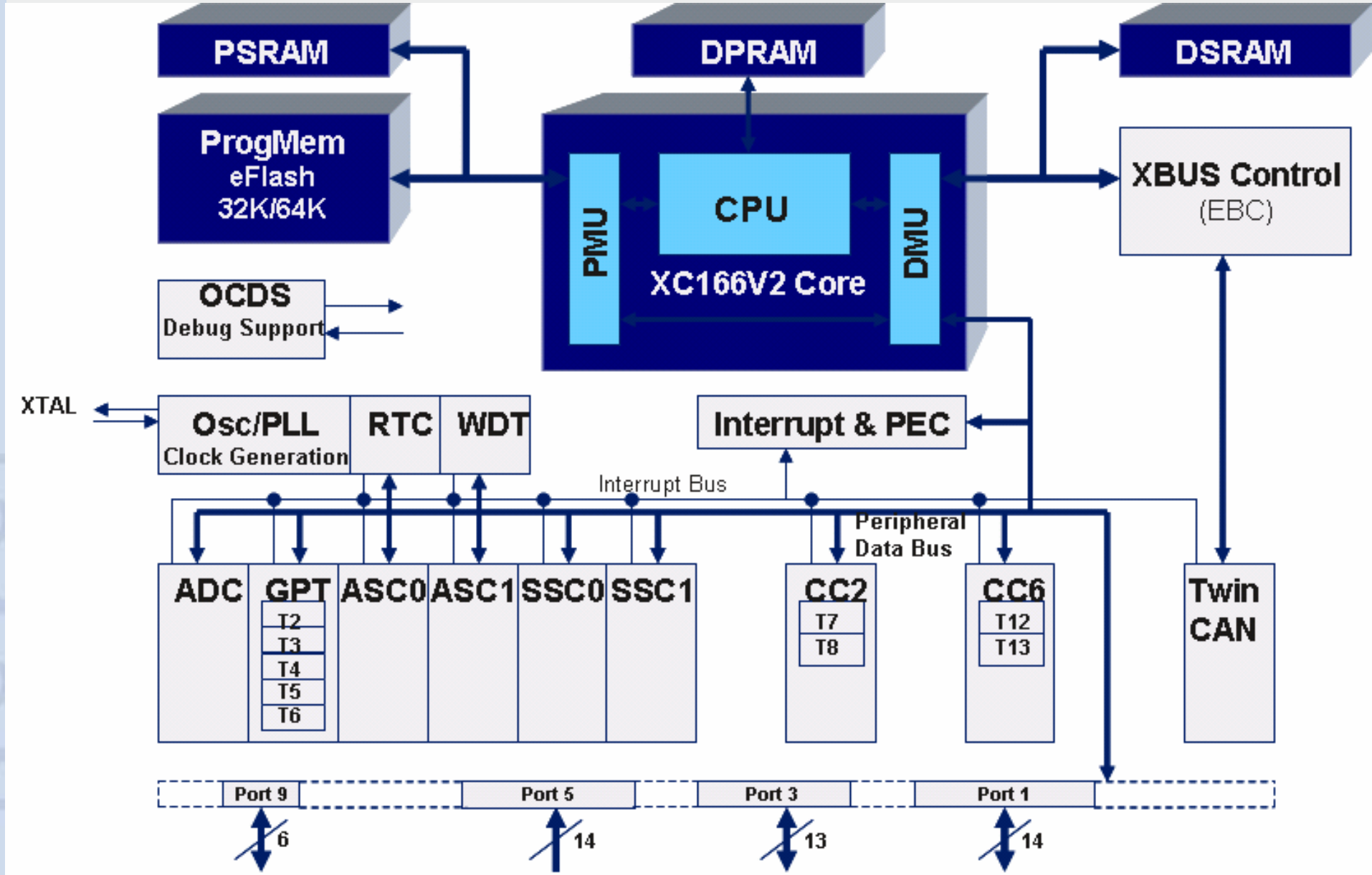
- Features
  - 2 KBytes on-chip Dual Port RAM (DPRAM)
  - 2 Kbytes on-chip Data SRAM (DSRAM)
  - 2 KBytes on-chip Program/Data SRAM (PSRAM)
  - Up to 64 KBytes on-chip Program memory (eFlash)

	PRAM E0,0000-07FF:2K	DPRAM F600-FDFF:2K	DRAM C000-C7FF:2k	Flash C0,0000
XC164CM-8F	2k	2k	2k	64KByte
XC164CM-4F	2k	2k	-	32KByte

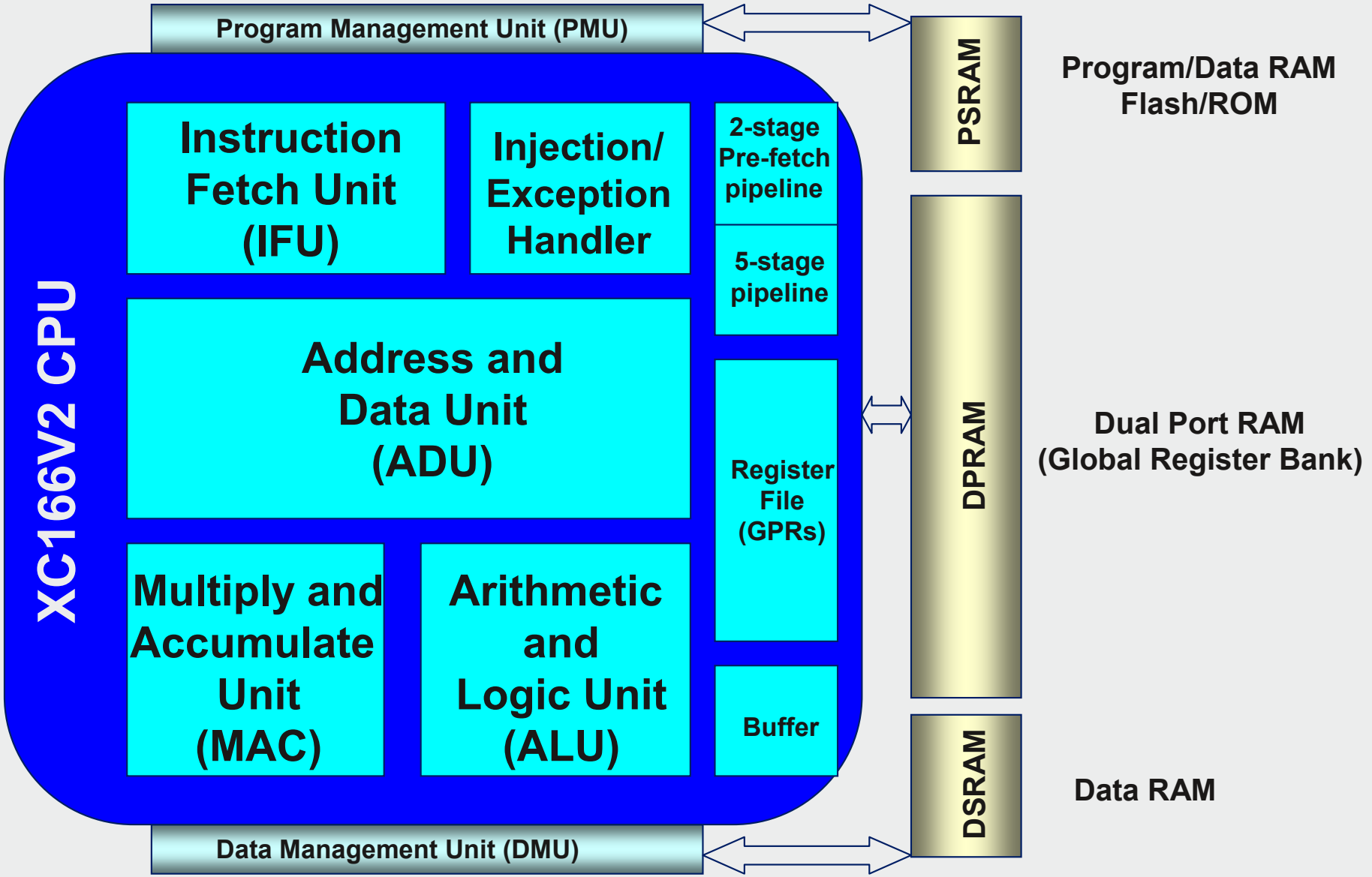
XC164CM series On-chip Peripherals

- Features
  - One 16-channel General Purpose Capture/Compare Units
  - CAPCOM6E module with two independent timers dedicated to PWM generation for AC motor control
  - Multi-Functional General Purpose Timer Unit with 5 Timers
  - Two Synchronous/Asynchronous Serial Channels (USARTs)
  - Two High-Speed Synchronous Serial Channels
  - On-chip Real Time Clock
  - Up to 47 General purpose I/O lines
  - 14-Channel A/D Converter with programmable 10-bit or 8-bit resolution
  - TwinCAN module: two full CAN modules with 32 message buffers and gateway function

XC164CM series CPU



XC164CM series CPU



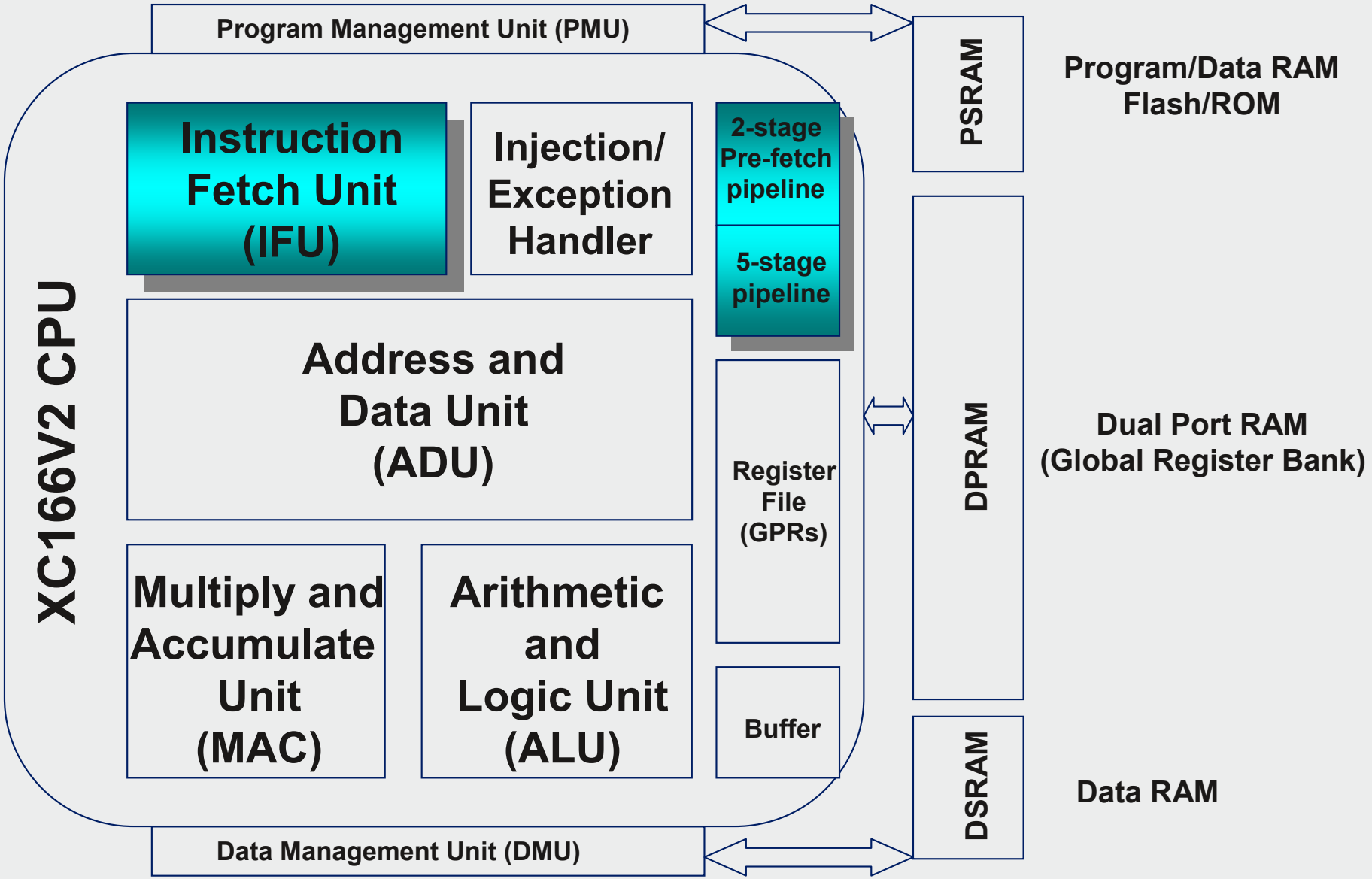
XC164CM series CPU Features (1)

- Summary of features
  - 2-stage instruction fetch pipeline with FIFO for instruction pre-fetching
  - 5-stage instruction execution pipeline
  - Pipeline forwarding controls data dependencies in hardware
  - Multiple high bandwidth buses for data and instructions
  - Linear address space for code and data (von Neumann architecture)
  - Register based design with multiple variable register banks (byte or word operands)
  - Two additional fast register banks
  - Variable stack with automatic stack overflow/underflow detection
  - Fast interrupt and fast context switching features for real time embedded control applications

XC164CM series CPU Features (2)

- Summary of features
  - Most instructions execute in one cycle
  - Fast multiplication (16-bit X 16-bit) in one CPU cycle
  - Fast background execution of division (32-bit/16-bit) in 21 CPU clock cycles
  - Advanced MAC (Multiply Accumulate) unit:
    - Single cycle MAC instruction with zero cycle latency
    - 40-bit barrel shifter and 40-bit accumulator to handle overflows
    - Automatic saturation to 32 bits or rounding included with the MAC instruction
    - Fractional numbers supported directly
    - One Finite Impulse Response Filter (FIR) tap per cycle with no circular buffer management
  - Enhanced boolean bit manipulation
  - High performance branch, call and loop processing
  - Zero cycle jump execution

XC164CM series Instruction Processing



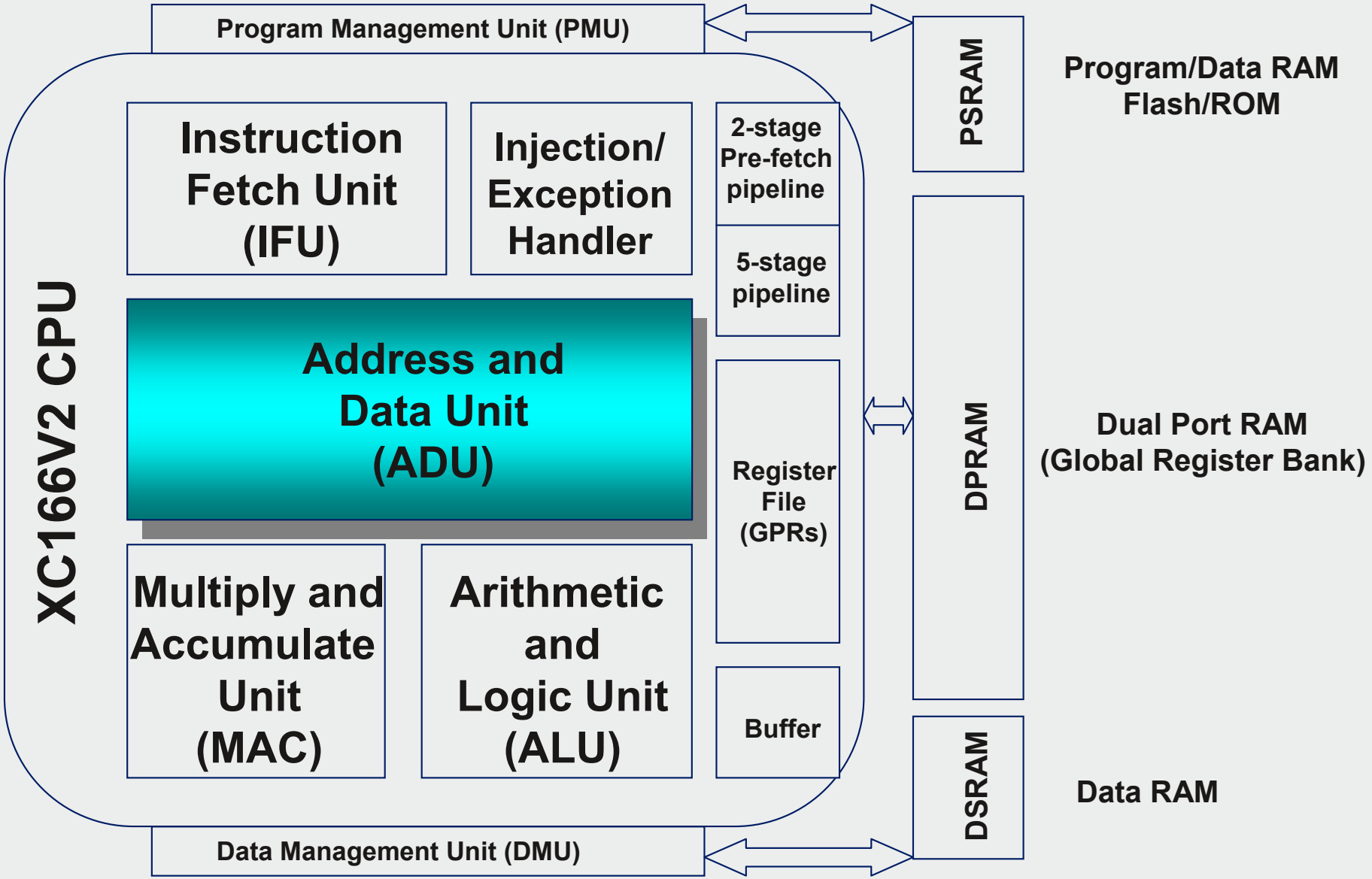
XC164CM series Instruction Processing

- Most instructions execute in one cycle
  - Special instructions such as SRST or PWRDN take more than one cycle
  - Divide instructions are executed in the background, so other instructions can be executed in parallel
- Instruction cycle time is dramatically reduced through pipelining.
  - Up to seven stages can operate in parallel
  - Two stage instruction fetch pipeline
  - Five stage instruction processing pipeline

XC164CM series Instruction Processing

- Two stage instruction fetch pipeline
  - Pre-Fetch from PMU in predicted order
    - Branch detection unit predicts branches
  - Fetch
    - The instruction pointer fetches next instruction according to the branch prediction rules.
- Five stage instruction processing pipeline
  - Decode
  - Address
  - Memory
  - Execute
  - Write Back

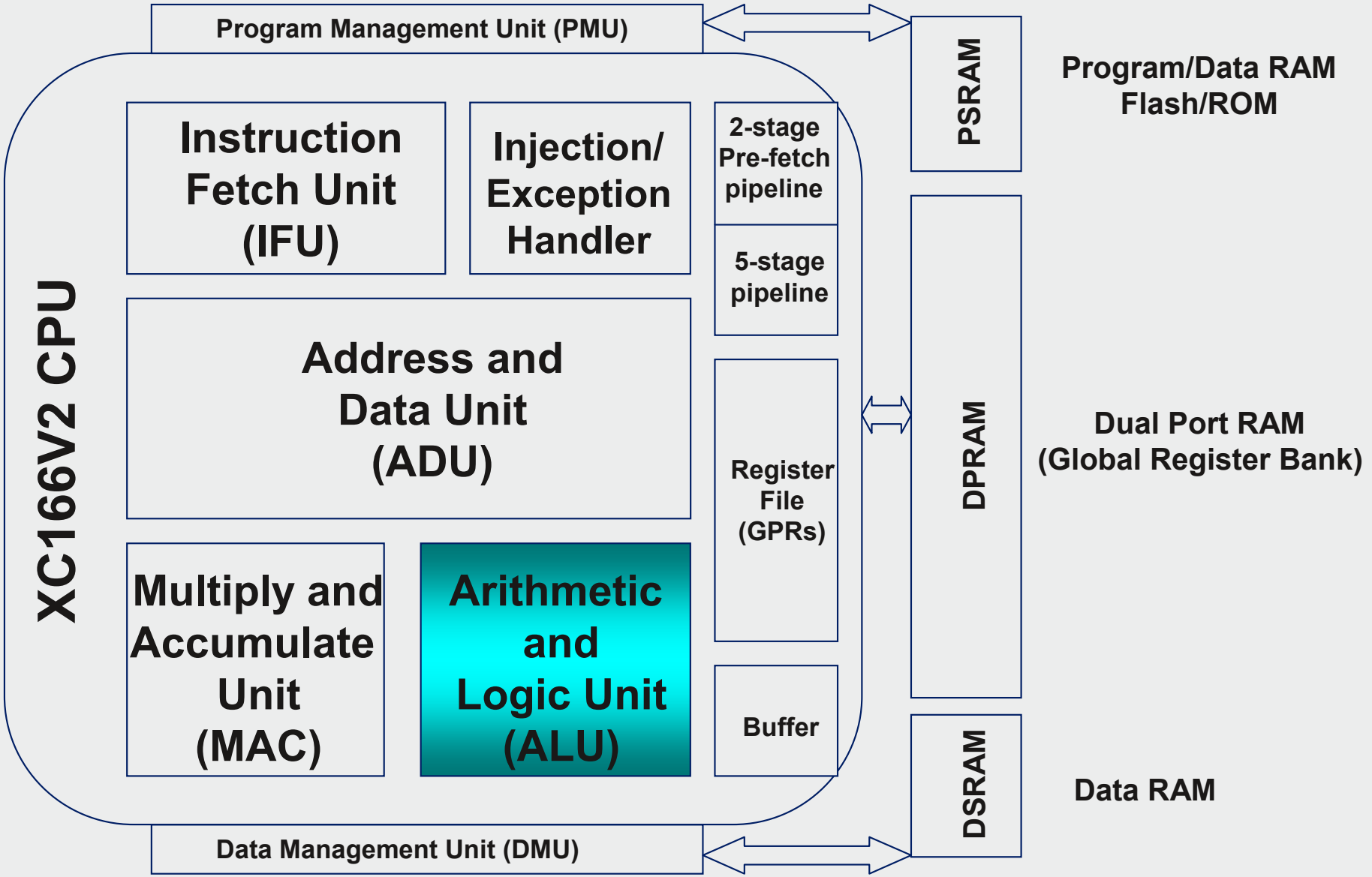
XC164CM series Address and Data Unit



XC164CM series Address and Data Unit

- Features
  - Contains two independent arithmetic units to generate, calculate and update addresses for data accesses
  - The Standard Address Unit
    - supports short, long and indirect addressing modes
    - Supports data paging and stack handling
  - The DSP Address Generation Unit
    - Contains an additional set of address pointers and offset registers which are used with the MAC unit instructions (CoXXX)

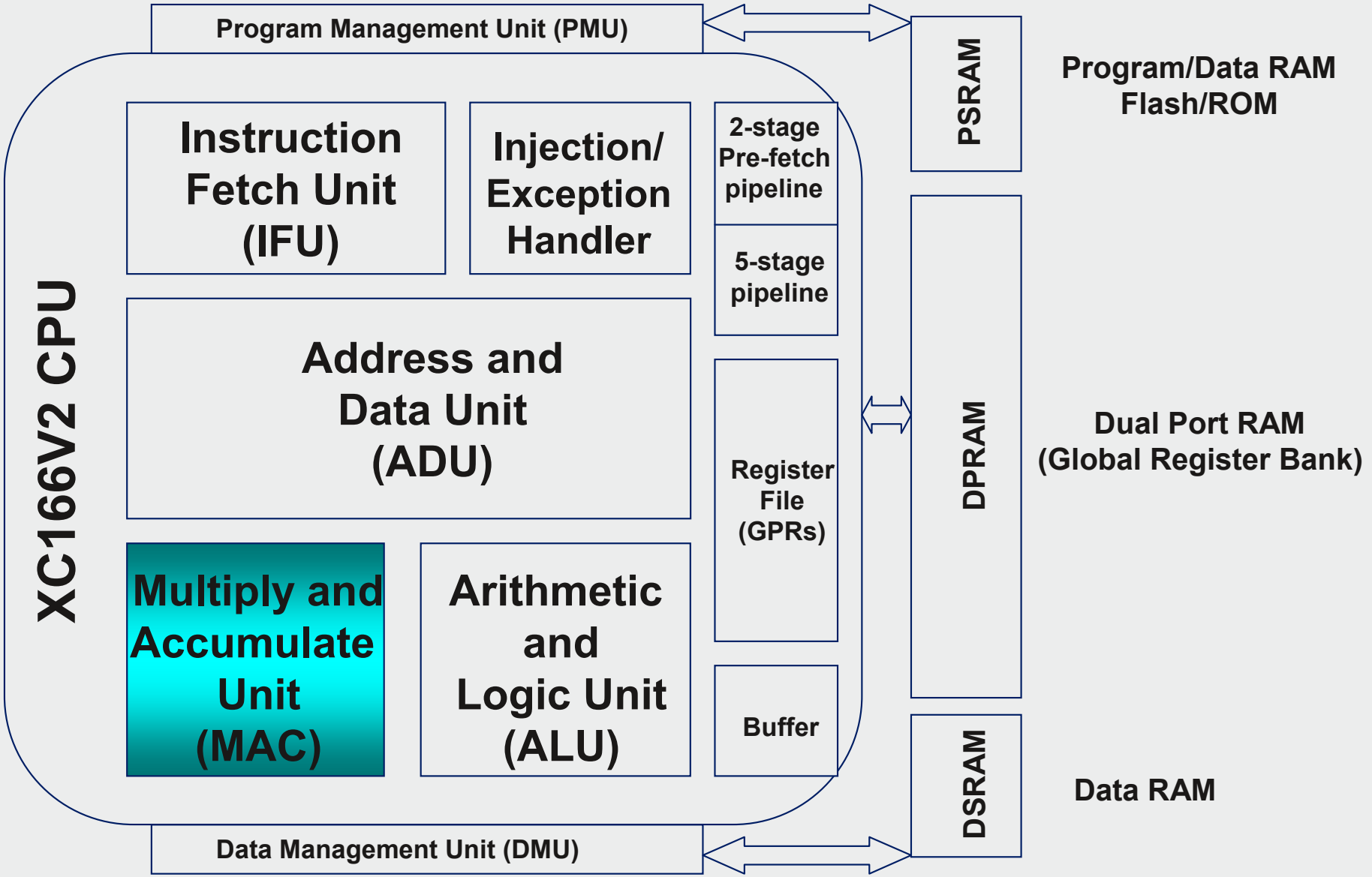
XC164CM series Arithmetic and Logic Unit (ALU)



XC164CM series Arithmetic and Logic Unit (ALU)

- Features
  - Performs all standard (word) arithmetic and logical operations
  - Optimized to perform operations on either 8-bit or 16-bit quantities.
  - Instructions to provide byte packing in memory
  - Sign extensions of bytes for word wide arithmetic operations
  - Flags for branching on specific conditions
  - Support for both signed and unsigned arithmetic through user-specified branch tests.
  - 16-bit barrel shifter for multiple bit shifts in single cycle
  - Support for rotate and arithmetic shift

XC164CM series Multiply and Accumulate Unit (MAC)



XC164CM series Multiply and Accumulate Unit (MAC)

- MAC unit provides
  - 16-bit by 16-bit signed / unsigned multiplication
  - multiplication with cumulative subtractions/additions
  - 32-bit additions
  - 32-bit subtractions
  - right / left shifts
  - Automatic saturation to 32 bit
  - 40bit accumulator to handle overflow
- 75 % of all MAC instructions executed in one CPU clock cycle

DSP Function Library

- Basic Ideas
  - Establishing a commonly used DSP function library using MAC instruction set in Assembly
  - Making it easy to develop large DSP program and optimize the DSP routines
  - Introducing the customers how to develop DSP function on XC166 microcontroller using MAC unit

www.infineon.com/c166dsplib

DSP Library Functions

- Arithmetic functions
- FIR filters
- IIR filters
- Adaptive filters
- Fast Fourier Transforms
- Matrix operations
- Mathematical operations
- Statistical functions

www.infineon.com/c166dsplib

Features of DSP Library

- For Infineon's 16-bit Microcontrollers XC166 family
- Free of charge
- Including many basic DSP algorithms, e.g. Fir, IIR, adaptive filters, FFT
- Hand-coded and optimized assembly modules with MAC instructions
- Examples to demonstrate the usage of functions
- Complete User's manual covering many aspects of implementation
- Version 1.0 and 1.1 released

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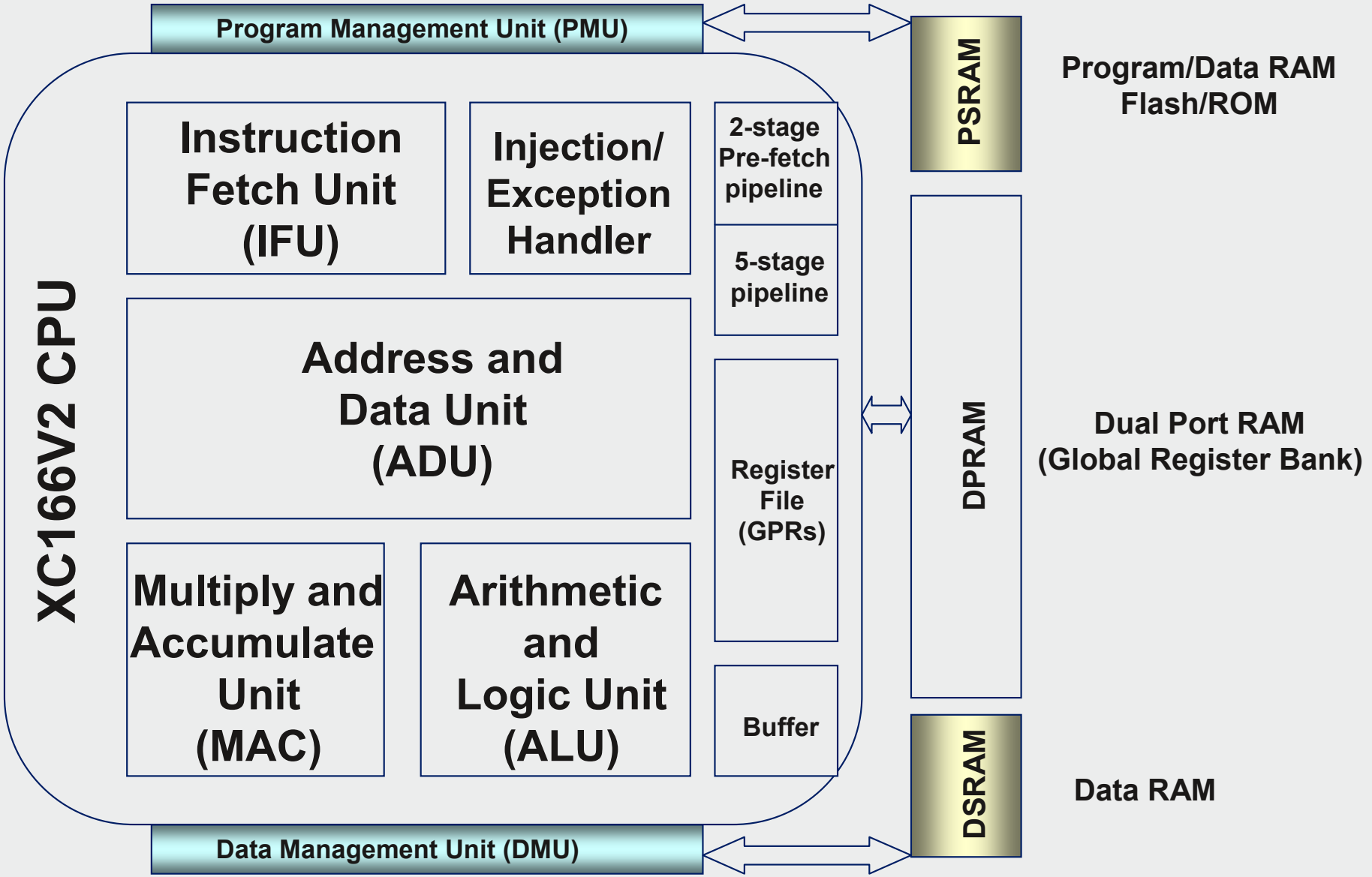
XC164CM series PMU/DMU



XC164CM series PMU/DMU

- Program Management Unit (PMU)
  - Controls access to the on-chip program memory
    - ROM/eFlash
    - Program/Data RAM (PSRAM)
  - High performance 64-bit interface between PMU and CPU
  - PMU decides if requested instruction is fetched from internal or external memory
- Data Management Unit (DMU)
  - Controls access to
    - on-chip Data RAM (DSRAM)
    - On-chip peripherals connected to peripheral bus
    - Resources on external bus
    - External accesses (including on-chip LXBus) are executed by the External Bus Controller (EBC)
- PMU and DMU are directly coupled to perform high-speed cross-over transfers

XC164CM series Flash Module

- Up to 64 KByte embedded Flash module
  - Any use for instruction code or constant data
  - 64 bit read interface
- Single voltage Flash (no external VPP required)
- Integrated Hardware Error Correction Code
  - detection and correction of single bit errors during read access
  - detection of double bit errors
- Programming time: typical 2 ms per page (128 byte)
- Fast erase per sector: typical 200 ms
- 10.000 programming/erase cycles per sector or wordline
  - Data retention 5 years
- 1.000 programming/erase cycles per sector or wordline
  - Data retention 20 years

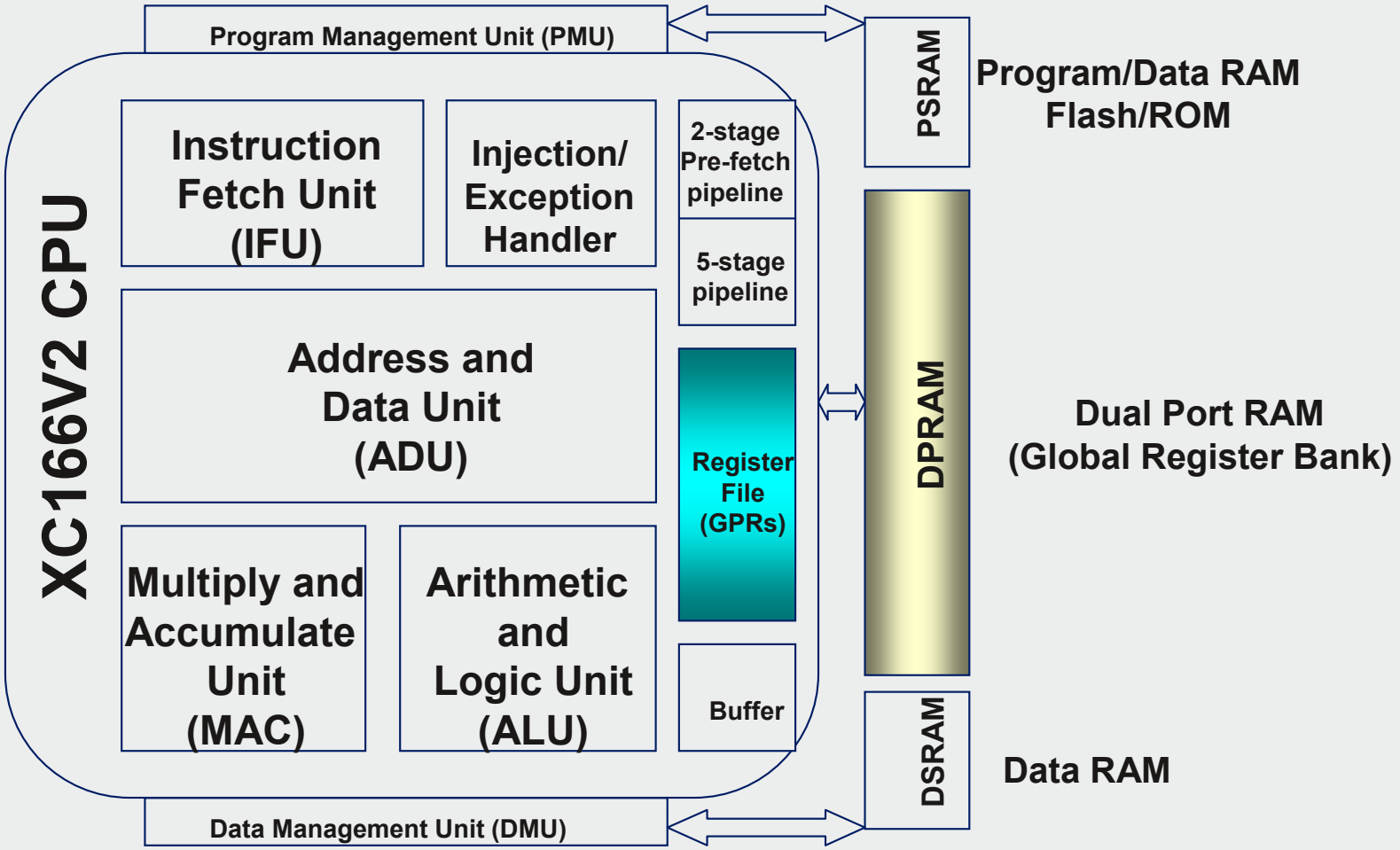
XC164CM series Flash Module

- Sector architecture
  - Four 8K (also organized as two physical 16K sectors), and one 32 Kbyte sector
  - Each sector separately erasable
  - Each physical sector separately lockable for protection against erase and programming
- Optional read protection for whole Flash
- Password checking for temporary disable of write or read protection

XC164CM series Flash Module

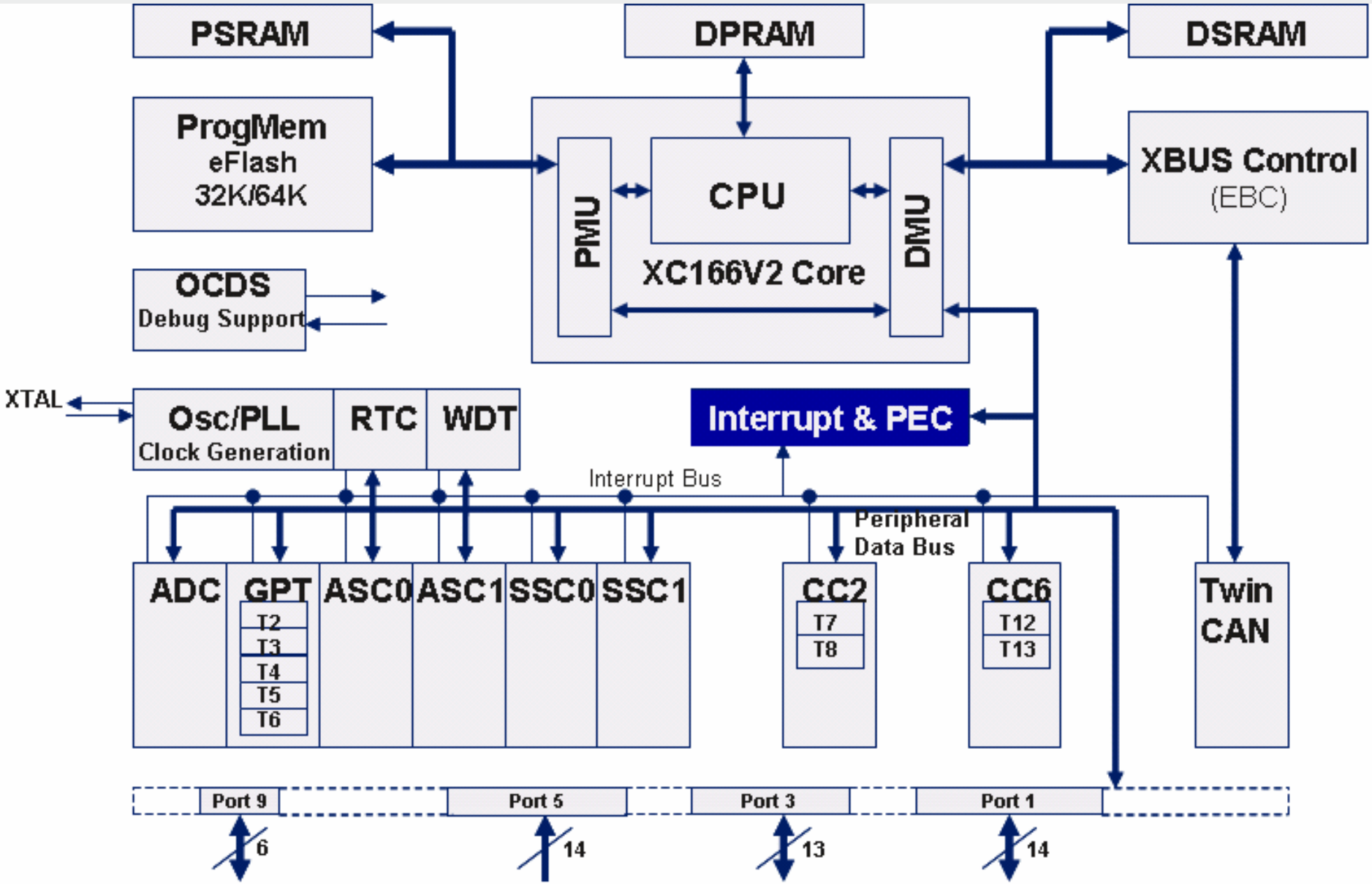
- Operational control per command sequences for protection against unintended operation
  - comfortable User Interface
  - command sequences according to JEDEC standard
  - Write state machine for automatic programming and erase
  - Efficient programming operation with 128 byte pages to be written in one step
- Support of in-system and in-operation programming and erase
- Global and sector status information

XC164CM series Dual Port RAM (DPRAM)



- Dual Port RAM (DPRAM) contains the global register banks
- Directly coupled to CPU to optimize transfers and performance

XC164CM series Interrupt and Exception Handling



XC164CM series Interrupt and Exception Handling

- Four different kinds of exceptions are executed
  - Interrupts generated by the Interrupt Controller
    - Suspend current program and branch to interrupt service routine
  - DMA transfers issued from the Peripheral Event Controller
    - Performs a single byte/word transfer between two memory locations
  - Software Traps caused by the Trap instructions
    - Trap instruction generates a software interrupt
  - Hardware Traps issued by faults or specific system states
    - Class A traps (NMI, Stack-overflow/underflow, SW-break)
    - Class B traps (Undef. Opcode, PMI Access Error, Protection fault, Illegal Word Operand Access)

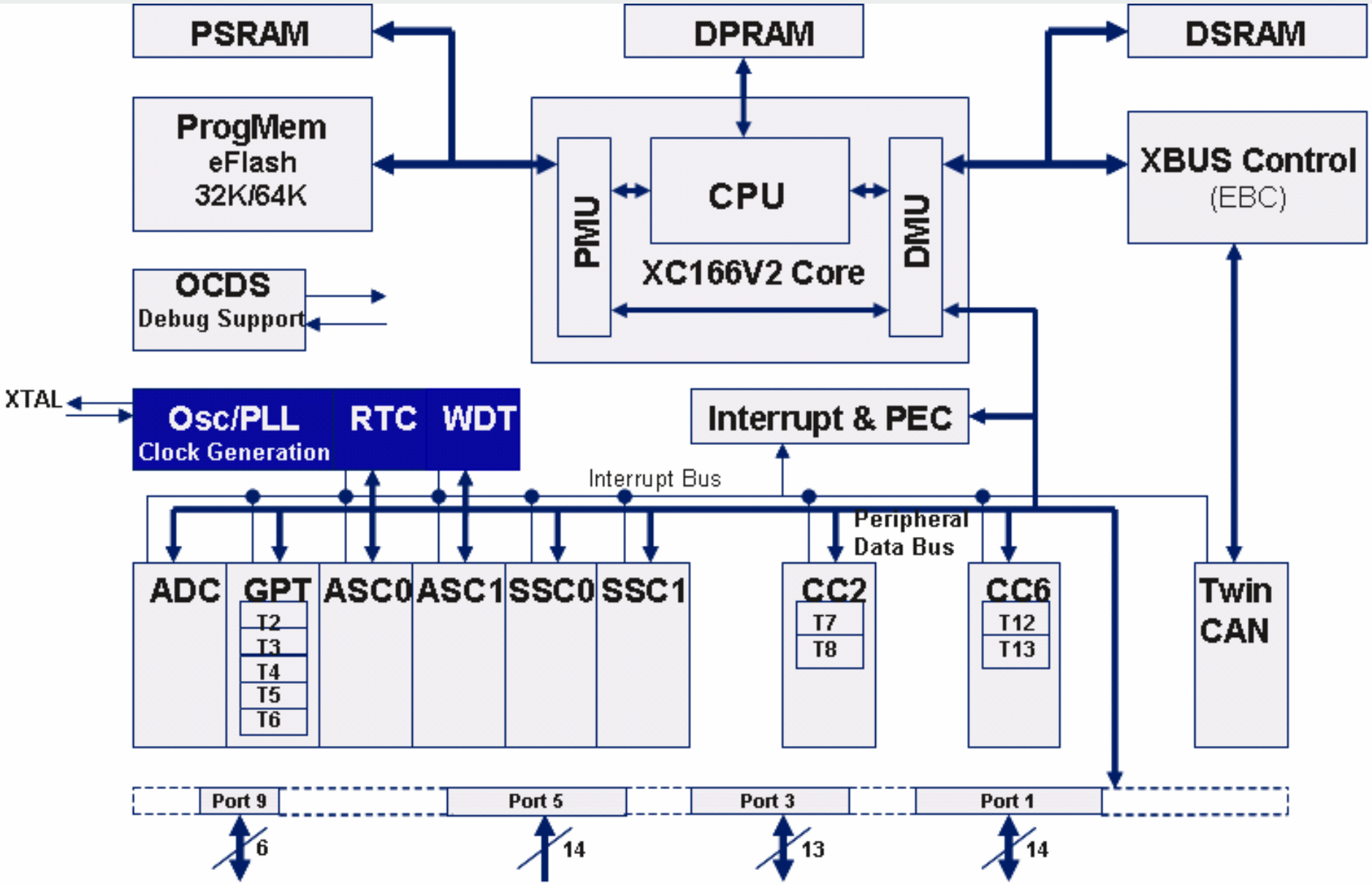
XC164CM series Interrupt and Exception Handling

- 16 Priority Level Interrupt system
  - Up to 63 interrupt nodes with separate interrupt vectors on 15 priority levels, each priority level consists of 8 group level
  - Very short interrupt response time(typ. 8 cycle) in case of internal program/data execution
  - Fast external interrupt
  - Programmable location of vector table
  - Interrupt arbitration
  - Fast bank switching
  - Interrupt Jump Table Cache (fast interrupt)

XC164CM series Interrupt and Exception Handling

- Single cycle data transfer facilities via Peripheral Event Controller (PEC)
  - 8 PEC channels
  - Programmable PEC interrupt request level (level 15 down to level 8)
  - Separate interrupt level for PEC termination interrupts (end of PEC interrupt) selectable
  - Full 24bit addresses for source and destination pointers, supporting any mapping of source and destination devices within the total address spaces

XC164CM series System Control Unit (SCU)



XC164CM series System Control Unit (SCU)

- Clock Generation Control
  - The clock generation path is controlled via the PLL control register PLLCON
  - The oscillator delivers the system's clock signal
    - external crystal (optimized 4-16 MHz)
    - external clock signal up to 40 MHz
  - Input clock divider adjusts the system's clock signal to the input frequency. Range of the PLL (optimized 4 - 35 MHz)
    - PLLIDIV PLL input divider (1:1 to 1:4)
  - The PLL multiplies the input frequency by a selectable factor
    - PLLMUL PLL multiplier factor (*8 to * 32)
    - The PLL can be bypassed
    - For device testing the complete clock generation can be bypassed by directly driving the system with the Oscillator
    - PLL VCO band can be selected in a range of 100 MHz-250MHz
  - Output clock divider scales the PLL's output frequency
    - PLLODIV PLL output divider (1:1 to 1:15)

XC164CM series System Control Unit (SCU)

- Register Security Mechanism
  - Some registers which control critical functions and modes are protected after EINIT.
    - 3 Security levels with password protection
      - **Write Protect Mode** - all protected registers are read only
      - **Secured Mode** - protected registers can be written if preceded by a command sequence
      - **Unprotected Mode** - no protection, protected registers can be written

XC164CM series System Control Unit (SCU)

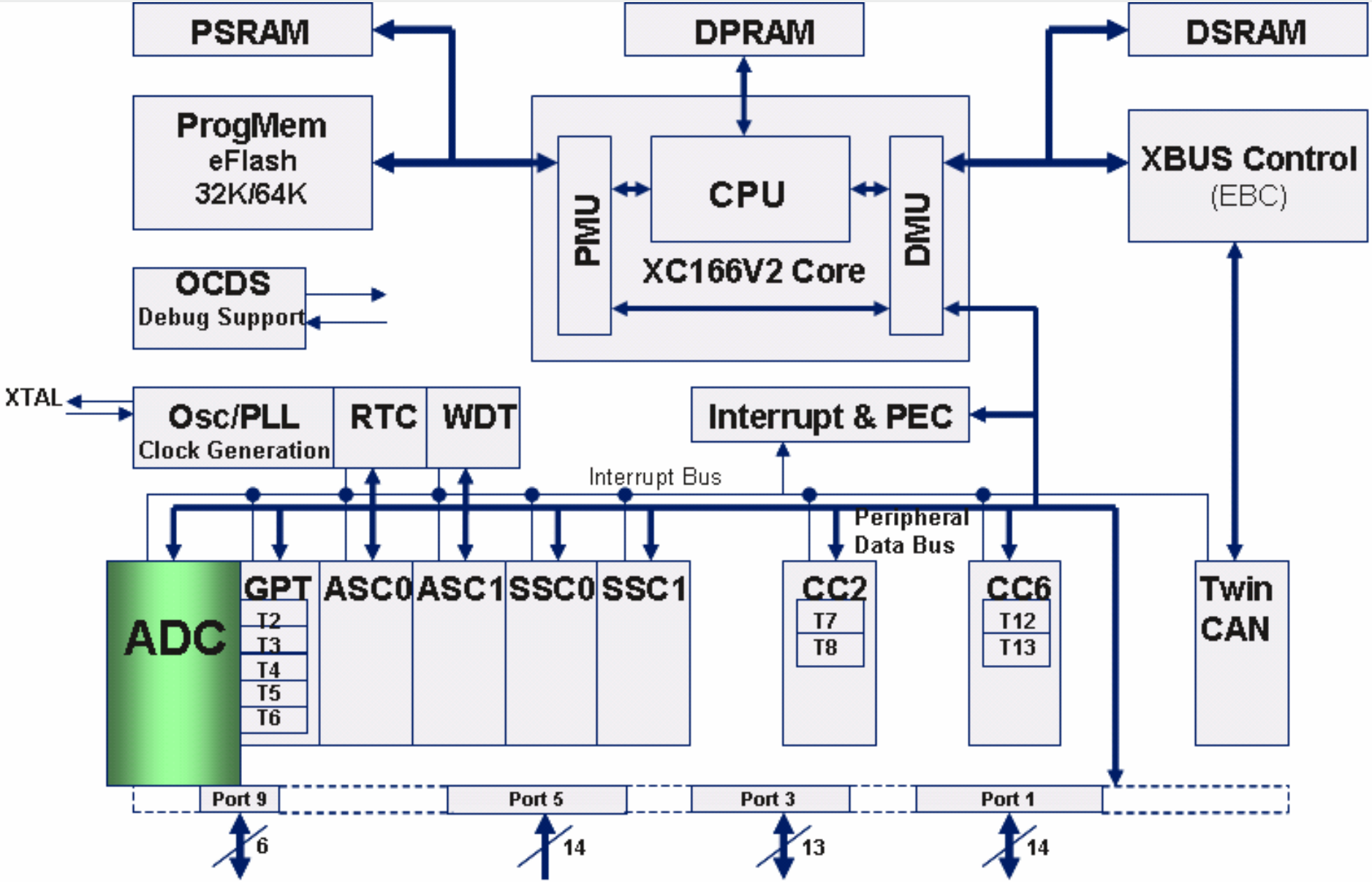
- Watchdog Timer
  - Watchdog Timer has been designed to recover from software or hardware failure
  - If the software fails to service the Watchdog Timer a timer overflow generates an internal reset
  - The watchdog timer is 16bits wide and can be clocked with the peripheral clock either divided by 2, 4, 128, 256
  - The upper 8 bits can be preset, the lower 8 bits are cleared upon each service access
  - Compatible mode, DISWDT will only be executed before EINIT, SRVWDT
  - Enhanced mode, watchdog timer can be disabled/enabled at any time

XC164CM series Real Time Clock (RTC)

- Real Time Clock (RTC)
  - Two reloadable timers, T14 (16-bit) and CNT (32-bit)
  - Both timers can be connected to one 48-bit timer
  - RTC can operate in Synchronous or Asynchronous Mode
  - Additional prescaler with a factor of 32 for one count input
  - RTC can operate independently from the main system
  - Optimized for low power consumption

XC164CM series
Peripherals

XC164CM series ADC
not on XC164LM and XC164KM



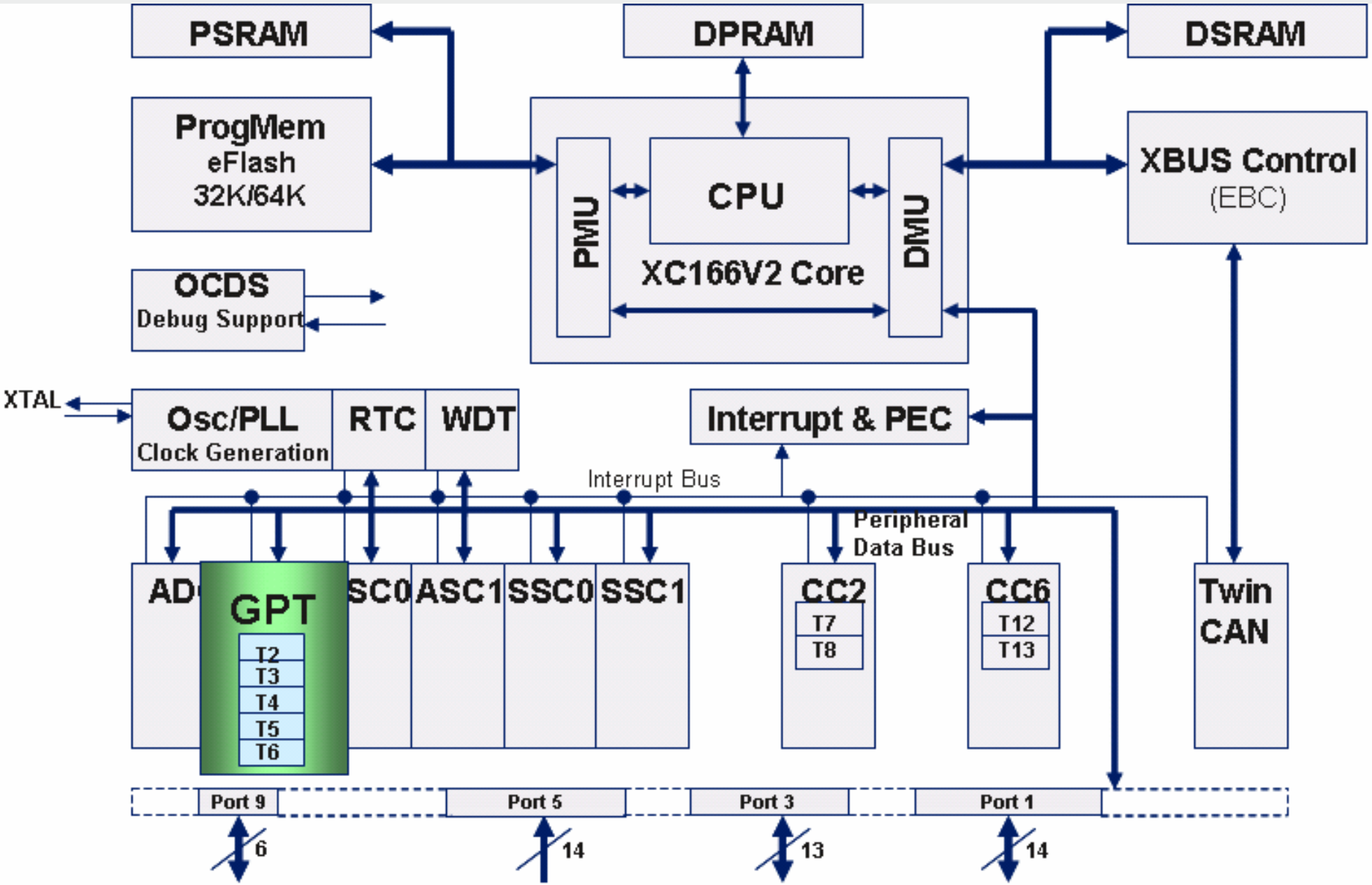
XC164CM series ADC
not on XC164LM and XC164KM

- ADC features
  - 14 channels
    - 10bit resolution ± 2LSB
    - 8bit resolution ± 1LSB
  - min. 2,15 µs conversion time @ 40 MHz for 8bit resolution
  - min. 2,55 µs conversion time @ 40 MHz for 10bit resolution
  - Support of Different Conversion Modes
    - Fixed Channel Single Conversion
    - Fixed Channel Continuous Conversion
    - Auto Scan Single Conversion
    - Auto Scan Continuous Conversion
    - Wait for Result Read and Start Next Conversion
    - Channel Injection during Group Conversion

XC164CM series ADC
not on XC164LM and XC164KM

- ADC Features
  - Flexible Programmable Conversion and Sample Timing Scheme
  - DMA (PEC) Support for Result Transfer to Memory Location
  - Automatic self-calibration to changing temperature or process variations
  - Auto-Power-Down Feature of the A/D Converter

XC164CM series GPT12E



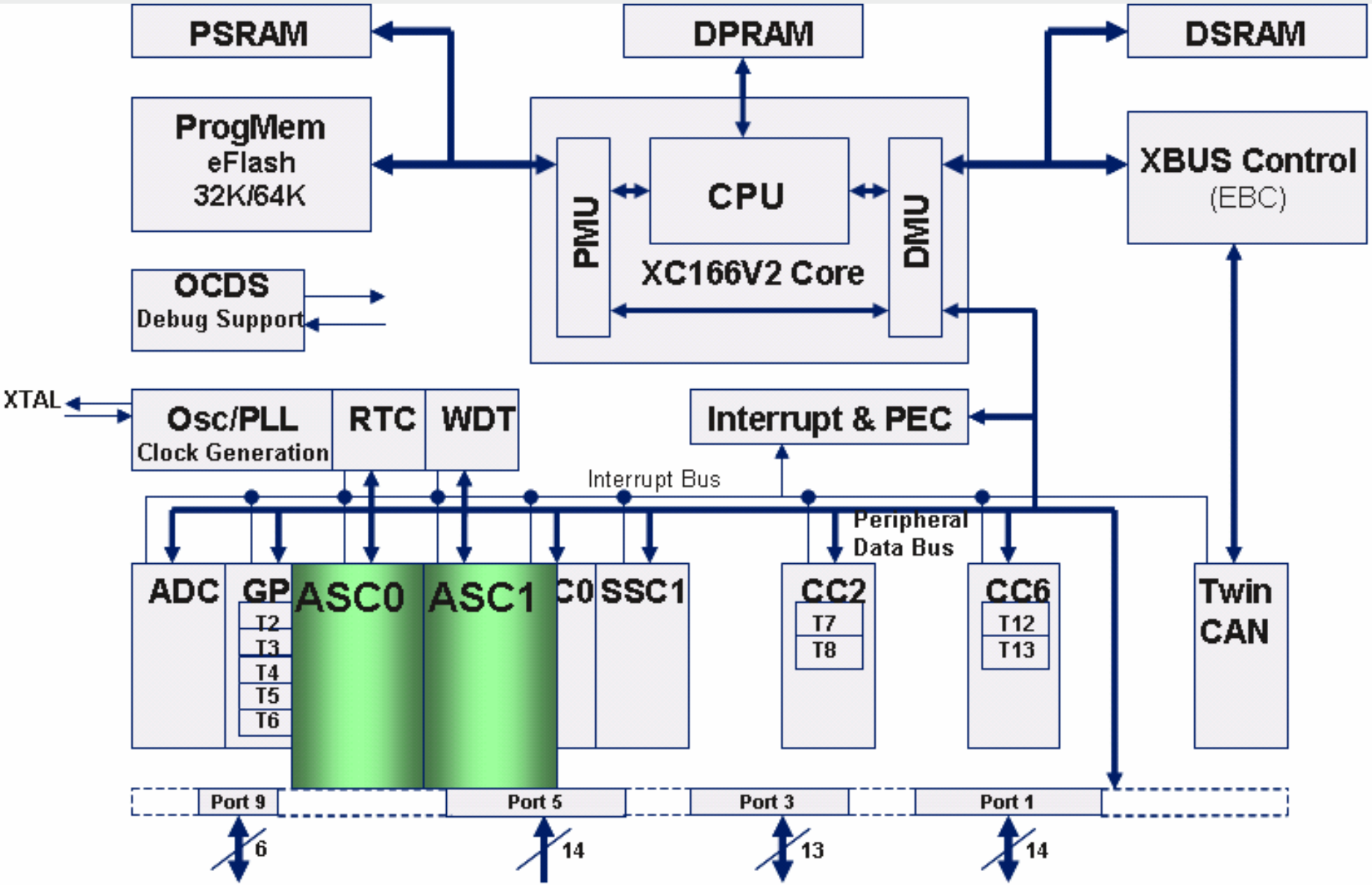
XC164CM series GPT12E

- Timer Block GPT1
  - f_{Clk}/4 maximum resolution (100ns @ f_{cpu} 40 MHz)
  - clock prescaler support
  - 3 independent timers/counters (T2, T3, T4)
  - timers/counters can be concatenated
  - 4 operating modes (timer, gated timer, counter, incremental)
  - enhanced incremental interface modes
    - rotation detection mode
    - edge detection mode
  - separate interrupt request lines
  - auxiliary timer in reload/capture mode

XC164CM series GPT12E

- Timer Block GPT2
  - $f_{CLK}/2$ maximum resolution (50ns @ f_{cpu} 40 MHz)
  - clock prescaler support
  - 2 independent timers/counters (T5, T6)
  - Timers/counters can be concatenated
  - 3 operating modes (timer, gated timer, counter)
  - Extended capture/reload functions via 16-bit Capture/Reload register CAPREL
  - Separate interrupt request lines
  - auxiliary timer in reload/capture mode

XC164CM series ASC



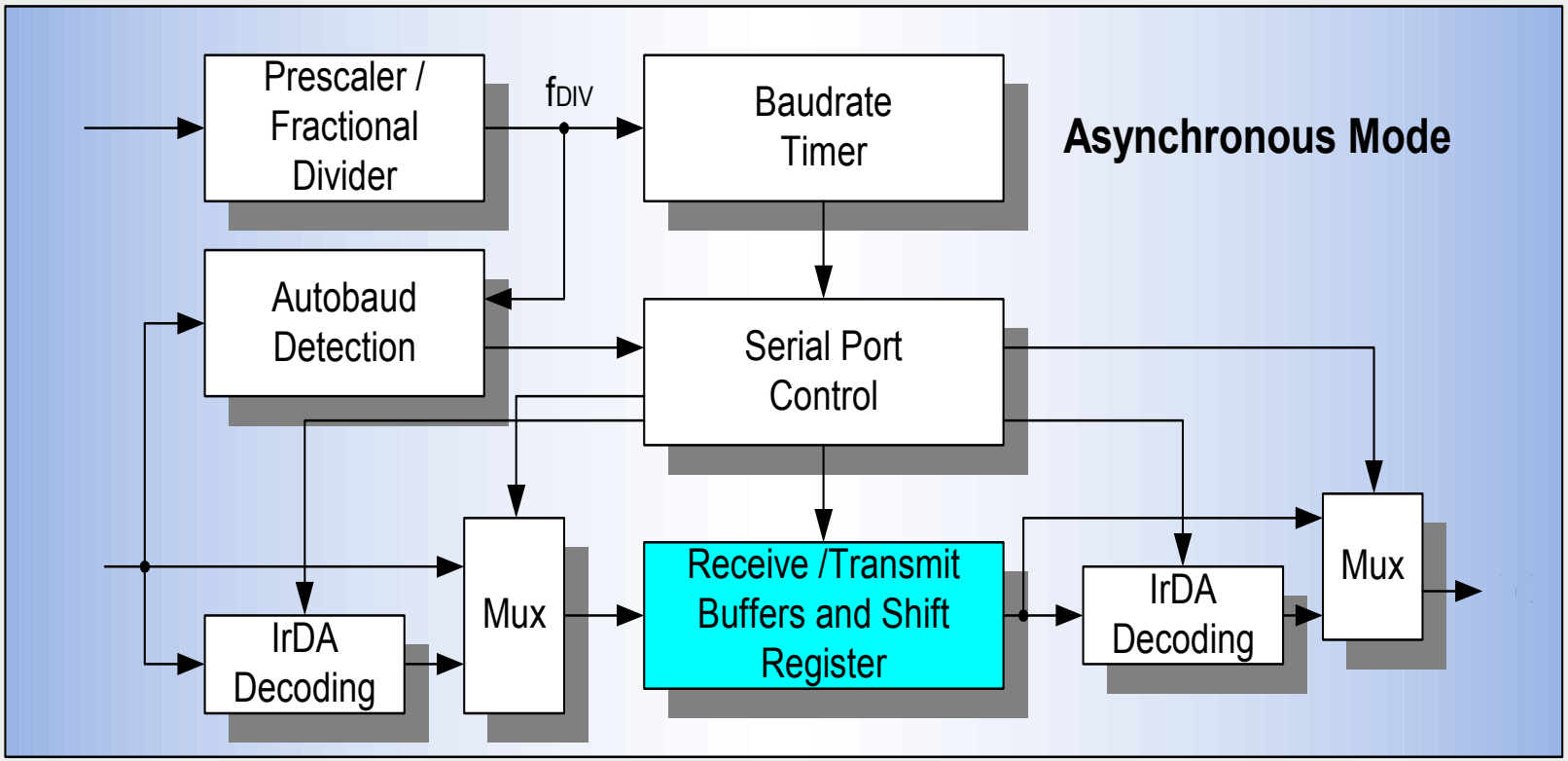
XC164CM series ASC

- Full-duplex asynchronous operating modes
  - 8- or 9-bit data frames, LSB first
  - Parity bit generation/checking
  - One or two stop bits
  - Baudrate up to 1.25 Mbaud (@ 40 MHz clock)
  - Multiprocessor mode for automatic address/data byte detection
  - Loop-back capability
  - Support for IrDA data Transmission/reception up to max. 115.2 Kbaud
- Half-duplex 8-bit synchronous operating mode
  - Baudrate up to 5 Mbaud (@ 40 MHz clock)

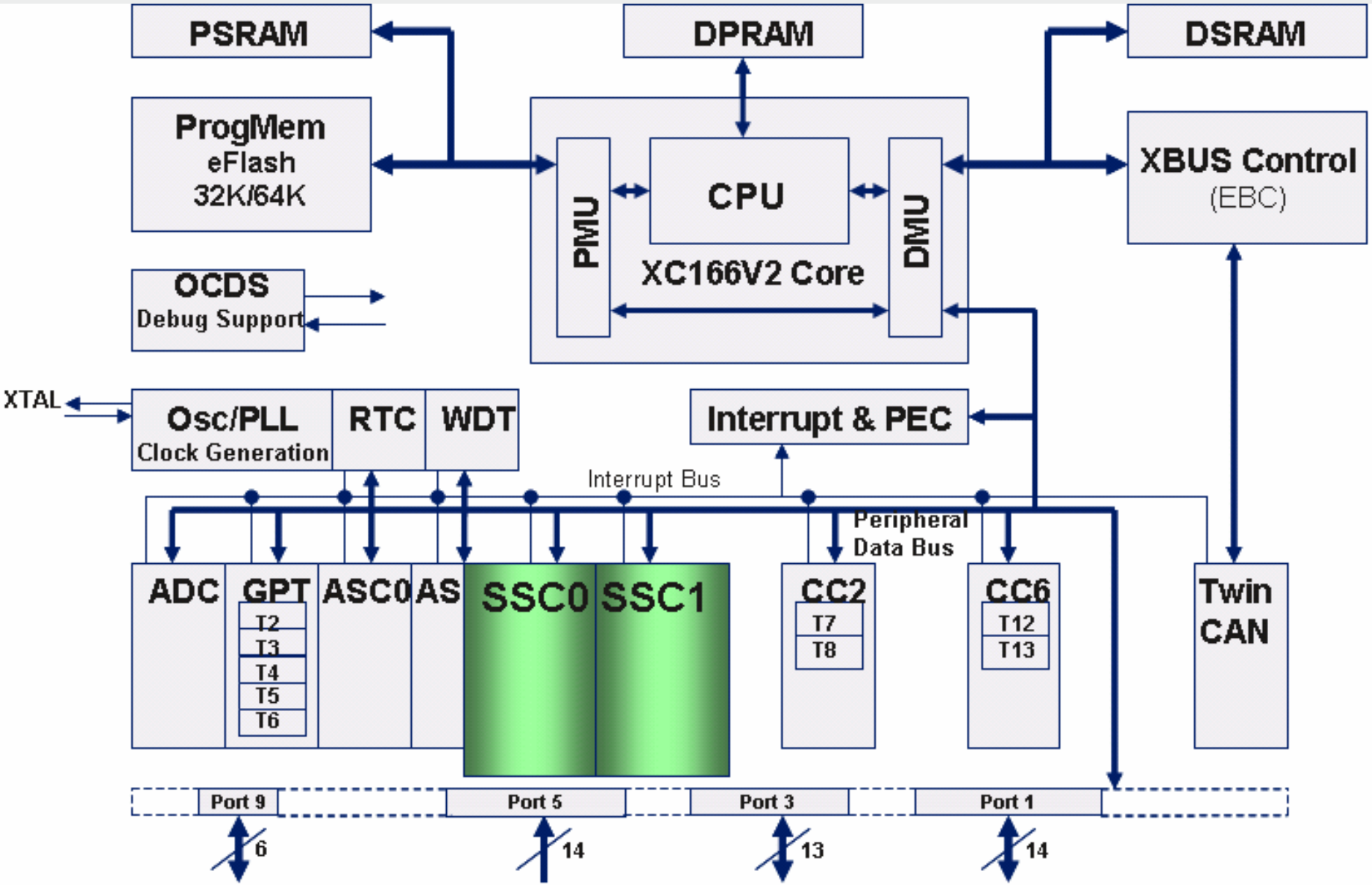
XC164CM series ASC

- Data transmission is double buffered
- Autobaud rate detection
- Buffered transmitter/receiver with FIFO support
- Comfortable Interrupt Generation
  - on a transmitter empty condition
  - on a transmission of a last bit of a frame
  - on a receiver buffer full condition
  - on an error condition (receive, parity, overrun error)
  - on the start and end of a autobaud detection

XC164CM series ASC



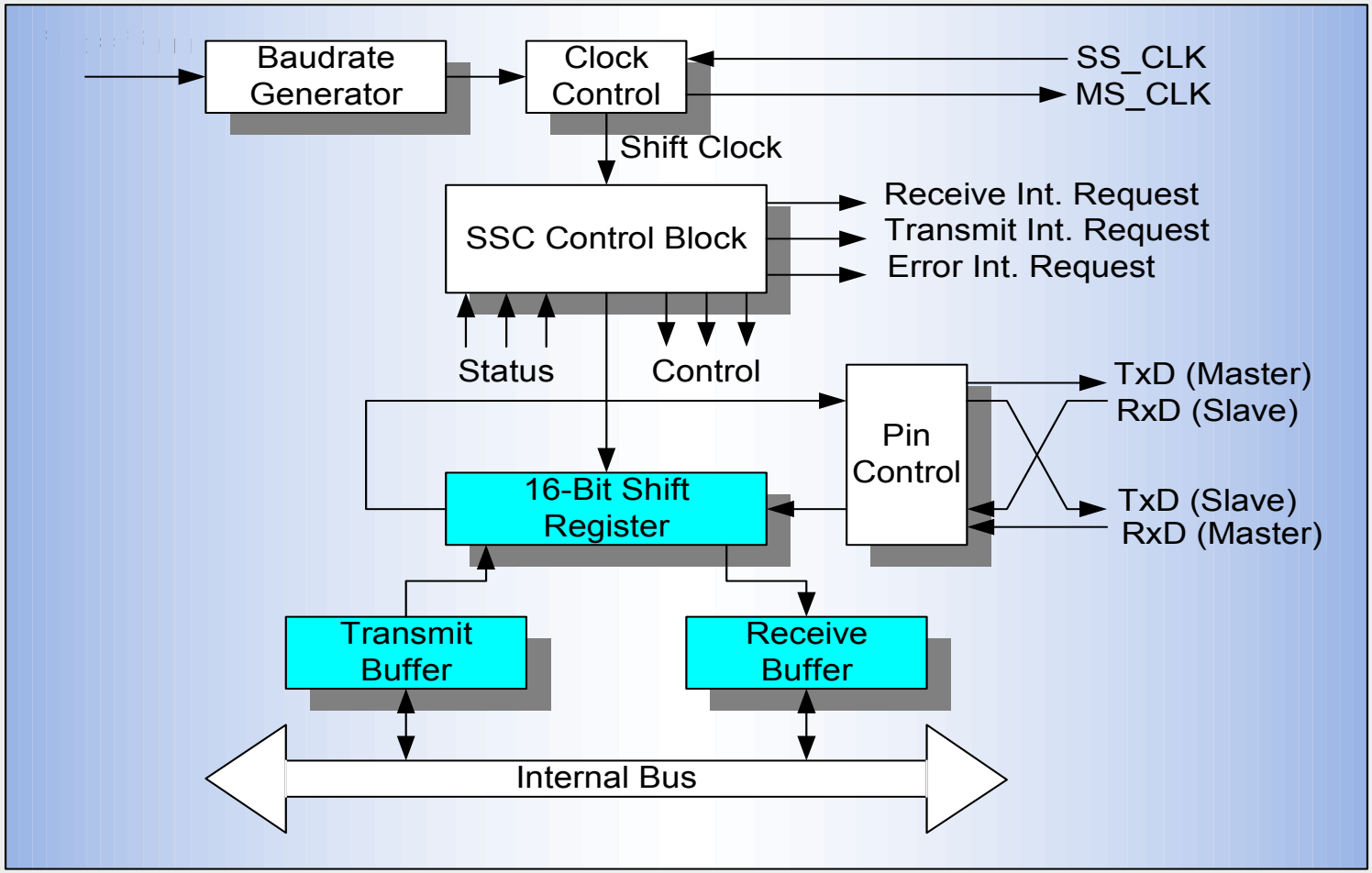
XC164CM series SSC



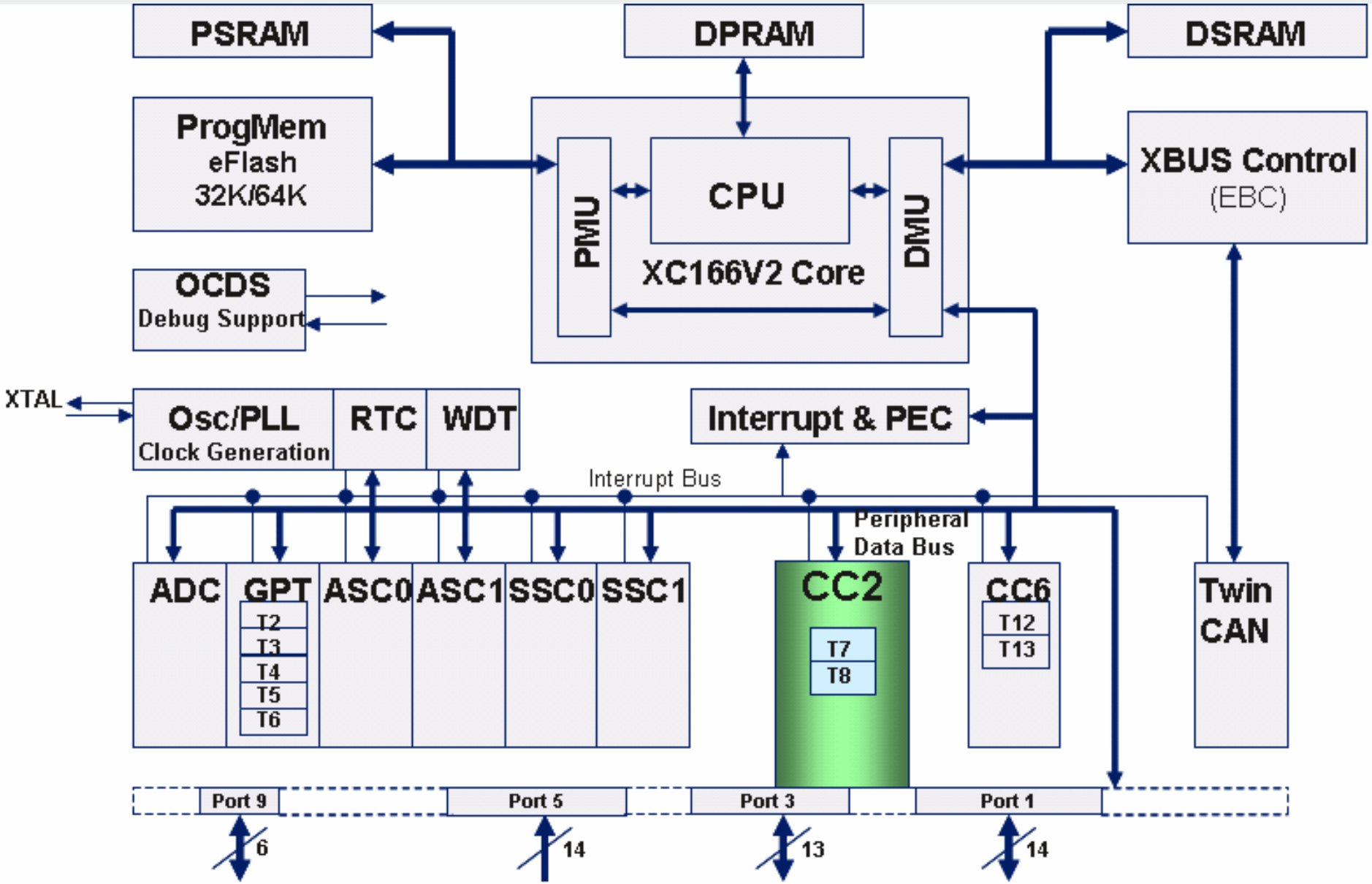
XC164CM series SSC

- Master and slave mode operation
  - Full-duplex or half-duplex
- Flexible
  - Programmable number of bits: 2 to 16bits
  - Programmable shift direction: LSB or MSB shift first
  - Programmable clock polarity
  - Programmable clock/data phase
- Max. Baudrate up to 20 Mbaud (@ 40 MHz clock)

XC164CM series SSC



XC164CM series CAPCOM2



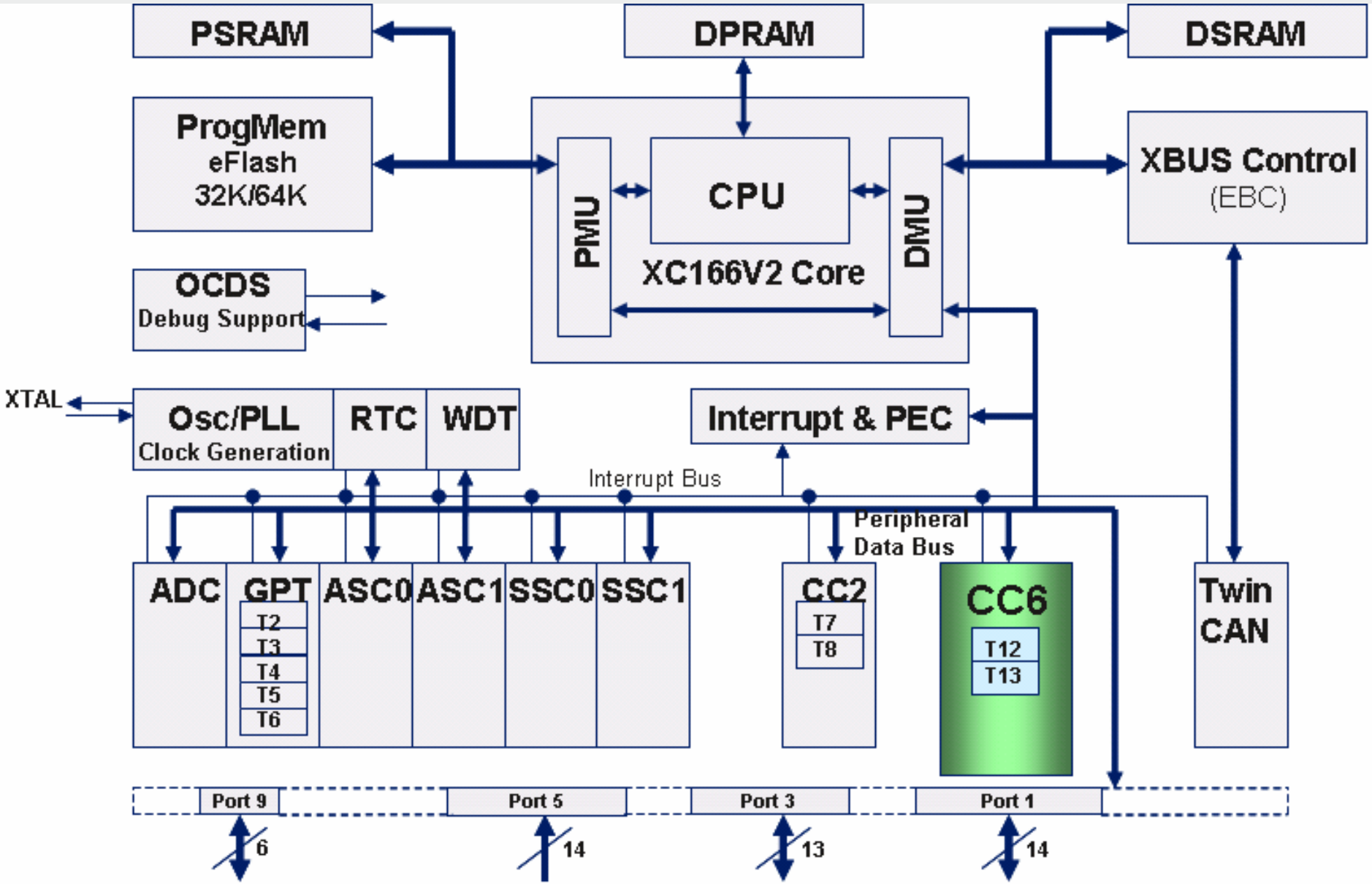
XC164CM series CAPCOM2

- Features
  - Two 16-bit timers with reload register
  - 16 registers individually configurable for capture or compare function
  - 18 interrupts: 16 capture compare interrupts with two timer interrupts
  - Up to 16 software timers
  - Programmable clock with multiple sources

XC164CM series CAPCOM2

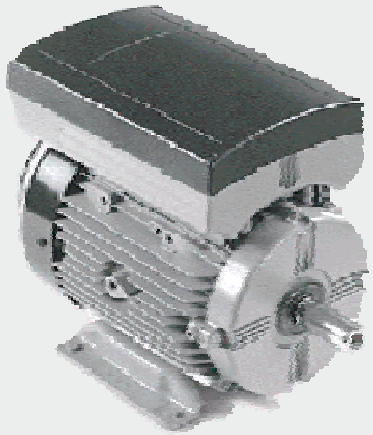
- Features
  - 200 ns maximum resolution (@ 40 MHz staggered mode), compatible to C16x
  - 25ns maximum resolution (@ 40 MHz non-staggered mode), enhanced mode
  - Double register compare function
  - Primary clock prescaler
  - Additional output register
  - Single event mode

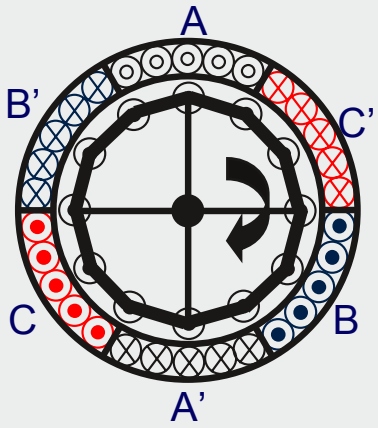
XC164CM series CAPCOM6E
not on XC164LM, XC164TM, XC164KM and XC164GM



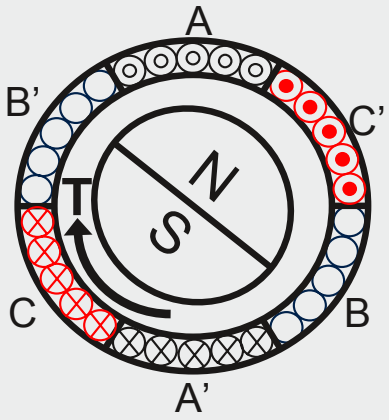
XC164CM series CAPCOM6E
not on XC164LM, XC164TM, XC164KM and XC164GM

- The CCU6 provides two independent timers (T12,T13) for PWM generation, especially for AC motor control. Support of special control modes for block commutation and multi-phase machines are supported

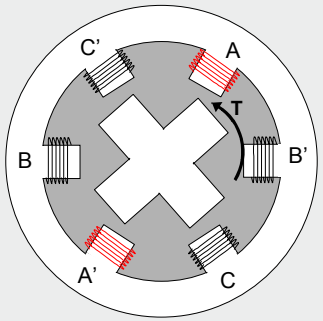




Induction Motor



BLDC-Motor



Switched Reluctance

XC164CM series CAPCOM6E
not on XC164LM, XC164TM, XC164KM and XC164GM

- Timer 12 Features
  - Three capture/compare channels, each channel can be used either as capture or compare channel.
  - Generation of a three-phase PWM supported (six outputs, individual signals for lowside and highside switches)
  - 16 bit resolution, maximum count frequency = peripheral clock
  - Dead-time control for each channel to avoid short-circuits in the power stage
  - Concurrent update of the required control registers due to synchronous design
  - Center-aligned and edge-aligned PWM can be generated
  - Single-shot mode supported
  - Many interrupt request sources
  - Hysteresis-like control mode (this mode might be used to realize a simple current regulator in combination with CTRAP)

XC164CM series CAPCOM6E
not on XC164LM, XC164TM, XC164KM and XC164GM

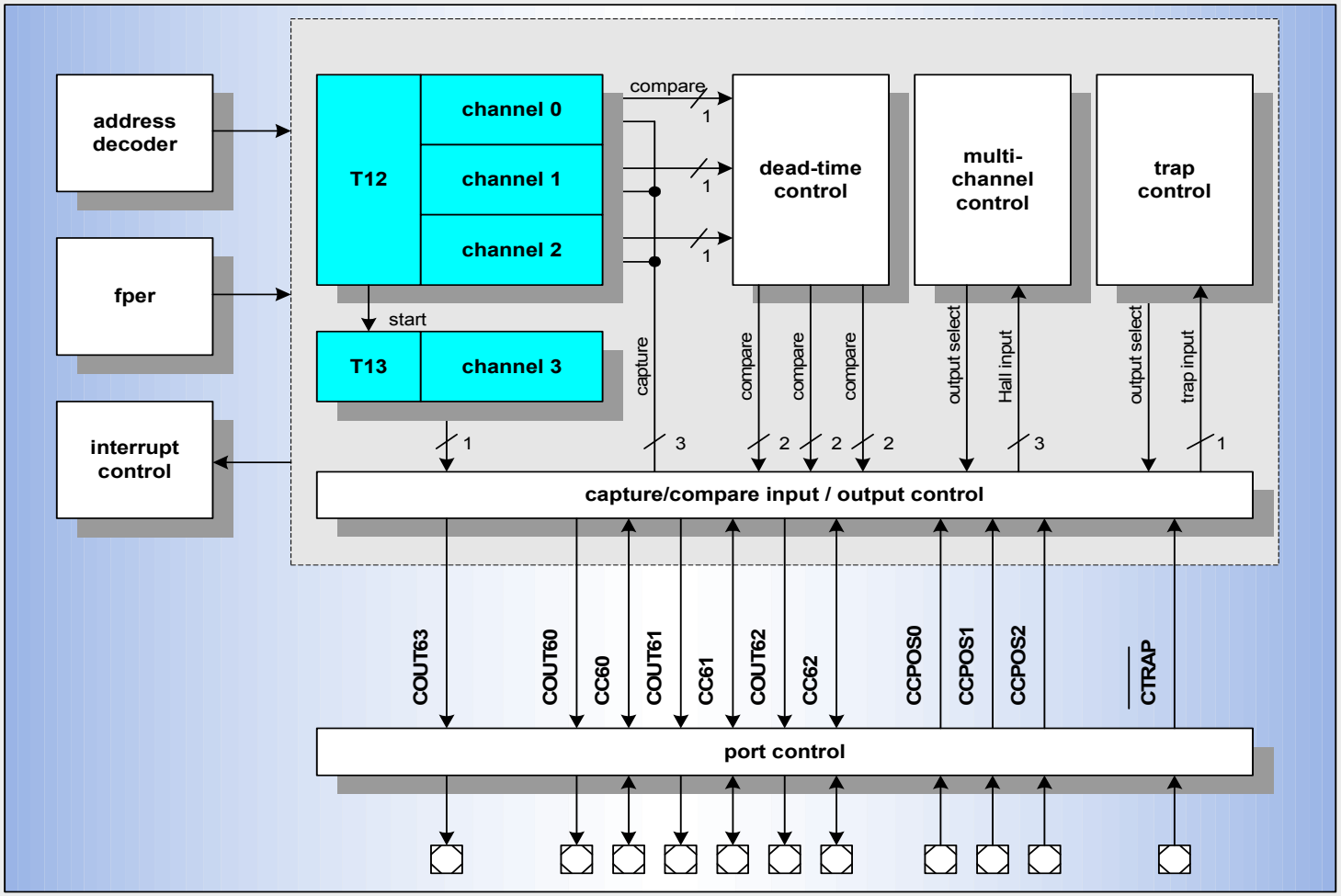
- Timer 13 Features
  - One independent compare channel with one output
  - 16 bit resolution, maximum count frequency = peripheral clock
  - Can be synchronized to T12 (Modulation of Timer 12)
  - Interrupt generation at period-match and compare-match
  - Single-shot mode supported

- Additional Features of CCU6
  - Block commutation for Brushless DC-drives implemented
  - Position detection via Hall-sensor pattern
  - Automatic rotational speed measurement for block commutation
  - Integrated error handling
  - Fast emergency stop without CPU load via external signal (CTRAP)

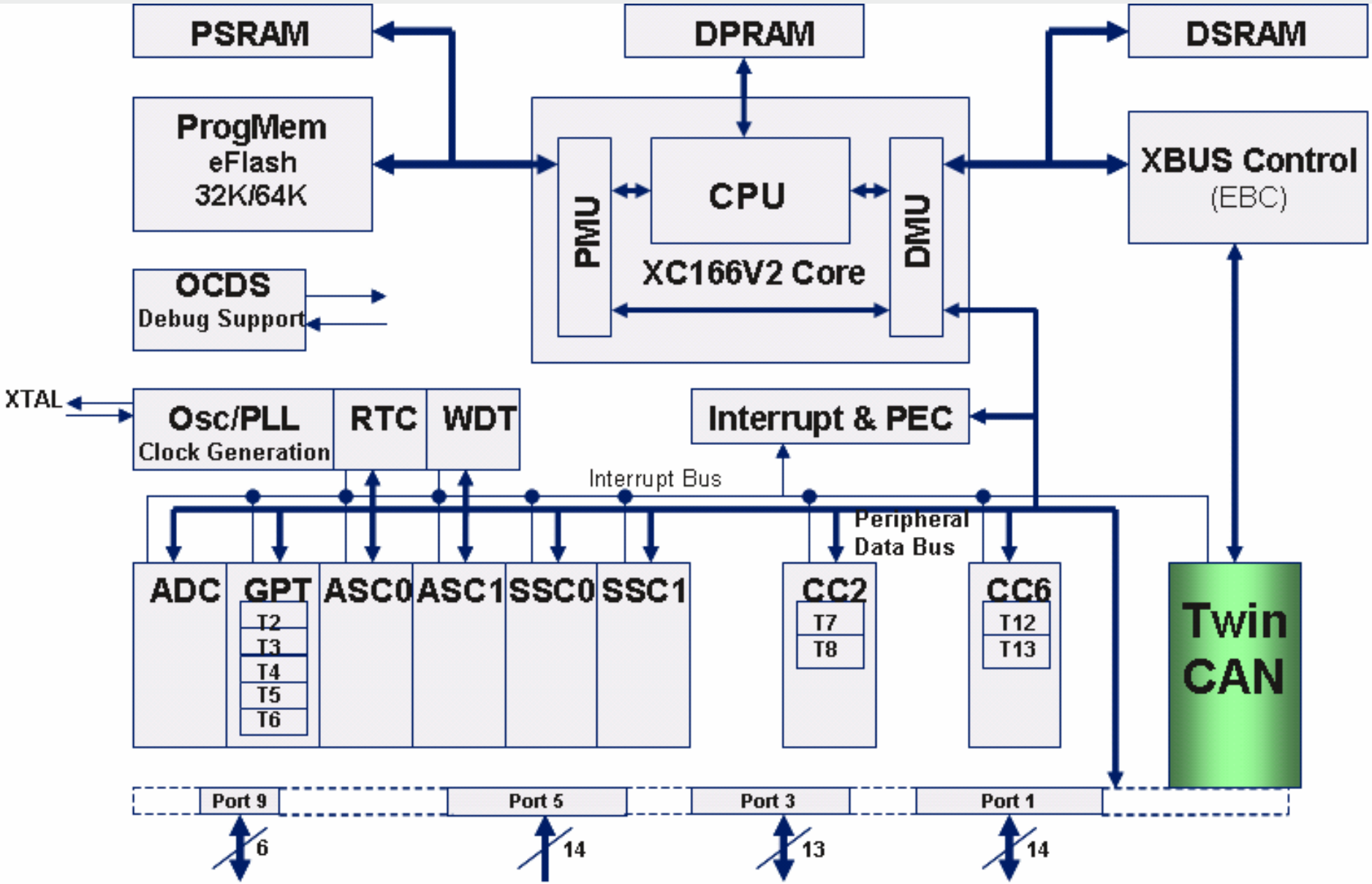
XC164CM series CAPCOM6E
not on XC164LM, XC164TM, XC164KM and XC164GM

- Multi-channel features: User specific control modes for 4-, 5- and 6-phase drives
- Output levels can be selected and adapted to the power stage
- Noise filtering for Hall inputs
- Support of sensorless positioning detection of BLDC
  - Timer T12 trigger Timer T13 to generate additional delay for demagnetization time
- Simple motor control feature (e.g. over current control)

XC164 CM series CAPCOM6E
not on XC164LM, XC164TM, XC164KM and XC164GM



XC164CM series TwinCAN
not on XC164LM, XC164TM and XC164SM



XC164CM series TwinCAN
not on XC164LM, XC164TM and XC164SM

- Features
  - CAN functionality according to CAN specification V2.0 B active.
  - Dedicated control registers are provided for each CAN node.
  - A data transfer rate up to 1MBaud is supported.
  - Flexible and powerful message transfer control and error handling capabilities are implemented.
  - Up to eight individually programmable interrupt nodes can be used.
  - CAN Analyzer Mode for bus monitoring is implemented.

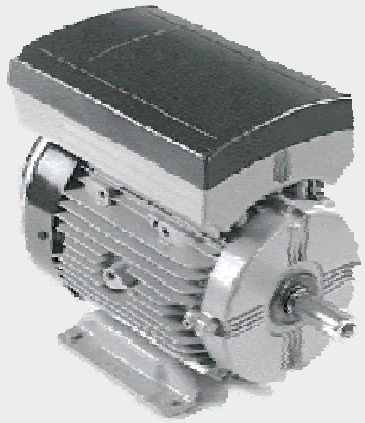
XC164CM series TwinCAN
not on XC164LM, XC164TM and XC164SM

- Full-CAN functionality: 32 message objects can be individually
  - assigned to one of the two CAN nodes,
  - configured as transmit or receive object,
  - participate in a 2,4,8,16 or 32 message buffer with FIFO algorithm,
  - setup to handle frames with 11 bit or 29 bit identifiers,
  - provided with programmable acceptance mask register for filtering,
  - monitored via a frame counter,
  - configured to Remote Monitoring Mode.

XC164CM series
Application Examples

The XC164CM series
A platform for Industrial motion control

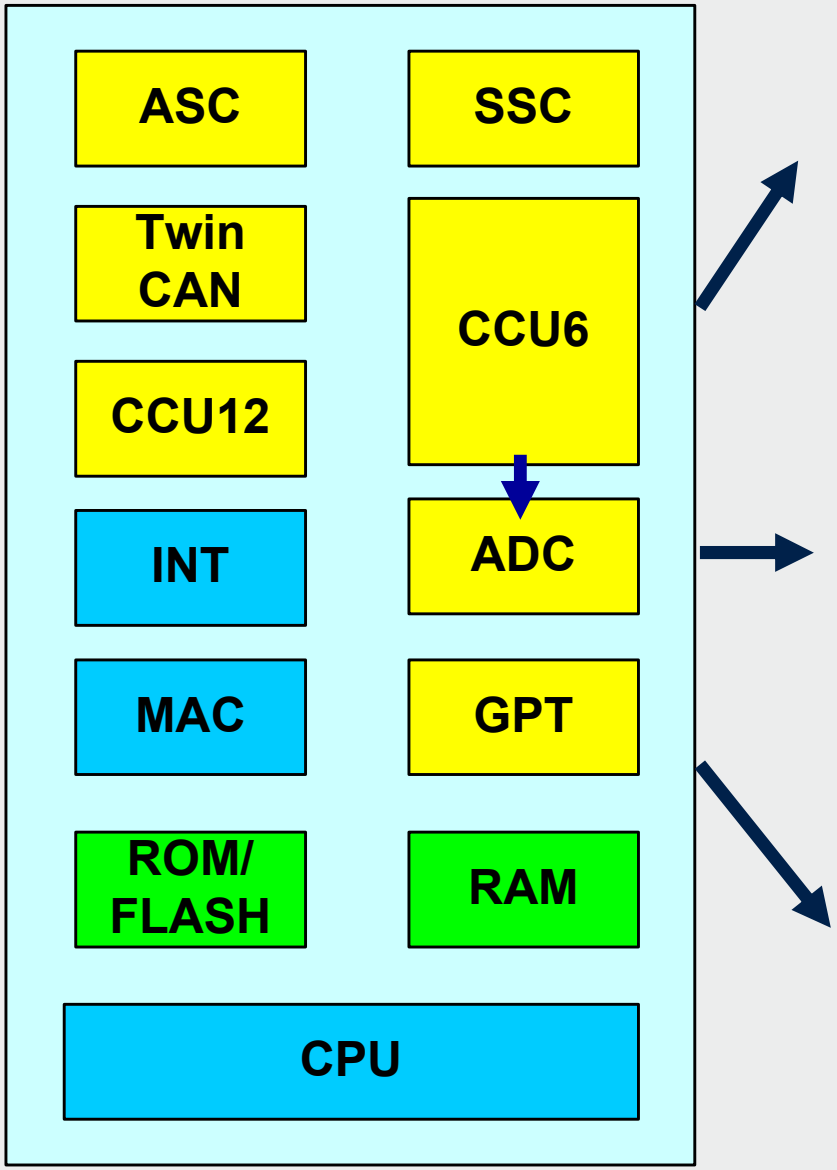
- Optimized peripheral set for
  - DC drives
  - AC drives
  - Stepper Motors



- Example Applications
  - Air-condition compressor
  - CNC Machines
  - Automated Assembly Systems
  - Inspection Systems
  - Labeling Machine
  - Robotics

Microcontroller peripheral features for your Application

Motor control

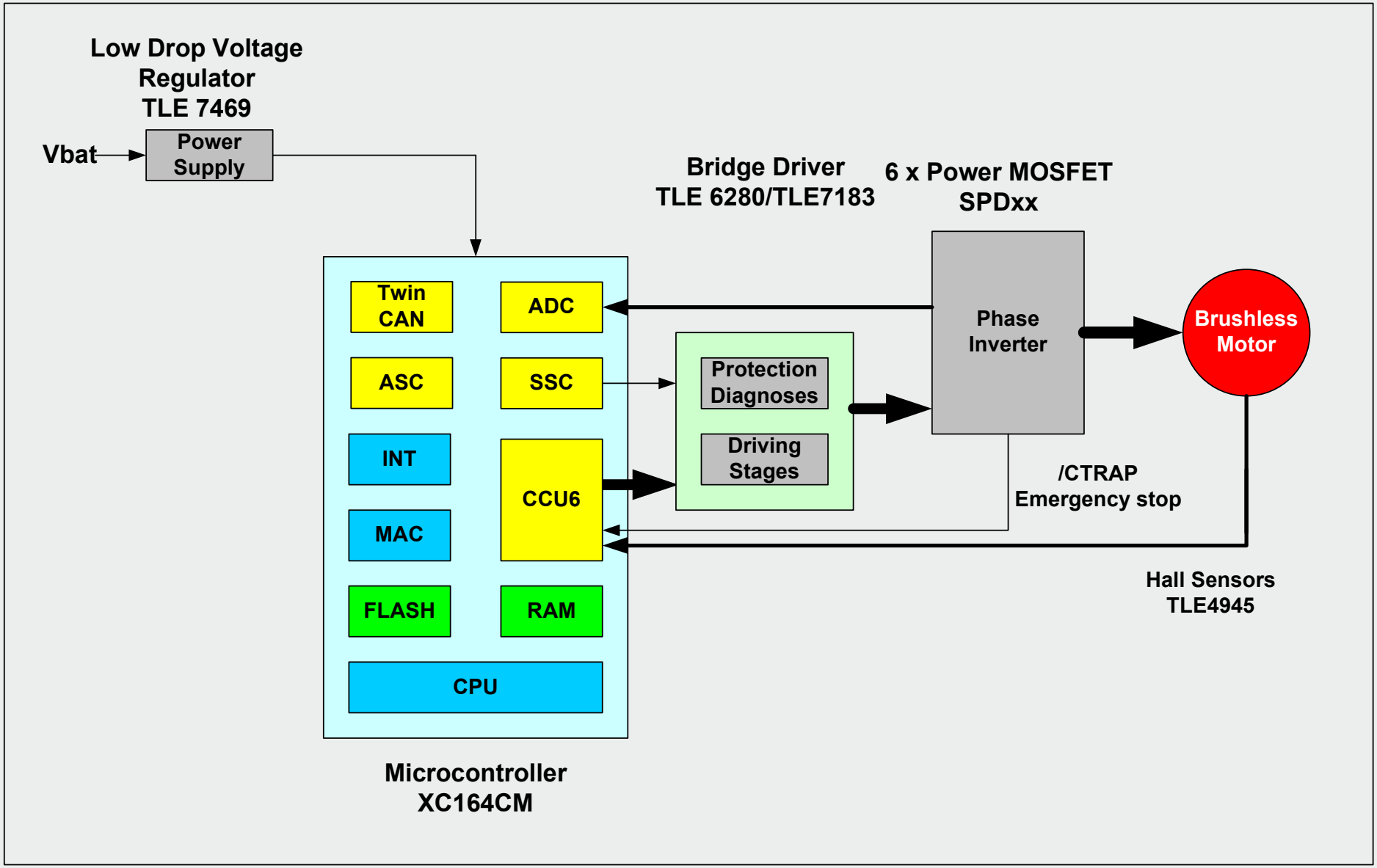


The **CCU6** provides two independent timers (T12,T13) for PWM generation, especially for AC motor control. Support of special control modes for block commutation and multi-phase machines are supported. Special Hardware trigger allow PWM synchronized ADC conversion with noise filtering.

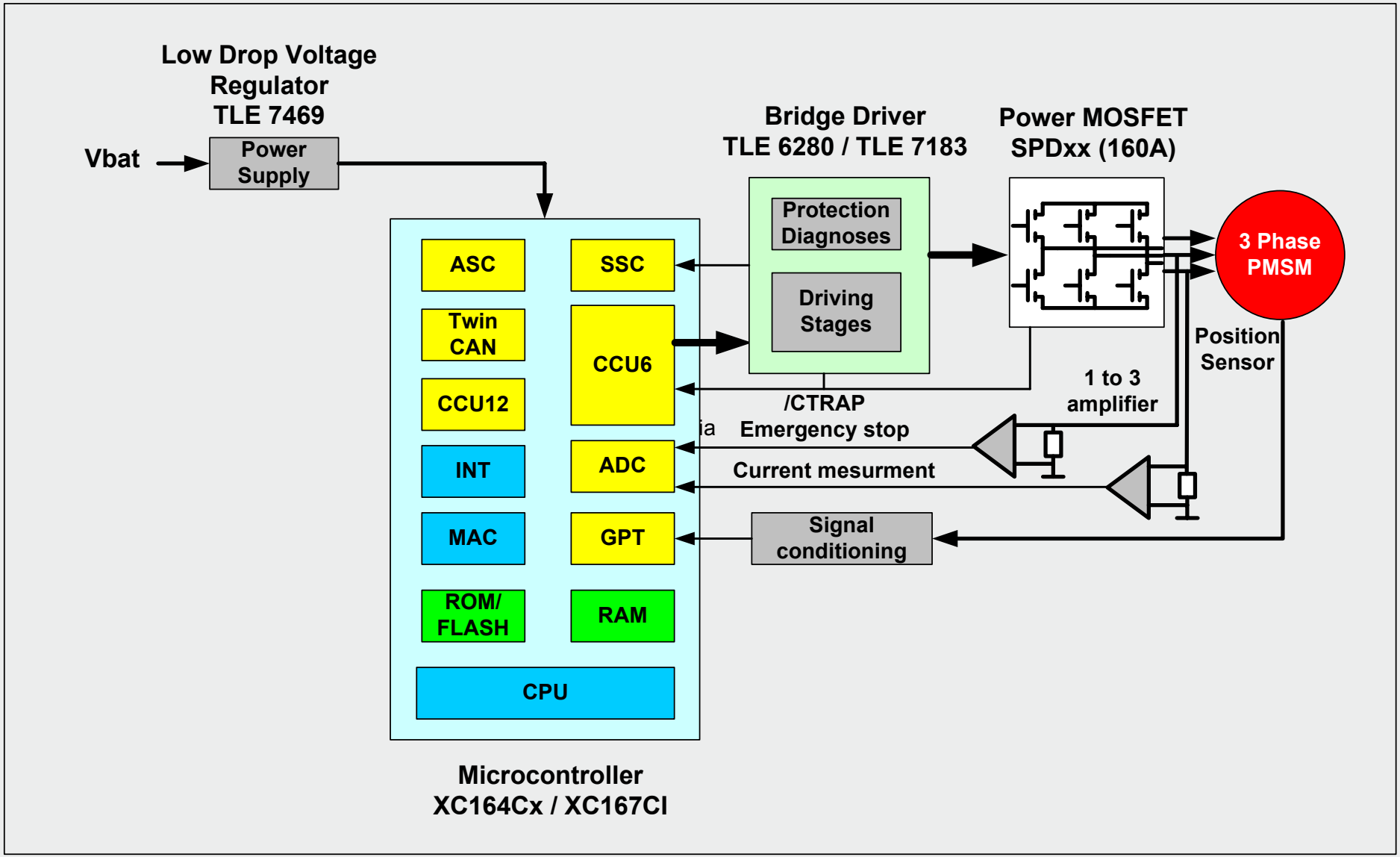
The **ADC** features up to 14 channels on the XC164CM with 10bit (+ 2LSB) fast conversion or 8bit (+ 1LSB) resolution. Different kind of Conversion Modes are supported, such like Fixed Channel Single/ Continuous Conversion, Auto scan, wait for read mode and channel injection mode.

The **General Purpose Timer Block GPT12** include 5 independent timers/counters in different operation modes such as timer, gated timer, counter, enhanced incremental interface modes for Encoder Signal decoding (rotation detection mode, edge detection mode) and separate interrupt request lines.

Application Example: Brush-Less DC Motor Drive with Hall Sensors or Sensor less



Application Example: Field Oriented Control (FOC) for Servo drive, Electrical Power Steering



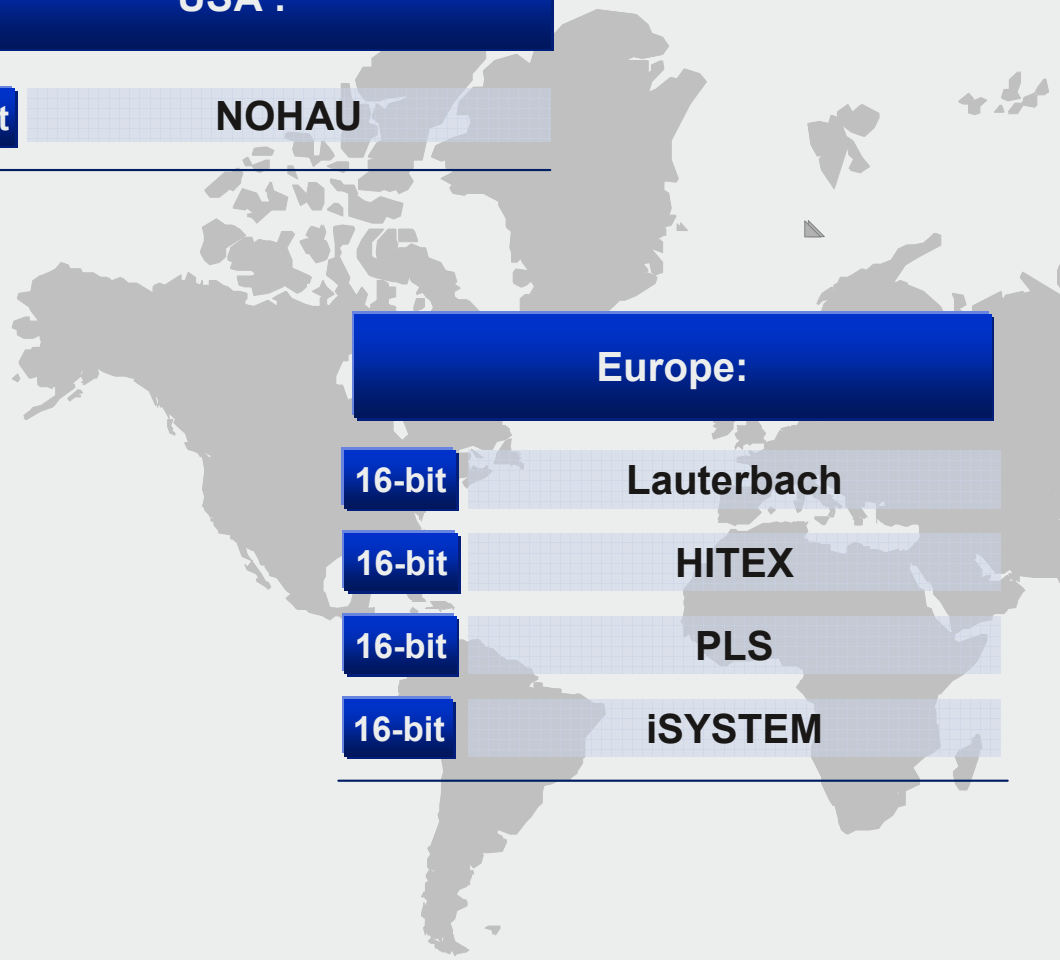
Industrial Motor Drive
powered and controlled by Infineon

Complete and easy to use solution

- Motor:
  - AC induction motor up to 15 kVA
- Power:
  - ***EconoPIM***™ FP75R12KE3
    - easy to use
    - high reliability
  - ***EiceDRIVER***™ 2ED020I12-F
    - high isolation capability
    - small size
    - low cost
- Control:
  - **XC164CM** Microcontroller with MAC unit enables Field oriented Control (FOC)
    - high dynamic behavior
    - constant torque over speed
    - less noise
    - versatile interface due to galvanic isolation
    - Demo Software and Application Notes available

XC164CM series
Tools & Software Overview

Development Tool Partners (Headquarters): Debugger



USA :

16-bit	NOHAU

Europe:

16-bit	Lauterbach
16-bit	HITEX
16-bit	PLS
16-bit	iSYSTEM

Compiler/Debugger Solutions

- TASKING (NL)
- KEIL (GER)
- COSMIC (FRA)
- KPID (IND)

Asia / Pacific:

16-bit	Wave

All TPVs are globally positioned with offices for sales/support in all regions.
Foil only shows headquarter locations

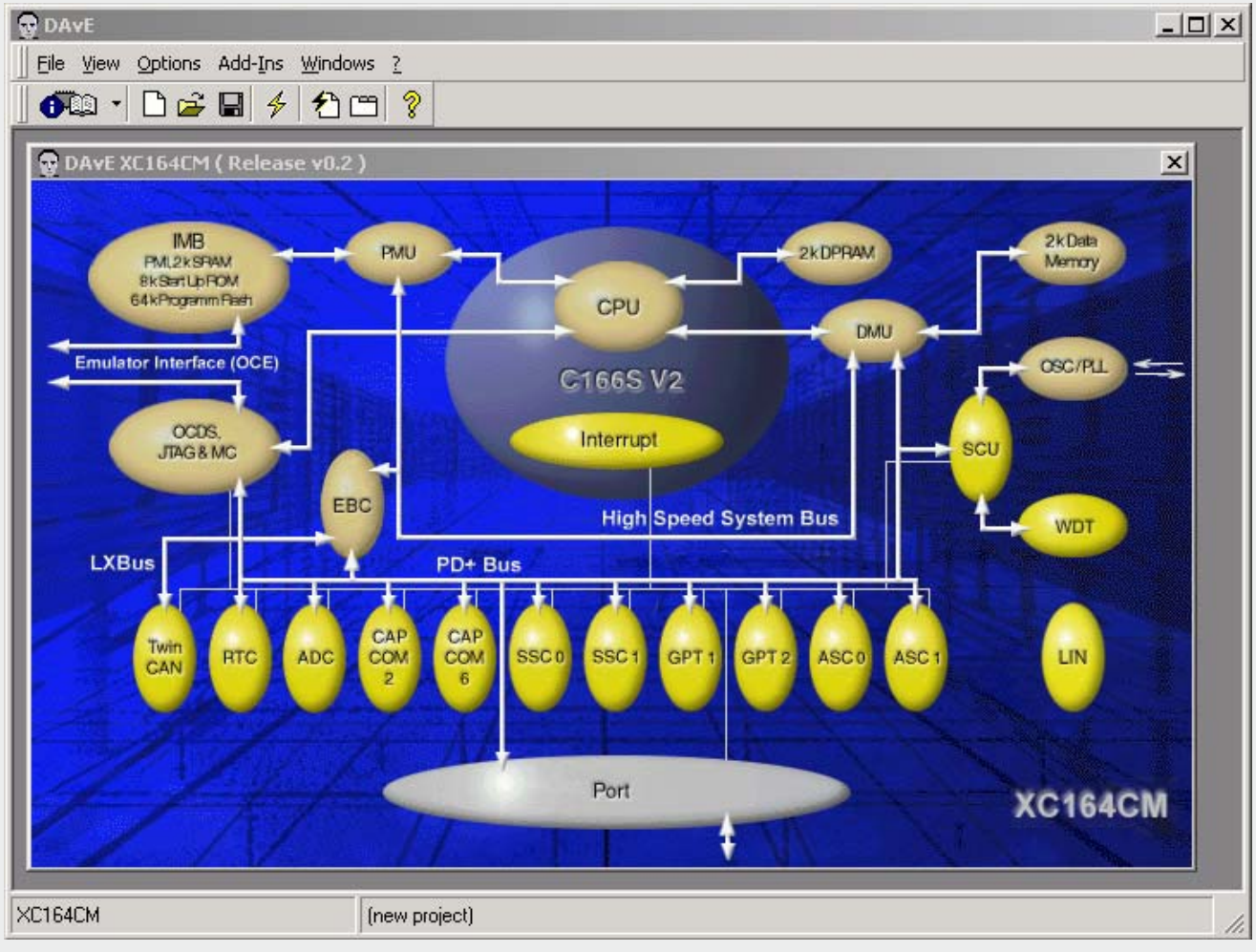
DAvE & XC164CM series

Infineon Technologies
DAvE – Digital Application virtual Engineer

- **DAvE now supports the XC164CM series !!**
  - DAvE let's you ….
    - Configure your system!
    - Auto-Generate your driver source
    - Fully supported by KEIL/TASKING Compiler technologies
  - DAvE is a "Expert Wizard", a tool for configuring your system and generating your initialisation code and will you up-to-speed in your development cycle
  - See www.infineon.com/dave

Is an Infineon Technologies Application Engineer Working for you? Meet DAvE.

DAvE & XC164CM series



Is an Infineon Technologies Application Engineer Working for you? Meet DAvE.

XC164CM Easy Kit
Board details

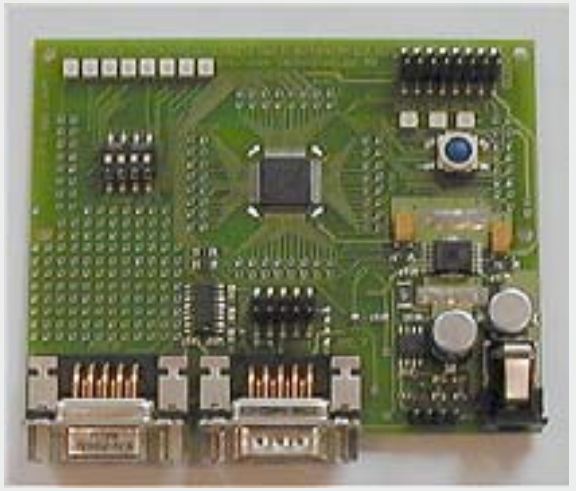
For the XC164CM series the Easy Kit is soldered only with the XC164CM.

- **Components:**
  - XC164CM
  - TLE 7469 (2.6V/5V)
  - TLE 6250 G (CAN)
  - TLE 7259 G (LIN)
  - 8 general purpose LED
- **Features**
  - JTAG interface
  - ASC boot loader
  - Easy access to all pins
  - Quick to configure
  - General purpose power supply input (9V/400mA)
  - Interface to power board BTS7960

XC164CM Easy Kit Package

USB Wiggler + Cable

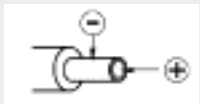
CD



Easy Kit Board

- **Online order: www.infineon.com/xc164cm**
- **Price: € 99**

Note: Additionally, you will need a DC power supply (7-12 Volts, min 400mA ensure correct polarity) which is **not** included in the Easy Kit!



XC164CM Easy Kit
CD content

- Getting Started to install the Software and execute the first Demo Project
- Compile/Debugger Demo Versions
  - Tasking Altium
  - Keil Software
  - Cosmic
- Development Tools
  - DAvE for all members of the XC164CM series
  - Memtool for Flash programming

- Demo Programs with a well structured guidance for a step by step setup with DAvE for Keil and Tasking Software
- Complete working projects for the Demo Programs
- All necessary Documentation to start **your** project (User Manuals, Data Sheets,…)

www.infineon.com

Never stop thinking