



PIC24 Microcontroller Family

Performance, Low Power, Advanced Peripherals

Up to 60 MIPS

12-bit ADC

Graphics Controller

nanoWatt XLP

High Performance DMA

CAN

USB-OTG

High-Temperature

**MPLAB® IDE
Common Development Platform**

32-bit PIC32

dsPIC DSCs

16-bit PIC24E, PIC24H, PIC24F

8-bit PIC18, PIC16, PIC12, PIC10

Functionality

Performance

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

- Three 16-bit PIC24 families
 - PIC24F, low power, 16 MIPS, mid-range performance
 - PIC24H, high performance 16-bit MCU at 40 MIPS
 - PIC24E, highest performance 16-bit MCU at 60 MIPS
- 4 to 512 Kbytes of Flash program memory
- 0.5 to 96 Kbytes of RAM
- 14- to 144-pin package options

Real-Time Embedded Control

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

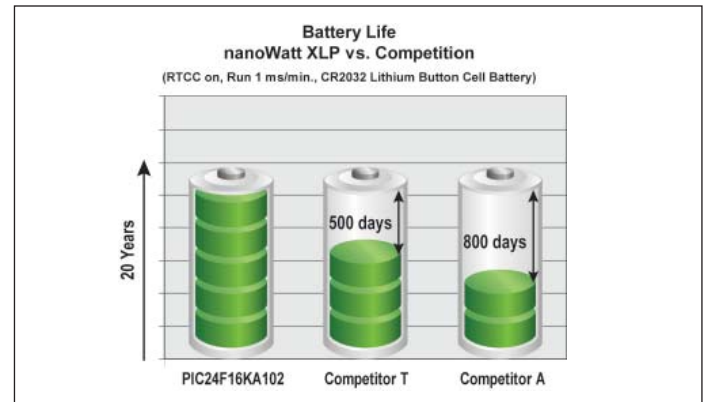
- Fast response to real-time events
 - Quick interrupt response, only 5 cycles
- Single-cycle bit manipulation
- Single-cycle instruction execution
- Single-cycle hardware multiply
- Optimized architecture for C Code

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)

nanoWatt XLP eXtreme Low Power

Products with Microchip's nanoWatt XLP Technology offer the industry's lowest Sleep currents, adding years to the life of today's low power and battery operated applications.

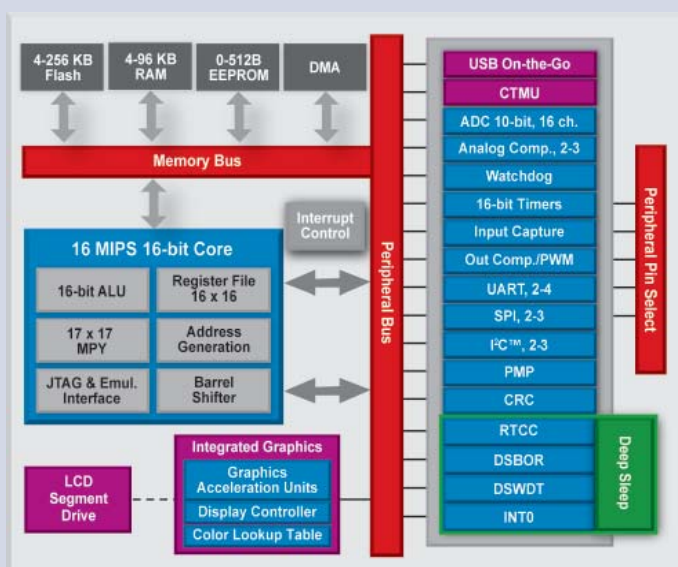


What's New!

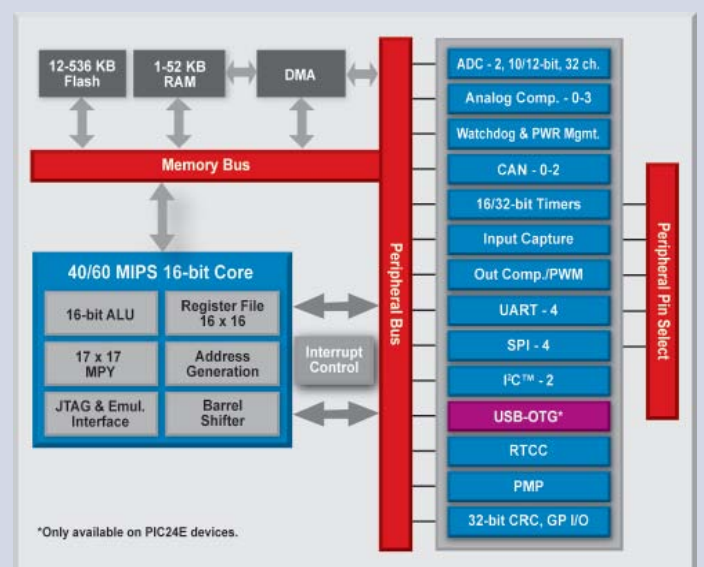
- High performance PIC24E core at 60 MIPS with enhanced and new peripherals
- Graphics controller with graphics acceleration and color look-up table to drive a color display
- nanoWatt XLP technology with Sleep currents as low as 20 nA
- USB-OTG peripheral available on 28- to 100-pin products
- PIC24H high-temperature (150°C) products

Peripherals, Memory and Analog



PIC24F Block Diagram



PIC24H/E Block Diagram



PIC24 16-bit Microcontrollers

Family	Pins	Flash Memory Kbytes	SRAM Kbytes	16-bit Timers Input Capture Output Compare	Analog	Communications Serial I/O	Additional Features
PIC24F Family – 16 MIPS, Lowest Cost, Lowest Power, General Purpose							
 PIC24F K Families	14-48	4-32	0.5-2	3-5 Timers 1-3 IC 1-3 OC	10-bit ADC (500 ksps) or 10/12-bit ADC (200/100 ksps), 7-16 ch., 3 comparators	UART w/IrDA® (2), SPI (1/2), I²C™ (1/2)	EEPROM, CTMU, RTCC, Deep Sleep
 PIC24F G Families	28-100	16-256	4-96	5 Timers 5-9 IC 5-9 OC	10-bit ADC (500 ksps) or 10/12-bit ADC (200/100 ksps), 9-24 ch., 2/3 comparators, CTMU (0/1)	UART w/IrDA (2/4), SPI (2/3), I²C (2/3), USB-OTG	LCD, DMA, PPS, PMP, RTCC, CRC, Deep Sleep, JTAG
PIC24F D Families	64-100	128-256	24-96	5 Timers 9 IC 9 OC	10-bit ADC (500 ksps), 16-24 ch., 3 comparators, CTMU	UART w/IrDA (4), SPI (3), I²C (3), USB-OTG	Graphics Display Controller PPS, PMP, RTCC, CRC, JTAG
PIC24H Family – 40 MIPS, High Performance, General Purpose							
PIC24H GP Families	18-100	12-256	1-16	3-9 Timers 4-8 IC 2-8 OC	User selectable 12-bit ADC (500 ksps) or 10-bit ADC (1.1 Msps), 8-32 ch., (0/2)	UART w/IrDA (1-2), SPI (1-2), I²C (1-2), CAN (0-2)	8 ch. DMA, PPS, PMP, RTCC, CRC, JTAG, High Temperature (150°C) Options
PIC24E Family – 60 MIPS, High Performance, General Purpose							
PIC24E GP Family	100-144	280-536	28-52	9 Timers 16 IC 16 OC	User selectable 12-bit ADC (500 ksps) or 10-bit ADC (1.1 Msps), 32 ch., 3 comparators	UART, CAN, SPI, I²C, USB-OTG	Auxiliary Flash, CTMU, RTCC

PIC24 Family Features

Memory	Flash	Up to 536 KB self-programmable Flash with security
	RAM	Up to 96 KB static RAM
	EEPROM	Up to 512 bytes of EEPROM on PIC24F K families
	DMA	Up to 8 channels between internal peripherals and up to 2 KB dual port RAM
I/O Interface	Graphics Controller	Graphics Display Controller that include acceleration units, a Color Look-Up Table, and a direct interface to monochrome, color STN, TFT and OLED LCDs
	LCD Driver	Directly drive segment LCD display
	PMP	Parallel I/O module supporting interface to external peripherals, memory and graphic displays
	PPS	Peripheral Pin Select maps user selected peripherals to I/O pins
Communications	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 transmit and 32 receive buffers
Timers/Control	CRC	Programmable Cyclic Redundancy Check peripheral
	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	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 (1 Msps) on PIC24H/E and up to 24 channels (200/100 ksps) on the PIC24F
	10-bit A/D Converter	Up to 24 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

Technical Training

Expand your knowledge with Microchip's on-line web seminars and hands-on courses at our worldwide Technical Training Centers. 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

HIF 2131: *Designing with Microchip's Graphics Library*

This hands-on class teaches students to harness the power of Microchip's Graphics Library to decrease the development time of sophisticated human interfaces using graphical LCD display technologies with various input devices. Students will use the Microchip Graphics Library, the Explorer 16 development board and the Graphics PICtail™ Plus Daughter board to implement a real life application.

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.

Device Resources

PIC24E: High Performance 60 MIPS 16-bit MCU

Microchip's PIC24E general purpose microcontroller family features the highest speed 60 MIPS core with an excellent performance and code density. It offers ADC, CAN, USB-OTG, PMP and up to 15 DMA channels for extensive data movement. These devices are available in various packages and with extended (125°C) temperature options.

Graphics Controller

The PIC24 product line now includes an integrated graphics controller that allows a designer to migrate beyond fixed-function, segmented LCDs to STN, TFT and OLED displays with up to VGA resolution in an affordable 16-bit family. The graphics controller contains graphic acceleration units, a Color Look-Up Table and a display controller providing a low cost system solution.













nanoWatt XLP Technology

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.

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

Application Notes, Software Libraries and Hardware Support at www.microchip.com	
 Graphics	Microchip Graphics library and the Graphics Display Designer (visual design tool) enable 16- and 32-bit products to design and run GUI interfaces on a color graphics displays.
 mTouch™ Capacitive Library	Microchip's mTouch Capacitive Touch stack provides an easy-to-use interface to enable integration of stylish touch interface features such as buttons, sliders and wheels.
 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.
 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.
 MiWi™ & MiWi P2P	Microchip's MiWi wireless stack enables our 8, 16- and 32-bit products with a light wireless networking protocol.
 TCP/IP	Microchip's TCP/IP stacks enable connection to the internet on the Microchip 8-, 16- and 32-bit products.
 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.
 Speech Playback	Microchip's speech solutions enable our 8- and 16-bit products for speech playback.
 IrDA® Stack	Microchip's IrDA stack allows 16-bit Microchip products to communicate using IrDA protocol.
 EEPROM Emulation	Microchip EEPROM Emulation application note allows a user to utilize program Flash as data EEPROM.
 Class B Safety	Class B Safety Software Library for PIC MCUs and dsPIC DSCs.
 Bootloaders	Microchip bootloaders allow for field software upgrades and are available to support all 16-bit products.
Bluetooth® Stack	Bluetooth stack designed for low cost and low power embedded stack.
Encryption	Mirocochip 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 – visit www.microchip.com/thirdparty for additional support.	

Common Development Environment

Microchip's MPLAB® tool chain supports all Microchip MCUs and DSCs from the smallest 8-bit® PIC MCU, to our highest performance 32-bit PIC32 microcontrollers. Microchip's MPLAB IDE serves as the single, unified graphical user interface for Microchip and third-party software and hardware development tools.

MPLAB Integrated Development Environment – Free Download

- Full featured editor, simulator, debugger and program manager with color-coded context
- Supports all PIC MCUs and dsPIC® DSCs
- Powerful plug-ins for data monitor and control, motor control, RTOS viewer and others

MPLAB C Compiler

- Full-featured ANSI-compatible compiler
- Completely integrated with MPLAB IDE
- Free “Evaluation” and “Lite” downloads 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.

MPLAB ICD 3 In-Circuit Debugger (DV164035)

The MPLAB ICD 3 is Microchip's standard real-time debugger with watch points, breakpoints, variable watch/modify, single and stepping from MPLAB C Compilers.

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)



An inexpensive way to evaluate the 16 MIPS PIC24FJ256GB110 with USB-OTG. Application demonstrations include mTouch capacitive sensing, driving an OLED display and USB-OTG to store data to a thumb drive

PIC24H Starter Kit (DM240021)



Everything needed to begin using the 40 MIPS PIC24H128GP504 MCU. Demonstrations include low cost speech play back, tri-axial analog accelerometer, and a differential input with analog conditioning circuitry to plug in a wide range of external sensors

PIC24E Starter Kit (DM240012)



Explore the PIC24E family using the 60 MIPS PIC24EP512GU810 MCU with USB-OTG. Preloaded demo software, USB mini-B and USB Micro B are included with the kit.

Explorer 16 Development Board (DM240001/2)



A cost-effective development board for Microchip's 16-bit products. The PICtail™ Plus connector works with PICtail Plus daughter cards.

PICtail Plus Daughter Cards

(www.microchip.com/pictailplus)

PICtail Plus daughter cards provide a hardware expansion ability that makes it easy to develop and evaluate complex systems.

- Graphics
- Ethernet)
- Motor Control
- USB
- IEEE 802.11 WiFi®
- MRF24J40MA 2.4 GHz
- CAN/LIN
- Speech Playback
- SD/MMC
- Prototyping
- IrDA® Standard
- And more...

Highlighted Boards

XLP 16-bit Development Board (DM240311)



This low-cost extreme low power 16-bit development board supports the PIC24F16KA102, PIC24FJ64GA102 and PIC24F64GB002 families. Includes multiple power sources, power test points and a PICtail connector for additional expansion such as the RF PICtail card.

PIC24FJ256DA210 Graphics Development Kit (DV164039)



Development platform for the PIC24FJ256DA210 with integrated graphics controller. Includes a 3.2" QVGA TFT display with resistive touch screen support. Easily prototype graphics boards using PICtail Plus expansion slots and MPLAB ICD 3 In-Circuit Debugger.

Microstick for dsPIC33F and PIC24H Development Board (DM330013)



This flexible, low cost, USB powered board includes integrated USB programmer/debugger and socketed 16-bit DSC and MCUs for easy device replacement. The 0.025" pin headers enable plug-in to a breadboard with room for jumper wire.

mTouch™ Capacitive Touch Evaluation Kit (DM183026-2)



Provides a simple platform for developing a variety of capacitive touch sense applications using 16- and 32-bit PIC® microcontrollers. The diagnostic tool provided allows the user to analyze application-critical information in real-time as it relates to touch sensor behavior.

PIC24H mTouch Capacitive Touch Evaluation Board (AC243026)



Facilitates the development of capacitive touch-based applications using PIC24H-series microcontrollers when used with the mTouch Capacitive Touch Evaluation Kit.

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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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.

- Technical Training Centers: www.microchip.com/training
- 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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