MICROCHIP

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 power, 16 MIPS, mid-range performance
  - PIC24H, highest performance 16-bit MCU at 40 MIPS
- Peripheral Pin Select (PPS), allows flexible peripheral pin mapping
- 4 to 256 Kbytes of Flash program memory
- 0.5 to 16 Kbytes of RAM
- 14- to 100-pin package options

Real-Time Embedded Control

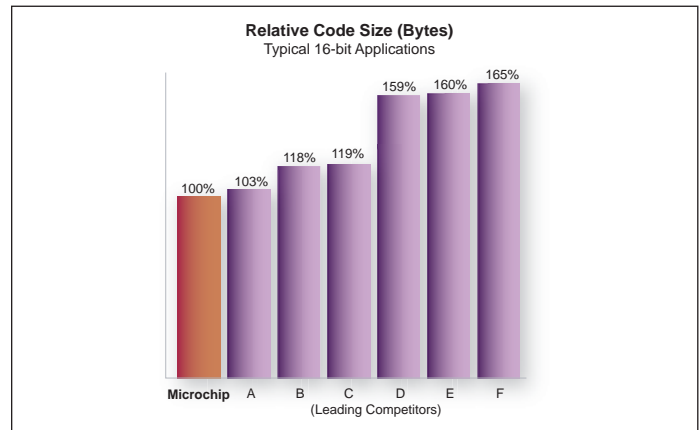The PIC24 architecture was designed to meet the demanding needs of real-time control.

- 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 XLP 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.

Relative Code Size (Bytes)
Typical 16-bit Applications

| Microchip | A | B | C | D | E | F |
| 100% | 103% | 118% | 119% | 159% | 160% | 165% |

(Leading Competitors)

What's New!

- nanoWatt XLP technology adds Deep Sleep for currents as low as 20 nA
- USB-OTG peripheral available on 28- to 100-pin products
- Data EEPROM available on select products
- Charge Time Measurement Unit added to implement Capacitive Touch Sense keypads
- Extended temperature products

PIC24 16-bit Microcontrollers

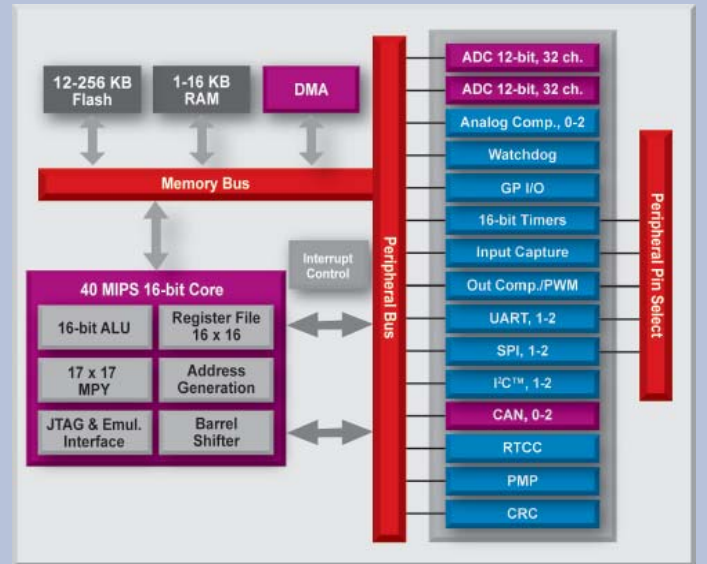| Pins	Flash Memory Kbytes	SRAM Kbytes	Timers 16-bit	Input Capture	Output Comp/PWM	Analog	Communications Serial I/O	Additional Features
PIC24F Family – 16 MIPS, Lowest Cost, Lowest Power, General Purpose								
14/18/20/28	4/8/16	0.5/1.5	3	1	1	10-bit ADC (500 ksps), 7/9 ch. 2 comparators	UART w/IrDA® (2), SPI, I²C™	Real-Time Clock Calendar (RTCC), CTMU, EEPROM, Deep Sleep (DS)
28/44	16/32/48/64	4/8	5	5	5	10-bit ADC (500 ksps), 10/13 ch. 2 comparators	UART w/IrDA (2), SPI (2) I²C (2), USB-OTG*	Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG, Deep Sleep (DS)*
64/80/100	64/96/128/ 192/256	8/16	5	5/9	5/9	10-bit ADC (500 ksps), 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 ksps), 16 ch. 3 comparators, CTMU	UART w/IrDA (4), SPI (3) I²C (3) USB-OTG,	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 ksps) or 10-bit ADC (1.1 Msps), 8/10/16 ch., comparators (0/2)	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 ksps) or 10-bit ADC (1.1 Msps), 18/32 ch., comparators (0/2)	UART w/IrDA (2), SPI (2) I²C (2), CAN (0/1/2)	8 ch. DMA, JTAG

* Contact Microchip for availability.

Peripherals, Memory and Analog

PIC24F Block Diagram
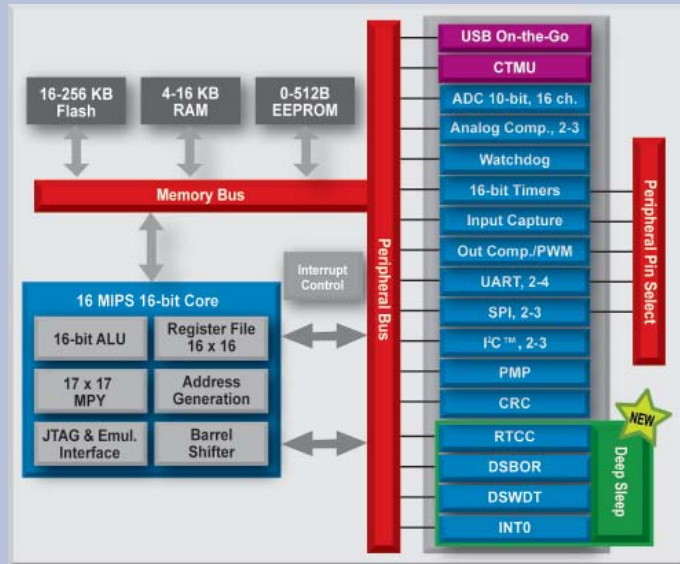
PIC24H Block Diagram

PIC24 Family Features

Memory	Key Features
Flash	Up to 256 KB self-programmable Flash with 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

MCU 3122: *Extended PIC24/dsPIC Peripheral Configuration and Usage Using the C30 C Compiler*
This class covers the extended peripheral set of Microchip's PIC24 microcontroller and dsPIC® digital signal controller families. Using hands-on exercises and the C30 compiler, students become familiar programming Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real Time Clock Calendar (RTCC), Cyclic Redundancy Code (CRC) and DMA modules.

COM 3202: *Designing a USB Embedded Host Application*
The USB On-The-Go (OTG) Supplement was designed to allow embedded devices with substantially less resources than a PC to become hosts to other USB devices. Attendees will learn about USB hosting options, using a FAT file system library to manipulate files on a thumb drive, a process for developing a generic (custom class) driver and an application that acts as a host to a simple USB device.

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.

nanoWatt XLP Technology

Many of today's designs are targeted for battery powered or low standby power applications. Products featuring nanoWatt XLP bring advanced low power design techniques and Deep Sleep operating mode to 16-bit controllers, giving sleep currents as low as 20 nA. The Deep Sleep operating mode supports wake-up from a number of sources including RTCC capability with currents as low as 500 nA.

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		PICtail™ Plus
FREE Libraries	Class B Safety Software Library for PIC MCUs and dsPIC DSCs.	–
FREE Graphics	Microchip Graphics library enables 16- and 32-bit products to design and run GUI interfaces on a color graphics displays.	AC164127
FREE 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.	AC164131
FREE ZigBee®	Microchip's ZigBee 2006 stack enables our 8-bit and 16-bit controller for connection to a ZigBee wireless network. ZigBee PRO also available.	AC163027-4
FREE MiWi™ & MiWi P2P	Microchip's MiWi wireless stack enables our 8, 16- and 32-bit products with a light wireless networking protocol.	AC163027-4
FREE TCP/IP	Microchip's TCP/IP stacks enable connection to the internet on the Microchip 8-, 16- and 32-bit products.	AC164123
FREE 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.	AC164122
FREE Speech Playback	Microchip's speech solutions enable our 8- and 16-bit products for speech playback.	AC164125
FREE IrDA® Stack	Microchip's IrDA stack allows 16-bit Microchip products to communicate using IrDA protocol.	AC164124
FREE EEPROM Emulation	Microchip EEPROM Emulation application note allows a user to utilize program Flash as data EEPROM.	–
FREE Bootloaders	Microchip bootloaders allow for field software upgrades and are available to support all 16-bit products.	–
Encryption	Mircochip 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.	–
Third-Party Tool Support – see www.microchip.com/thirdparty for additional support		

www.microchip.com/16bit

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 provides easy migration between PIC24 families and dsPIC DSC applications.

PIC24F Starter Kit (DM240011)

- Easy and inexpensive way to learn the PIC24F 16-bit MCU family
- Starter kit features the PIC24FJ256GB110 MCU with 256KB Flash
- Peripherals including CTMU for capacitive touch and USB-OTG
- USB powered with an integrated debugger/programmer
- CD contains MPLAB IDE with full editor, programmer and debugger; MPLAB C Compiler; code examples and user's guide

PIC24H Starter Kit (DM240021)

- Everything needed to begin using the PIC24H using an interactive, menu-driven OLED display and Microchip's Free Graphics library
- Low cost speech play back of G.711 compressed speech
- USB powered with an integrated debugger/programmer
- Tri-axial analog accelerometer, on-board speaker, switches for application utility
- Differential input with analog conditioning circuitry to plug in a wide range of external sensors
- 40 MIPS PIC24H128GP504 MCU with 128 KB Flash and 8 KB RAM
- CD contains MPLAB IDE with full editor, programmer and debugger; MPLAB C Compiler; code examples and user's guide

Explorer 16 Development Board (DM240001/2)

- Cost-effective development board for Microchip's 16-bit products
- Includes PIC24FJ128GA010 and dsPIC33FJ256GP710 or 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
- PICtail™ Plus connector for future expansion boards

PICtail™ Plus Daughter Cards (www.microchip.com/pictailplus)

PICtail Plus Daughter cards are designed to plug into the expansion connections on the Explorer 16 board.

- Graphics (AC164127)
- USB (AC164131)
- Wireless (AC163027-4)
- Ethernet (AC164123)
- SD/MMC (AC164122)
- Speech Playback (AC164125)
- IrDA® Standard (AC164124)
- Motor Control (AC164128)
- Prototyping (AC164126)
- ECAN/LIN (AC164130)

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
- Powerful plug-ins for data monitor and control, motor control, RTOS viewer and others

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 "Evaluation Version" 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 3 In-Circuit Debugger (DV164035)

- Real-time debugging with watch points, breakpoints, variable watch/modify, single stepping from MPLAB C Compilers, integrated into MPLAB IDE
- High-speed programming
- USB high-speed 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
- **Sample** link offers evaluation samples of any Microchip device: http://sample.microchip.com
- **Forum** link provides access to knowledge base and peer help: http://forum.microchip.com
- **Buy** link provides locations of Microchip Sales Channel Partners: www.microchip.com/sales

Training

If additional training interests you, then Microchip can help. We continue to expand our technical training options, offering a growing list of courses and in-depth curriculum locally, as well as significant online resources – whenever you want to use them.

- Regional Training Centers: www.microchip.com/rtc
- MASTERs Conferences: www.microchip.com/masters
- Worldwide Seminars: www.microchip.com/seminars
- eLearning: www.microchip.com/webseminars
- Resources from our Distribution and Third Party Partners www.microchip.com/training

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