16-bit Microcontrollers

MICROCHIP

High-Performance PIC24 Microcontroller Family

www.microchip.com/16bit

The top challenges facing today's embedded system designer are attaining product specification and performance goals, achieving on-time market launch and meeting cost goals. Microchip's PIC24 16-bit Microcontroller Families deliver the performance, peripherals, software and hardware development tools and production support to reach these objectives.

Broad and Scalable Portfolio

- Two 16-bit PIC24 families
  – PIC24F, low-cost, 16 MIPS, mid-range performance
  – PIC24H, highest performance 16-bit MCU at 40 MIPS
- Introducing Peripheral Pin Selection (PPS), taking peripheral utilization to a new level
- 12 to 256 Kbytes of Flash program memory
- 1 to 16 Kbytes of RAM
- 18- to 100-pin package options

Real-Time Embedded Control

The PIC24 architecture was designed to meet the demanding needs of real-time control.

- Fast response to real-time events
  – Quick interrupt response, only 5 cycles
- Fast and easy bit manipulation – single cycle
- Single-cycle instruction execution
- Single-cycle hardware multiply
- 32/16 and 16/16 divide instructions

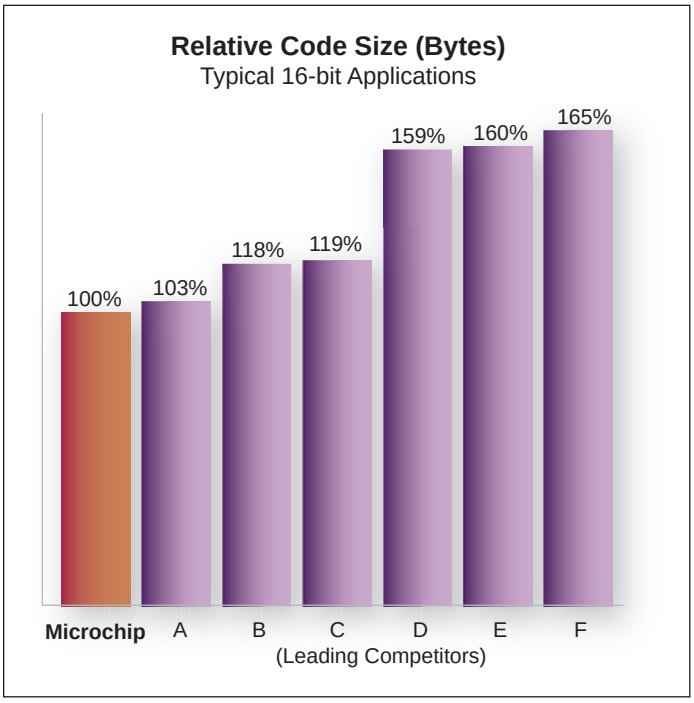
System Robustness and Management Features

- Flexible high-speed and low-power integrated oscillators with PLL eliminates need for external crystal
- Power-on Reset and fail-safe clock monitor
- nanoWatt Technology power management
- On-chip Low-Dropout Voltage Regulator (LDO)

Highly Efficient C Code Size

The PIC24 architecture and the MPLAB® C30 compiler are optimized to achieve small code size in embedded control applications.

- Selectable file level optimization for size or speed
- Keep your project on schedule and integrate those features that excite your customers
- Keep your code in the smallest device, reducing cost

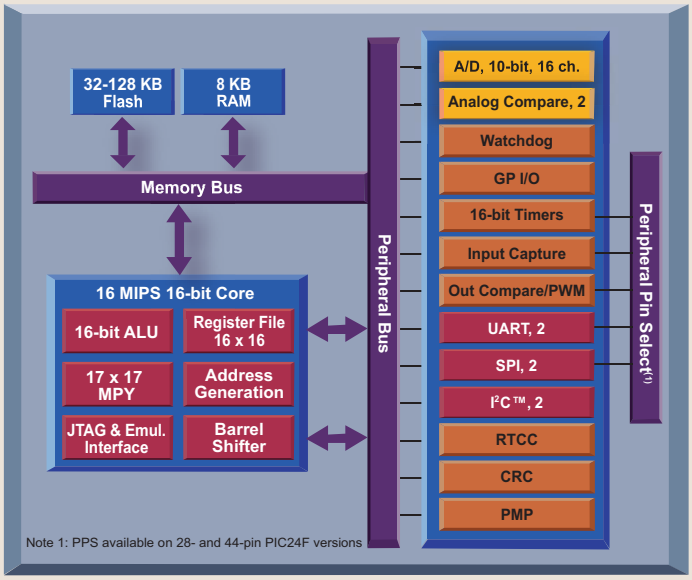


PIC24 16-bit Microcontrollers

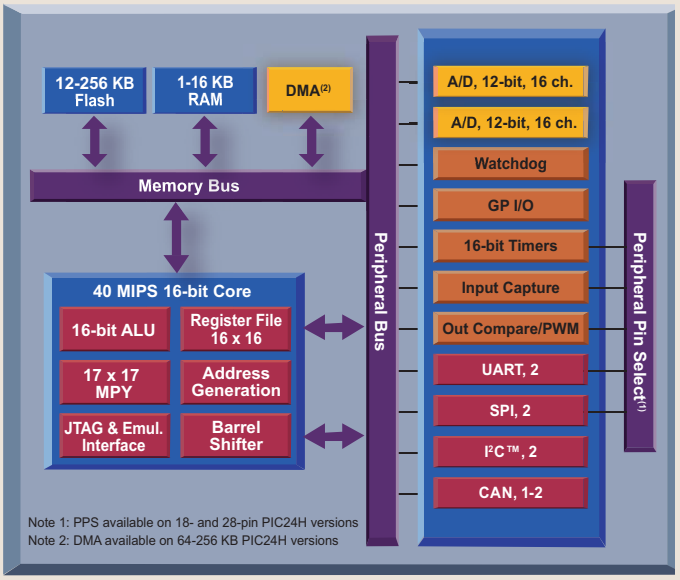
Pins	Flash Memory Kbytes	SRAM Kbytes	Timers 16-bit	Input Capture	Output Comp/ PWM	Analog	Communications Serial I/O	Additional Features
PIC24F Family – 16 MIPS, Lowest Cost, General Purpose								
28/44	32/64	8	5	5	5	10-bit (500 ksps), 10/13 ch. 2 comparators	UART w/IrDA® (2), SPI (2) I²C™ (2)	Peripheral Pin Select (PPS), JTAG, Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC
64/80/100	64/96/128	8	5	5	5	10-bit (500 ksps), 16 ch. 2 comparators	UART w/IrDA® (2), SPI (2) I²C (2)	JTAG, Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC
PIC24H Family – 40 MIPS, Highest Performance, General Purpose								
64/100	64/128/256	8/16	9	8	8	User selectable 12-bit A/D (500 ksps) or 10-bit A/D (1.1 Msps), 16 ch.	UART w/IrDA® (2), SPI (2) I²C™, CAN (0, 1, 2)	JTAG, 8 ch. DMA
18/28	12	1	3	4	2	User selectable 12-bit A/D (500 ksps) or 10-bit A/D (1.1 Msps), 16 ch. 8/10 ch.	UART (1), SPI (1) I²C™ (1)	Peripheral Pin Select (PPS), JTAG

Peripherals, Memory and Analog

PIC24F Block Diagram



PIC24H Block Diagram

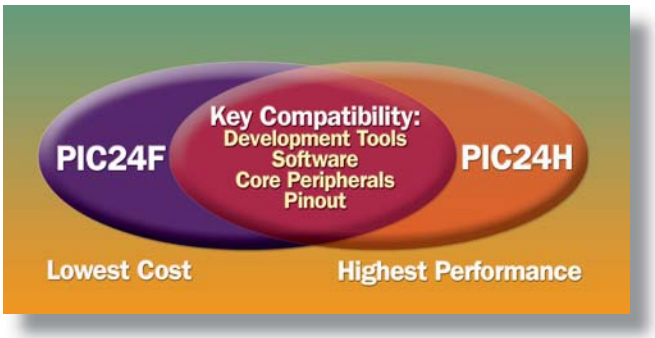


PIC24 Family Features

Memory	Key Features
Flash	Up to 256 KB self-programmable Flash with CodeGuard™ Security
RAM	Up to 16 KB static RAM
DMA	8 channel to internal peripherals with 2 KB dual port RAM
I/O Interface	**Key Features**
PMP	Parallel I/O module with multiple address and data options
PPS	Peripheral Pin Select maps user selected peripherals to I/O pins
Communications	**Key Features**
UART	Asynchronous channel supporting LIN, IrDA®, RS-232, RS-485 with 4-deep FIFO buffer
SPI	High-speed synchronous channel including 8-deep FIFO buffer
I²C™	Support Multi-Master/Slave mode with 7-bit/10-bit addressing
CAN with buffer, filters	Automotive/Industrial standard, includes 8 transit and 32 receive buffers
CRC	Programmable Cyclic Redundancy Check peripheral

Timers/Control	Key Features
16-bit timers, cascadable to 32-bit	Cascadable to 32-bit, up/down, with multiple clock sources including a low-power 32 kHz oscillator, trigger for A/D conversion
Input Capture (IC)	The highly configurable Input Capture, Output Compare and PWM modules are easily configured with the Timer modules to generate waveforms and monitor external events
Output Compare (OC)	
Pulse Width Modulation (PWM)	
Watchdog Timer (WDT)	On-chip low-power RC oscillator, post-scaler for wide range of time-out values
Real-Time Clock Calendar (RTCC)	Hardware module provides 100-year calendar, clock and alarm functions
Analog	**Key Features**
10/12-bit A/D converter	Up to 32 channels on PIC24H
10-bit A/D converter	Up to 16 channels on PIC24F
Comparators	With on-chip programmable reference voltage
Integrated Voltage Regulator with Power-on Reset and Brown-out Reset	Power-on Reset and Brown-out Reset provide stable system operation

16-bit Microcontroller Migration



Microchip's two 16-bit families, PIC24 MCUs and dsPIC® DSCs are the only truly compatible MCU and DSP architecture in the industry. You can migrate from low-cost PIC24F MCUs to 40 MIP PIC24H MCUs to dsPIC33F DSCs, while preserving your code base, development tool investment and engineering know-how.

Accelerate Time-to-Market with Training, Software Libraries and Development Tools

Training

Expand your knowledge with Microchip's online web seminars and hands-on courses at our worldwide Regional Training Centers (RTCs). Our seminars and training classes are designed to fit your schedule and offer an overview of many product, development tool and application topics. Visit www.microchip.com/training for class content and schedules.

Class Examples

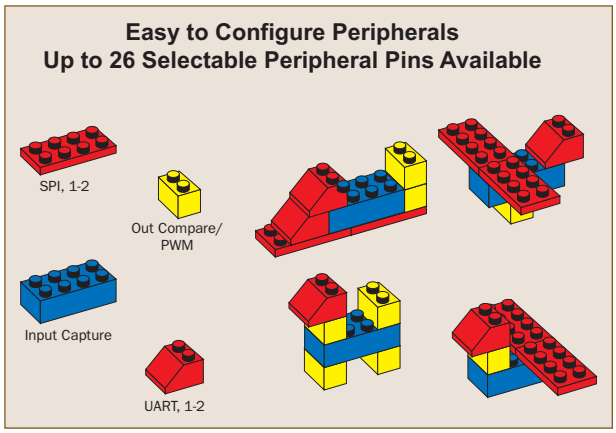
101 TLS: ***Getting Started with Microchip Tools, MPLAB® IDE, MPLAB® SIM Simulator and MPLAB® ICD 2***

This hands-on class covers the basics of getting started with Microchip tools. Hands-on exercises are conducted using the MPLAB IDE and the MPLAB SIM simulator. Attendees create a project, edit and compile a program, as well as run and simulate a program. Attendees leave with a basic knowledge of how to use Microchip tools.

103 ASP: ***Getting Started with 16-bit Microcontroller Architecture, Instruction Set and Assembly Programming***

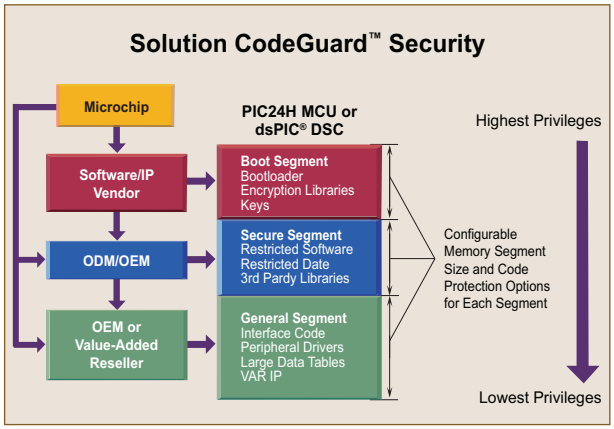
This hands-on class covers the fundamentals of the microcontroller architecture and instruction set of the Microchip's 16-bit families. Attendees leave with knowledge of the PIC24 MCU product family.

Peripheral Pin Select (PPS), Unravels I/O Multiplexing



With Peripheral Pin Select (PPS), you determine the peripheral-to-pin map select digital peripherals. This highly flexible capability is introduced on the PIC24FJ64 and PIC24HJ12 families. The PPS is easy to configure and is fully supported by MPLAB® Visual Device Initializer (VDI). Peripherals are "drag-and-drop", while VDI displays your progress, provides error checking and generates configuration code.

CodeGuard™ Security



Many 16-bit PIC24H MCUs feature CodeGuard Security, which enables multiple parties to more securely share on-chip resources such as memory, interrupts and peripherals. CodeGuard Security can also increase security during program distribution and Flash memory update. With CodeGuard Security, multiple microcontroller systems can be consolidated while compartmentalizing intellectual property, achieving overall cost and size reduction and boosting system security.

Third-Party Tools and Software

Microchip and many of our third-party partners offer development tools, software libraries and application hardware support to enable many industry standard functions.

PIC24 Resource Guide	
Application Software Libraries and Hardware Support – see www.microchip.com/libraries for additional support	
TCP/IP	Microchip's free TCP/IP stack enables connection to the internet on the Microchip 8- and 16-bit products along with the Ethernet PICtail™ Plus Daughter Card (AC164123)
FAT16 File System	Microchip's free FAT16 File System enables 8- and 16-bit Microchip products to utilize standard Flash media cards along with the SD/MMC PICtail™ Plus Daughter Card (AC164122)
IrDA® Stack	Microchip's free IrDA® stack allows 16-bit Microchip products to communicate using IrDA® protocol (www.microchip.com/libraries)
CANbedded	CAN driver for dsPIC® DSC and PIC24H devices (www.vector-informatik.com)
Third-Party Tool Support – see www.microchip.com/thirdparty for additional support	
BPM Microsystems®	Flash memory programmers (www.bpmicrosystems.com)
CCS	Provides complete tool chains including integrated development environment, in-circuit debugger and C compiler (www.ccsinfo.com)
CMX Systems, Inc.	CMX-Scheduler™, CMX-TINY+™, CMX-RTX™ RTOS, file systems and CMX-TCP/IP™ software (www.cmx.com)
Data I/O	Flash memory programmers (www.dataio.com)
FreeRTOS™	Portable, open source, mini real-time kernel (www.freertos.org)
HI-TECH Software	Provides integrated development environment and C compilers (www.htsoft.com)
Micriμm	Provides μC/OS-II RTOS (www.micrium.com)
SEGGER	Provides embOS RTOS and emWIN, a graphical user interface (www.segger.com)

Hardware and Software Development Tools To Jump-Start Your Design

A variety of hardware and software development tools are available for the PIC24 family of microcontrollers, enabling you to shorten your design cycle.

Explorer 16 Starter Kit (DV164033)

- One-stop tool set for application development using 16-bit PIC24F and PIC24H microcontrollers and dsPIC33 digital signal controllers
- Includes MPLAB® ICD 2 In-Circuit Debugger, Explorer 16 Development Board, 9V universal power supply and serial cable
- MPLAB Integrated Development Environment (IDE) and "Student Edition" of MPLAB C30 C Compiler, with tutorials and user manuals on CD-ROM

Explorer 16 Development Board (DM240001)

- Cost-effective development board for Microchip's 16-bit products
- PIC24FJ128GA010 and dsPIC33FJ256GP710 devices included
- Alpha-numeric 16x2 LCD display
- MPLAB ICD 2 debug connector
- USB and RS-232 interfaces
- Microchip's TC1047A high accuracy, analog output temperature sensor
- Expansion connector accesses full device pinout and bread board prototyping area.
- PICtail™ Plus connector for future expansion boards
- Full documentation includes user guides, schematics and PCB layout on CD-ROM

MPLAB® ICD 2 In-Circuit Debugger (DV164007)

- Real-time debugging with watch points, breakpoints, variable watch/modify, single stepping from MPLAB C30 Compiler, integrated into MPLAB IDE
- Firmware upgradable from PC
- Supports low voltage to 2.0 volts
- Reading/programming Flash memory space
- USB (full speed) and RS-232 interface to PC
- 9V power supply (AC162039)

MPLAB REAL ICE™ In-Circuit Emulation Kit (DV244005)

The MPLAB REAL ICE In-Circuit Emulator is Microchip's next-generation emulation and debugging system. This tool provides a powerful in-circuit emulation platform for easy and rapid application development and debugging.

- Up to 6 hardware breakpoints
- Up to 1,000 software breakpoints
- User-controlled program memory trace/data memory log
- High-speed USB 2.0 PC interface
- In-Circuit Serial Programming™ (ICSP™) interface or Low Voltage Differential Signaling (LVDS) (add-on option)
- Run, Halt and Single-Step modes
- Logic probe
- Stopwatch

Common Development Environment

Microchip's MPLAB® IDE serves as the single, unified graphical user interface for Microchip and third-party software and hardware development tools. Whether you're designing with the smallest 8-bit PIC® MCU, or a high-performance 16-bit PIC24 microcontroller, both share this common development environment.

FREE MPLAB® Integrated Development Environment (SW007002) – Free Download

- Programmer's editor with color-coded context highlighting, code folding/browsing fully integrated with the debugger
- Graphical project manager
- Full-featured debugger with watch points, mouse-over variable inspection and immediate editor access at breakpoints and single stepping
- MPLAB SIM high-speed software simulator with complex stimulus control
- Visual Device Initializer (VDI) tool generates initialization code with an easy graphical dialog for setting up complex peripherals
- Powerful plug-ins for data monitor and control, motor control, RTOS viewer and others

MPLAB® C30 C Compiler (SW006012)

- Full-featured ANSI-compatible compiler including libraries, and all components of the full version
- Completely integrated with MPLAB IDE
- Selectable file level optimization for size or speed
- MPLAB ASM30 assembler, MPLAB LINK30 and utilities to support Microchip 16-bit MCUs
- Peripheral driver libraries reduce design time
- FREE Free "Student Edition" download available

Support

Microchip is committed to supporting its customers in developing products faster and more efficiently. We maintain a worldwide network of field applications engineers and technical support ready to provide product and system assistance. In addition, the following service areas are available at www.microchip.com:

- **Support** link provides a way to get questions answered fast: **http://support.microchip.com**
- **Sample** link offers free evaluation samples of any Microchip device: **http://sample.microchip.com**
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