



PIC24 Microcontroller Family

PIC24H High Performance

PIC24F Low Power

The diagram illustrates the PIC24 Microcontroller Family. On the left, a vertical axis labeled 'Performance' shows a progression of PIC models: PIC10, PIC12, PIC16, PIC18, PIC24F, PIC24H, dsPIC30, dsPIC33, and PIC32. A yellow arrow points from the lower models towards the upper ones. The PIC24F is highlighted in red, and the PIC24H is highlighted in blue. The PIC24H is shown in a larger, detailed view in the center, with the Microchip logo and 'MICROCHIP PIC24' printed on it. To the right, a detailed block diagram of the PIC24H core and peripherals is shown. The core includes a 16 MIPS 16-bit Core, 16-bit ALU, 17 x 17 MPY, JTAG & Emul. Interface, Register File (16 x 16), Address Generation, and Barrel Shifter. The memory section includes 16-256 KB Flash and 4-16 KB RAM, connected via a Memory Bus. The peripheral section includes USB On-the-Go, CTMU, ADC 10-bit, 16 ch., Analog Comp., 2-3, Watchdog, GP I/O, 16-bit Timers, Input Capture, Out Comp./PWM, UART, 2-4, SPI, 2-3, I2C™, 2-3, RTCC, PMP, and CRC. A Peripheral Pin Select is also indicated.

16-256 KB Flash

4-16 KB RAM

Memory Bus

16 MIPS 16-bit Core

16-bit ALU

17 x 17 MPY

JTAG & Emul. Interface

Register File 16 x 16

Address Generation

Barrel Shifter

Peripheral Pin Select

USB On-the-Go

CTMU

ADC 10-bit, 16 ch.

Analog Comp., 2-3

Watchdog

GP I/O

16-bit Timers

Input Capture

Out Comp./PWM

UART, 2-4

SPI, 2-3

I2C™, 2-3

RTCC

PMP

CRC

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 power, 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.

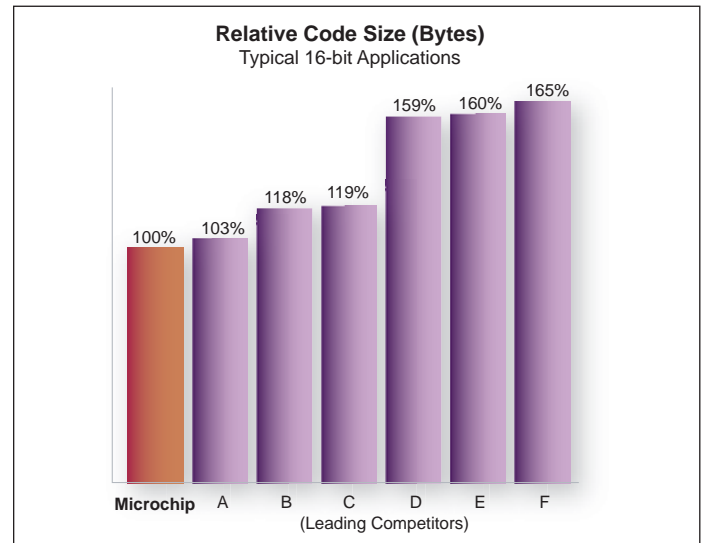
- Fast response to real-time events
 - Quick interrupt response, only 5 cycles
- Fast and easy bit manipulation – single cycle
- Single-cycle instruction execution
- Single-cycle hardware multiply

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® C compiler are optimized to achieve small code size in embedded control applications.



What's New!

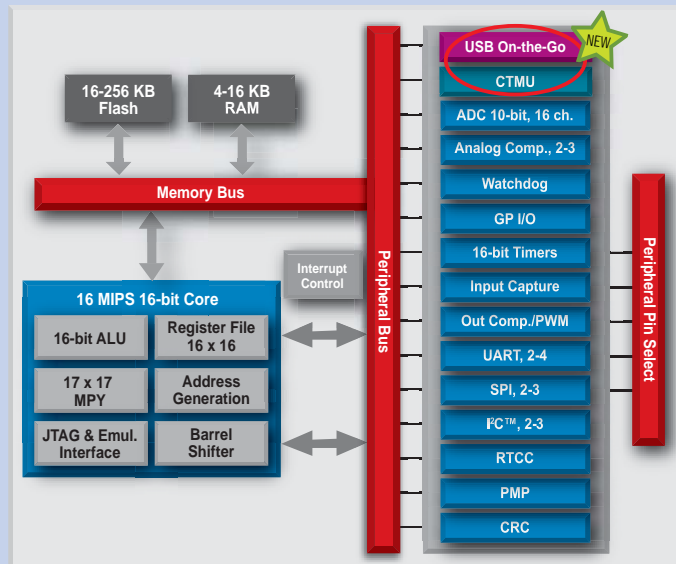
- Free Graphics Library for graphics displays with touch screen
- USB-OTG peripheral added to 16-bit products
- Charge Time Measurement Unit added to implement Capacitive Touch Sense keypads
- 28-pin MCUs with 128 KB of Flash

PIC24 16-bit Microcontrollers

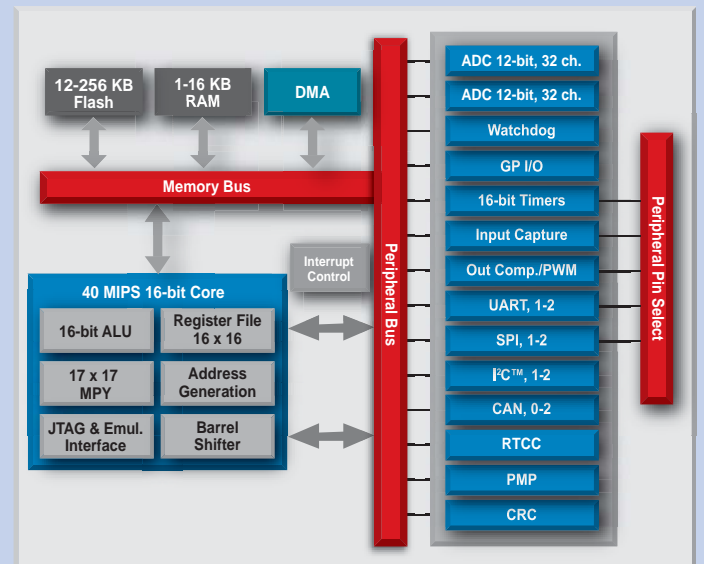
Pins	Flash Memory Kbytes	SRAM Kbytes	Timers 16-bit	Input Capture	Output Comp/ PWM	Analog	Communications Serial I/O	Additional Features
PIC24F Family – 16 MIPS, Lowest Cost, Lowest Power, General Purpose								
28/44	16/32/48/64	4/8	5	5	5	10-bit ADC (500 ksp/s), 10/13 ch. 2 comparators	UART w/IrDA® (2), SPI (2) I²C™ (2)	Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG
64/80/100	64/96/128/192/256	8/16	5	5/9	5/9	10-bit ADC (500 ksp/s), 16 ch. 2/3 comparators, CTMU (0/1)	UART w/IrDA (2/4), SPI (2/3) I²C (2/3)	Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG
64/80/100	64/128/192/256	16	5	9	9	10-bit ADC (500 ksp/s), 16 ch. 3 comparators, CTMU	USB-OTG , UART w/IrDA (4), SPI (3) I²C (3)	Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG
PIC24H Family – 40 MIPS, Highest Performance, General Purpose								
18/28/44	12/16/32/64/128	1/2/4/8	3/5	4	2/4	User selectable 12-bit ADC (500 ksp/s) or 10-bit ADC (1.1 Msp/s), 8/10/16 ch.	UART w/IrDA (1/2), SPI (1/2), I²C (1/2), CAN (0/1)	8 ch. DMA, Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG
64/100	64/128/256	8/16	9	8	8	User selectable 12-bit ADC (500 ksp/s) or 10-bit ADC (1.1 Msp/s), 18/32 ch.	UART w/IrDA (2), SPI (2) I²C (2), CAN (0/1/2)	8 ch. DMA, 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	Up to 8 channels between internal peripherals and up to 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
USB-OTG	USB Standard now available and targeted for embedded control with application notes supporting Embedded Host, Peripheral and OTG
UART	Asynchronous channel supporting LIN, IrDA*, RS-232, RS-485 with 4-deep FIFO buffer or DMA
SPI	High-speed synchronous channel including 8-deep FIFO buffer or DMA
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
Charge Time Measurement Unit (CTMU)	A constant current source coupled with the ADC to provide the ability to measure capacitance or time with ns resolution. CTMU makes it easy to implement a capacitive touch sense keypad.
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

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

Training

Expand your knowledge with Microchip's on-line 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 In-Circuit Debugger*

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 for selected digital peripherals. This highly flexible capability is available on many of the PIC24 devices. 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.

Charge Time Measurement Unit (CTMU)











The Charge Time Measurement Unit is a versatile peripheral that can be used to implement a capacitive touch-sense keypad, or to implement a timer or pulse delay with ns resolution. The CTMU includes dedicated hardware that is combined with the device's A/D to easily implement capacitive touch sense keypad matrix with a minimum of processor overhead.

USB On-the-Go

The PIC24 product line now offers products that include USB-OTG. The USB-OTG allows a product to be used as either an embedded host, a peripheral, or to negotiate to perform as either an embedded host or peripheral. USB can now be implemented in your 16-bit system, making it practical for your embedded system and computer to share many of the same peripherals.

PIC24 Resource Guide

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

Application Notes & Software Libraries and Hardware Support – see www.microchip.com for additional support		App Note/ Libraries	PICtail™ Plus
 Graphics	Microchip Graphics library enables 16- and 32-bit products to design and run GUI interfaces on a color graphics displays.	Yes	AC164127
 USB	Microchip's USB application notes enable our USB equipped 16- and 32-bit products for connection as an embedded host, peripheral or an OTG in many USB connected systems.	Yes	AC164131
 ZigBee	Microchip's ZigBee™ stack enables our 8-bit and 16-bit controller for connection to a ZigBee wireless network.	Yes	AC163027-4
 MiWi	Microchip's MiWi™ wireless stack enables our 8- and 16-bit products with a light wireless networking protocol.	Yes	AC163027-4
 TCP/IP	Microchip's TCP/IP stack enables connection to the internet on the Microchip 8-, 16- and 32-bit products.	Yes	AC164123
 File Systems	Microchip's Memory Disk Drive (FAT 16) and FAT 32 File Systems enable 8-, 16- and 32-bit Microchip products to utilize standard Flash media cards.	Yes	AC164122
 Speech Playback	Microchip's speech solutions enable our 8- and 16-bit products for speech playback.	Yes	AC164125
 IrDA® Stack	Microchip's IrDA® stack allows 16-bit Microchip products to communicate using IrDA® protocol.	Yes	AC164124
 EEPROM Emulation	Microchip EEPROM Emulation application note allows a user to utilize program Flash as data EEPROM.	Yes	–
 Bootloaders	Microchip bootloaders allow for field software upgrades and are available to support all 16-bit products.	Yes	–
Encryption	Microchip provides a variety of encryption algorithms. Triple DES and AES algorithms are enabled on 8- and 16-bit controllers for as little as a \$5 handling fee.	Yes	–
Third-Party Tool Support – see www.microchip.com/thirdparty for additional support			

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. The development and evaluation tool chain provide easy migration between PIC24 Families as well as dsPIC for DSC application.

Explorer 16 Development Board (DM240001/2)



- Cost-effective development board for Microchip's 16-bit products
- Includes PIC24FJ128GA010 and dsPIC33FJ256GP710 or the PIC24FJ64GA004
- 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.
- Full documentation includes user guides, schematics and PCB layout on CD-ROM
- PICtail™ Plus connector for future expansion boards

Explorer 16 Starter Kit (DV164033)

- One-stop tool set for application development using the Explorer 16 board
- Includes MPLAB® ICD 2 In-Circuit Debugger, Explorer 16 Development Board, 9V universal power supply and a serial cable
- MPLAB Integrated Development Environment (IDE) and a "Student Edition" of MPLAB C Compiler for PIC24 MCUs and dsPIC DSCs

PICtail™ Plus Daughter Cards

PICtail Plus Daughter cards are designed to plug into the expansion connections on the Explorer 16 to create a low cost development and evaluation platform for complex application. When combined with application notes and free source code they make an ideal platform proof of concept development.

- Graphics PICtail Plus Daughter Card (AC164127)
- USB PICtail Plus Daughter Card (AC164131)
- Wireless PICtail Plus Daughter Card (AC163027-4)
- Ethernet PICtail Plus Daughter Card (AC164123)
- SD/MMC PICtail Plus Daughter Card (AC164122)
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- IrDA® Standard PICtail Plus Daughter Card (AC164124)
- Motor Control PICtail Plus Daughter Card (AC164128)
- Prototyping PICtail Plus Daughter Card (AC164126)

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, a high-performance 16-bit PIC24 microcontroller or our 32-bit PIC32 microcontrollers, all share this common development environment.



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® C Compiler for PIC24 MCUs and dsPIC DSCs (SW006012)

- Full-featured ANSI-compatible compiler
- Completely integrated with MPLAB IDE
- Selectable file level optimization for size or speed
- Peripheral driver and math libraries reduce design time



- Free "Student Edition" download available

MPLAB REAL ICE™

In-Circuit Emulation Kit (DV244005)



The MPLAB REAL ICE In-Circuit Emulator is Microchip's next-generation emulation and debugging system 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

MPLAB® ICD 2 In-Circuit Debugger (DV164007)



- Real-time debugging with watch points, breakpoints, variable watch/modify, single stepping from MPLAB C Compilers, integrated into MPLAB IDE
- Reading/programming Flash memory space
- USB (full speed) and RS-232 interface to PC

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>
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