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 (140ºC) products
- Implement mTouch™ capacitive touch sense keypads

Peripherals, Memory and Analog
PIC24F Block Diagram
- 4-256 KB Flash
- 4-96 KB RAM
- 0-512 KB EEPROM
- 16 MIPS 16-bit Core
- 16-bit ALU
- 17 x 17 MPY
- JTAG & Emul. Interface
- Barrel Shifter
- Register File 16 x 16
- Address Generation
- Interrupt Control
- Memory Bus
- USB On-the-Go
- CTMU
- 10-bit, 16 ch. ADC
- Analog Comp., 2-3
- Watchdog
- 16-bit Timers
- Input Capture
- Out Comp./PWM
- UART, 2-4
- SPI, 2-3
- I2C™, 2-3
- PMP
- CRC
- RTCC
- DSBORE
- DSBOBR
- DSBOB
- DSWDT
- INT0
- INT1
- INT2
- INT3
- INTS
- Deep Sleep

PIC24H Block Diagram
- 12-256 KB Flash
- 1-16 KB RAM
- DMA
- 40 MIPS 16-bit Core
- 16-bit ALU
- 17 x 17 MPY
- JTAG & Emul. Interface
- Barrel Shifter
- Register File 16 x 16
- Address Generation
- Interrupt Control
- Memory Bus
- ADC 12-bit, 32 ch.
- Analog Comp., 0-2.
- Watchdog
- GP I/O
- 16-bit Timers
- Input Capture
- Out Comp./PWM
- UART, 1-2
- SPI, 1-2
- I2C™, 1-2
- CAN, 0-2
- RTCC
- PMP
- CRC
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
- I^C^™: 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): On-chip low-power RC oscillator, post-scaler for wide range of time-out values
- Pulse Width Modulation (PWM): 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 Msps) on PIC24H and up to 16 channels (200/100 ksp) on the PIC24F
- Comparator: 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

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**PIC24 Family - 16 MIPS, Lowest Cost, Lowest Power, General Purpose**

<table>
<thead>
<tr>
<th>Family</th>
<th>Pins</th>
<th>Flash Memory Kbytes</th>
<th>SRAM Kbytes</th>
<th>16-bit Timers Input Capture</th>
<th>IO</th>
<th>Analog</th>
<th>Communications Serial I/O</th>
<th>Additional Features</th>
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<tr>
<td>PIC24F K Families</td>
<td>14-44</td>
<td>4-32</td>
<td>0.5-2</td>
<td>3-5 Timers 1-3 IC 1-3 OC</td>
<td></td>
<td>10-bit ADC (500 ksp) or 10/12-bit ADC (200/100 ksp)</td>
<td>UART w/I^D^A^®^ (2), SPI (1/2), I^C^™ (1/2)</td>
<td>EEPROM, CTMU, Real-Time Clock Calendar (RTCC), Deep Sleep (DS)</td>
</tr>
<tr>
<td>PIC24F G Families</td>
<td>28-100</td>
<td>16-256</td>
<td>4-96</td>
<td>5 Timers 5-9 IC 5-9 OC</td>
<td></td>
<td>10-bit ADC (500 ksp), 9-24 ch., 2/3 comparators, CTMU (0/1)</td>
<td>UART w/I^D^A^®^ (2/4), SPI (2/3), I^C^™ (2/3), USB-OTG</td>
<td>Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, Deep Sleep (DS), JTAG</td>
</tr>
<tr>
<td>PIC24F D Families</td>
<td>64-100</td>
<td>128-256</td>
<td>24-96</td>
<td>5 Timers 9 IC 9 OC</td>
<td></td>
<td>10-bit ADC (500 ksp), 16-24 ch., 3 comparators, CTMU</td>
<td>UART w/I^D^A^®^ (4), SPI (3), I^C^™ (3), USB-OTG</td>
<td>Graphics Display Controller, Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG</td>
</tr>
</tbody>
</table>

**PIC24 Family - 40 MIPS, Highest Performance, General Purpose**

<table>
<thead>
<tr>
<th>Family</th>
<th>Pins</th>
<th>Flash Memory Kbytes</th>
<th>SRAM Kbytes</th>
<th>16-bit Timers Input Capture</th>
<th>IO</th>
<th>Analog</th>
<th>Communications Serial I/O</th>
<th>Additional Features</th>
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<tr>
<td>PIC24H GP Families</td>
<td>18-100</td>
<td>12-256</td>
<td>1-16</td>
<td>3-9 Timers 4-8 IC 2-8 OC</td>
<td></td>
<td>User selectable 12-bit ADC (500 ksp) or 10-bit ADC (1.1 Msps), 8-32 ch., comparators (0/2)</td>
<td>UART w/I^D^A^®^ (1-2), SPI (1-2), I^C^™ (1-2), CAN (0-2)</td>
<td>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</td>
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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
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.

<table>
<thead>
<tr>
<th>Application Notes &amp; Software Libraries and Hardware Support – see <a href="http://www.microchip.com">www.microchip.com</a> for additional support</th>
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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.

Third-Party Tool Support – see www.microchip.com/thirdparty for additional support

www.microchip.com/16bit
**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 playback, 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)**
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:

- **Support** link provides a way to get questions answered fast: [http://support.microchip.com](http://support.microchip.com)
- **Sample** link offers evaluation samples of any Microchip device: [http://sample.microchip.com](http://sample.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.

- **Regional Training Centers**: [www.microchip.com/rtc](http://www.microchip.com/rtc)
- **MASTERs Conferences**: [www.microchip.com/masters](http://www.microchip.com/masters)
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