



# PIC24 Microcontroller Family

Performance, Low Power, Advanced Peripherals

**PIC24H High Performance**  
**PIC24F Low Power**

**Graphics Controller**

**12-bit ADC**

**nanoWatt XLP**

**High Performance DMA**

**CAN**

**USB-OTG**

**High-Temperature**

**MPLAB IDE Common Development Platform**

**8-bit PIC10, PIC12, PIC16, PIC18, PIC24F, PIC24H, dsPIC30, dsPIC33, 32-bit PIC32**

**Functionality** (vertical arrow)

**Performance** (horizontal arrow)

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
- 4 to 256 Kbytes of Flash program memory
- 0.5 to 96 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.

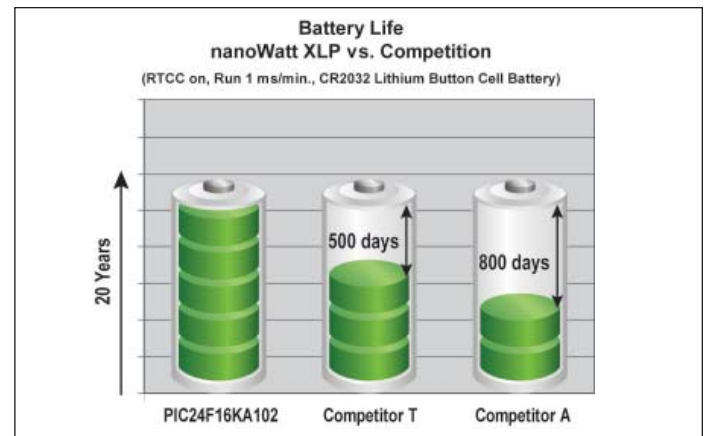
- Fast response to real-time events
  - Quick interrupt response, only 5 cycles
- Single-cycle bit manipulation
- Single-cycle instruction execution
- Single-cycle hardware multiply
- Optimized architecture for C Code

## 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.

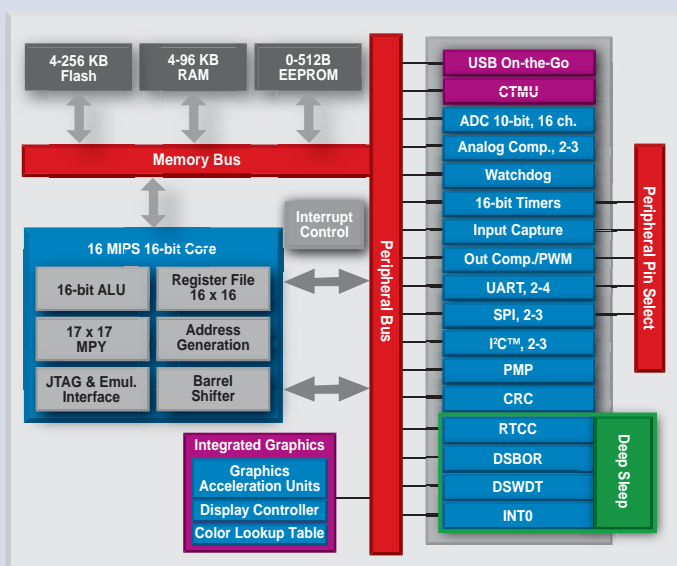


## What's New!

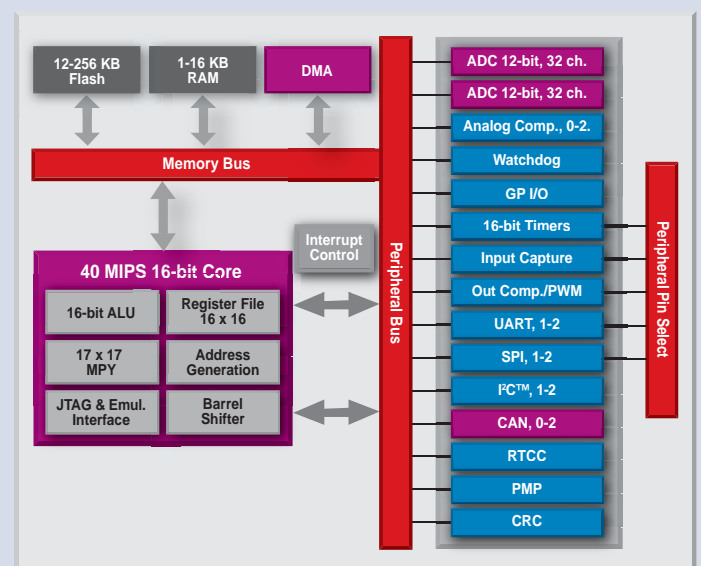
- Graphics controller with graphics acceleration and Color Look-Up Table to drive a color display
- nanoWatt XLP technology with Sleep currents as low as 20 nA
- USB-OTG peripheral available on 28- to 100-pin products
- Extended temperature & high-temperature (140°C) products
- Implement mTouch™ capacitive touch sense keypads

## Peripherals, Memory and Analog



### PIC24F Block Diagram



### PIC24H 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
<b>PIC24F Family – 16 MIPS, Lowest Cost, Lowest Power, General Purpose</b>							
 PIC24F K Families	14-44	4-32	0.5-2	3-5 Timers 1-3 IC 1-3 OC	10-bit ADC (500 ksp/s) or 10/12-bit ADC (200/100 ksp/s), 7-16 ch., 2 comparators	UART w/IrDA® (2), SPI (1/2), I²C™ (1/2)	EEPROM, CTMU, Real-Time Clock Calendar (RTCC), Deep Sleep (DS)
 PIC24F G Families	28-100	16-256	4-96	5 Timers 5-9 IC 5-9 OC	10-bit ADC (500 ksp/s), 9-24 ch., 2/3 comparators, CTMU (0/1)	UART w/IrDA (2/4), SPI (2/3), I²C (2/3), <b>USB-OTG</b>	Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, Deep Sleep (DS), JTAG
PIC24F D Families	64-100	128-256	24-96	5 Timers 9 IC 9 OC	10-bit ADC (500 ksp/s), 16-24 ch., 3 comparators, CTMU	UART w/IrDA (4), SPI (3), I²C (3), <b>USB-OTG</b>	<b>Graphics Display Controller</b> Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG
<b>PIC24H Family – 40 MIPS, Highest Performance, General Purpose</b>							
PIC24H GP Families	18-100	12-256	1-16	3-9 Timers 4-8 IC 2-8 OC	User selectable 12-bit ADC (500 ksp/s) or 10-bit ADC (1.1 Msp/s), 8-32 ch., comparators (0/2)	UART w/IrDA (1-2), SPI (1-2), I²C (1-2), <b>CAN (0-2)</b>	8 ch. DMA, Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG, Extended Temperature and High Temperature (140°C) Options

## PIC24 Family Features

Memory	Key Features
Flash	Up to 256 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	Key Features
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
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	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 transmit 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 (1 Msp/s) on PIC24H and up to 16 channels (200/100 ksp/s) 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

### 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](http://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.

## 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.

## Device Resources

### 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 (CLUT) 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.













### 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.

### Application Notes & Software Libraries and Hardware Support – see [www.microchip.com](http://www.microchip.com) for additional support

 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.
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.

### Third-Party Tool Support – see [www.microchip.com/thirdparty](http://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 (SW007002) – 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 and HI-TECH C® Compilers

- 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)



- 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.

### Explorer 16 Development Board (DM240001/2)



- Cost-effective development board for Microchip's 16-bit products
- Expansion connector accesses full device pinout and bread board prototyping area.
- PICTail Plus connector for future expansion boards

### PICTail™ Plus Daughter Cards

([www.microchip.com/pictailplus](http://www.microchip.com/pictailplus))

PICTail Plus daughter cards are designed to plug into the expansion connections on the Explorer 16 board.

- Graphics (AC164127)
- Ethernet (AC164123)
- Motor Control (AC164128)
- USB (AC164131)
- IEEE 802.11 WiFi® (AC164136-4)
- MRF24J40MA 2.4 GHz (AC164134-1)
- CAN/LIN (AC164130)
- Speech Playback (AC164125)
- SD/MMC (AC164122)
- Prototyping (AC164126)
- IrDA® Standard (AC164124)
- And More...

## Highlighted Boards

### XLP 16-bit Development Board (DM240311)



- Low cost extreme low power 16-bit development board
- Supports the PIC24F16KA102, PIC24FJ64GA102 and PIC24F64GB002 families
- Multiple power sources, power test points
- 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
- 3.2" truly TFT Display with resistive touch screen support
- Prototype graphics boards and PICTail Plus expansion slots
- MPLAB ICD-3 Emulator and Debugger

### Microstick for dsPIC33F and PIC24H Development Board (DM330013)



- Low Cost
- Integrated USB programmer/debugger – No external debugger required
- USB Powered – Ease of use, No external power required
- Socketed dsPIC/PIC24 – flexible, easy device replacement
- 0.025" pin headers – enables plug-in to breadboard with room for jumper wire

## 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](http://www.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.

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- MASTERS Conferences: [www.microchip.com/masters](http://www.microchip.com/masters)
- Worldwide Seminars: [www.microchip.com/seminars](http://www.microchip.com/seminars)
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- Resources from our Distribution and Third Party Partners [www.microchip.com/training](http://www.microchip.com/training)

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