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 70 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 and Active currents, adding years to the life of today’s low power and battery operated applications.

**What’s New!**
- High performance PIC24E core at 70 MIPS with enhanced and new peripherals
- nanoWatt XLP technology with Sleep currents as low as 20 nA and Active currents as low as 150 μA/HMz
- VBAT battery back-up for RTCC
- USB-OTG peripheral available on 28 to 100-pin products
- PIC24H high-temperature (150ºC) products
- Integrated on-chip Op Amps for high speed signal amplification
- Graphics controller with graphics acceleration and color look-up table to drive a color display
- LCD controller capable of driving up to 480 segments

**Peripherals, Memory and Analog**

**PIC24 Block Diagram**

- 32-bit CRC, GP I/O
- CAN, 0-2
- SPI, 2-4
- I2C, 2-3
- PMP
- CRC
- RTCC
- DSBOR
- DSWDT
- INT0
- VBAT
- USB On-the-Go
- ADC 10-bit, 16 ch.
- Op Amp/Analog Comp., 0-3
- Watchdog & PWR Mgmt.
- Input Capture
- Out Comp./PWM
- UART, 2-4
- IC™, 2-3
- PMP
- 16/40/70 MIPS 16-bit Core
- 16-bit ALU
- Register File 16 x 16
- Address Generation
- Barrel Shifter
- JTAG & Emul. Interface
- LCD Segment Drive
- Integrated Graphics
  - Graphics Acceleration Units
  - Display Controller
  - Color Lookup Table
- DMA
- Memory Bus
- Peripheral Bus
- Interrupt Control
- Deep Sleep
- Peripheral Pin Select
## PIC24 16-bit Microcontrollers

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<th>Family</th>
<th>Pins</th>
<th>Flash Memory Kbytes</th>
<th>SRAM Kbytes</th>
<th>16-bit Timers</th>
<th>Input Capture</th>
<th>Output Compare</th>
<th>Analog</th>
<th>Communications</th>
<th>Additional Features</th>
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<tbody>
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<td>PIC24F Family: 16 MIPS, Lowest Cost, Lowest Power, General Purpose</td>
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<tr>
<td>PIC24F K Families</td>
<td>14–48</td>
<td>4–32</td>
<td>0.5–2</td>
<td>3–5 Timers</td>
<td>1-3 IC</td>
<td>1-3 OC</td>
<td>10-bit ADC (500 ksp) or 10/12-bit ADC (200/100 ksp), 7–16 ch, 3 comparators</td>
<td>UART w/IRDA® (2), SPI (1/2), I²C™ (1/2)</td>
<td>EEPROM, CMTU, RTCC, Deep Sleep</td>
</tr>
<tr>
<td>PIC24F G Families</td>
<td>28–100</td>
<td>16–256</td>
<td>4–96</td>
<td>5 Timers</td>
<td>5-9 IC</td>
<td>5-9 OC</td>
<td>10-bit ADC (500 ksp) or 10/12-bit ADC (200/100 ksp), 9–24 ch, 2/3 comparators, CTMU (0/1)</td>
<td>UART w/IRDA® (2/4), SPI (2/3), I²C (2/3), USB-OTG</td>
<td>LCD, DMA, PPS, PMP, RTCC, CRC, Deep Sleep, JTAG, Var</td>
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<tr>
<td>PIC24F D Families</td>
<td>64–100</td>
<td>128–256</td>
<td>24–96</td>
<td>5 Timers</td>
<td>9 IC</td>
<td>9 OC</td>
<td>10-bit ADC (500 ksp), 16–24 ch, 3 comparators, CTMU</td>
<td>UART w/IRDA® (4), SPI (3), I²C (3), USB-OTG</td>
<td>Graphics Display Controller, PPS, PMP, RTCC, CRC, JTAG</td>
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<td>PIC24H Family: 40 MIPS, High Performance, General Purpose</td>
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<td>PIC24H GP Families</td>
<td>18–100</td>
<td>12–256</td>
<td>1–16</td>
<td>3–9 Timers</td>
<td>4-8 IC</td>
<td>2-8 OC</td>
<td>User selectable 12-bit ADC (500 ksp) or 10-bit ADC (1.1 Msps), 8–32 ch, (0/2)</td>
<td>UART w/IRDA® (1-2), SPI (1–2), I²C (1–2), CAN</td>
<td>8 ch, DMA, PPS, PMP, RTCC, CRC, JTAG, High Temperature (150°C) Options</td>
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<tr>
<td>PIC24E Family: 70 MIPS, High Performance, General Purpose and Motor Control</td>
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<tr>
<td>PIC24E GP Family</td>
<td>28–64</td>
<td>64</td>
<td>16</td>
<td>5 Timers</td>
<td>4 IC</td>
<td>4 OC</td>
<td>User selectable 12-bit ADC (500 ksp) or 10-bit ADC (1.1 Msps), 6–16 ch, 4 analog comparators, 3 Op Amps</td>
<td>UART, CAN, SCI, I²C</td>
<td>mTouch™, DMA</td>
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<tr>
<td>PIC24E MC Family</td>
<td>28–64</td>
<td>64</td>
<td>16</td>
<td>5 Timers</td>
<td>4 IC</td>
<td>4 OC</td>
<td>User selectable 12-bit ADC (500 ksp) or 10-bit ADC (1.1 Msps), 6–16 ch, 4 analog comparators, 3 Op Amps</td>
<td>UART, CAN, SCI, I²C</td>
<td>mTouch, 6 Motor Control PWM, Outputs, DMA</td>
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<tr>
<td>PIC24E GU Family</td>
<td>64–144</td>
<td>256–512 + 24 Aux Flash</td>
<td>53</td>
<td>9 times, 16 IC, 16 OC</td>
<td>Two user selectable ADCs at 12-bit (500 kps) or 10bit (1.1 MSPS), 24–32 ch, 3 analog comparators</td>
<td>UART, CAN, SCI, I²C</td>
<td>USB, DMA, PMP parallel port</td>
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## PIC24 Family Features

| Memory | 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 |
| 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 |
| 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 |
| 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 |
| Pulse Width Modulation (PWM) | The highly configurable Input Capture, Output Compare and PWM modules are easily configured with the Timer modules to generate waveforms and monitor external events |
| 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, Var battery back-up |
| 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 ksp) 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 |
| Op Amps | On-chip Op Amps for high speed signal amplification |
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.

PIC24 Resource Guide

<table>
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Third-Party Tool Support: visit www.microchip.com/thirdparty for additional support.

PIC24 Microcontroller Family
**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

**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**

**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.

**PIC24E Starter Kit (DM240012)**

Explore the PIC24E family using the 70 MIPS PIC24EP512GU810 MCU with USB-OTG. Preloaded demo software, USB mini-B and USB Micro B are included with the kit.

**Microstick II for dsPIC33F and PIC24H Development Board (DM330013-2)**

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.

**Microstick for PIC24F K-Series Development Board (DM240013-1)**

This low cost, easy-to-use, USB powered board includes an on-board debugger/programmer, a DUT socket for easy device swapping of 3V PIC24 K devices, a user LED and reset button. Designed for insertion into a proto board, it is extremely portable and is about the size of a stick of gum!

**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...

**Featured Development 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.

**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.

**LCD Explorer Development Board (DM240314)**

The LCD Explorer Development Board supports Microchip’s 100-pin microcontrollers with x 8 common segment LCD drivers. The LCD Explorer provides an ideal platform for a customer to evaluate a MCU with a x 8 common LCD driver on a 38 segment x 8 common LCD display. PicTail Plus connections allow a customer to evaluate the selected MCU in a complex system by adding Microchip’s PicTail Plus daughter boards.
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:

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