Highly Efficient C Code Size

The PIC24 architecture and the MPLAB® C compiler are optimized to achieve small code size in embedded control applications.

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)

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

<table>
<thead>
<tr>
<th>Pins</th>
<th>Flash Memory Kbytes</th>
<th>SRAM Kbytes</th>
<th>Timers 16-bit</th>
<th>Input Capture</th>
<th>Output Comp/ PWM</th>
<th>Analog</th>
<th>Communications Serial I/O</th>
<th>Additional Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC24F Family – 16 MIPS, Lowest Cost, Lowest Power, General Purpose</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14/18/20/28</td>
<td>4/8/16</td>
<td>0.5/1.5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>10-bit ADC (500 ksp), 7/9 ch. 2 comparators</td>
<td>UART w/IrDA® (2), SPI, I²C™</td>
<td>Real-Time Clock Calendar (RTCC), CTMU, EEPROM, Deep Sleep (DS)</td>
</tr>
<tr>
<td>28/44</td>
<td>16/32/48/64</td>
<td>4/8</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>10-bit ADC (500 ksp), 10/13 ch. 2 comparators</td>
<td>UART w/IrDA® (2), SPI (2) I²C (2), USB-OTG*</td>
<td>Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG, Deep Sleep (DS)*</td>
</tr>
<tr>
<td>64/80/100</td>
<td>64/64/128/192/256</td>
<td>8/16</td>
<td>5</td>
<td>9</td>
<td>9</td>
<td>10-bit ADC (500 ksp), 16 ch. 2/3 comparators, CTMU (0/1)</td>
<td>UART w/IrDA® (2/4), SPI (2/3) I²C (2/3)</td>
<td>Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG</td>
</tr>
<tr>
<td>64/80/100</td>
<td>64/128/192/256</td>
<td>16</td>
<td>5</td>
<td>9</td>
<td>9</td>
<td>10-bit ADC (500 ksp), 16 ch. 3 comparators, CTMU</td>
<td>UART w/IrDA® (4), SPI (3) I²C (3) USB-OTG,</td>
<td>Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG</td>
</tr>
<tr>
<td>PIC24H Family – 40 MIPS, Highest Performance, General Purpose</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18/28/44</td>
<td>12/16/32/64/128</td>
<td>1/2/4/8</td>
<td>3/5</td>
<td>4</td>
<td>2/4</td>
<td>User selectable 12-bit ADC (500 ksp) or 10-bit ADC (1.1 Msp), 8/10/16 ch., comparators (0/2)</td>
<td>UART w/IrDA® (1/2), SPI (1/2), I²C (1/2), CAN (0/1)</td>
<td>8 ch. DMA, Peripheral Pin Select (PPS), Parallel Master Port (PMP), Real-Time Clock Calendar (RTCC), CRC, JTAG</td>
</tr>
<tr>
<td>64/100</td>
<td>64/128/256</td>
<td>8/16</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>User selectable 12-bit ADC (500 ksp) or 10-bit ADC (1.1 Msp), 18/32 ch., comparators (0/2)</td>
<td>UART w/IrDA® (2), SPI (2) I²C (2), CAN (0/1/2)</td>
<td>8 ch. DMA, JTAG</td>
</tr>
</tbody>
</table>

* Contact Microchip for availability.
### PIC24 Family Features

<table>
<thead>
<tr>
<th>Category</th>
<th>Key Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Memory</strong></td>
<td></td>
</tr>
<tr>
<td>Flash</td>
<td>Up to 256 KB self-programmable Flash with security</td>
</tr>
<tr>
<td>RAM</td>
<td>Up to 16 KB static RAM</td>
</tr>
<tr>
<td>DMA</td>
<td>Up to 8 channels between internal peripherals and up to 2 KB dual port RAM</td>
</tr>
<tr>
<td><strong>I/O Interface</strong></td>
<td></td>
</tr>
<tr>
<td>PMP</td>
<td>Parallel I/O module with multiple address and data options</td>
</tr>
<tr>
<td>PPS</td>
<td>Peripheral Pin Select maps user selected peripherals to I/O pins</td>
</tr>
<tr>
<td><strong>Communications</strong></td>
<td></td>
</tr>
<tr>
<td>USB-OTG</td>
<td>USB Standard now available and targeted for embedded control with application notes supporting Embedded Host, Peripheral and OTG</td>
</tr>
<tr>
<td>UART</td>
<td>Asynchronous channel supporting LIN, IrDA®, RS-232, RS-485 with 4-deep FIFO buffer or DMA</td>
</tr>
<tr>
<td>SPI</td>
<td>High-speed synchronous channel including 8-deep FIFO buffer or DMA</td>
</tr>
<tr>
<td>i²C™</td>
<td>Support Multi-Master/Slave mode with 7-bit/10-bit addressing</td>
</tr>
<tr>
<td>CAN</td>
<td>Automotive/Industrial standard, includes 8 transit and 32 receive buffers</td>
</tr>
<tr>
<td>CRC</td>
<td>Programmable Cyclic Redundancy Check peripheral</td>
</tr>
<tr>
<td><strong>Timers/Control</strong></td>
<td></td>
</tr>
<tr>
<td>16-bit timers, cascadable to 32-bit</td>
<td>Cascadable to 32-bit, up/down, with multiple clock sources including a low-power 32 kHz oscillator, trigger for A/D conversion</td>
</tr>
<tr>
<td>Input Capture (IC)</td>
<td>The highly configurable Input Capture, Output Compare and PWM modules are easily configured with the Timer modules to generate waveforms and monitor external events</td>
</tr>
<tr>
<td>Output Compare (OC)</td>
<td></td>
</tr>
<tr>
<td>Pulse Width Modulation (PWM)</td>
<td></td>
</tr>
<tr>
<td>Watchdog Timer (WDT)</td>
<td>On-chip low-power RC oscillator, post-scaler for wide range of time-out values</td>
</tr>
<tr>
<td>Real-Time Clock Calendar (RTCC)</td>
<td>Hardware module provides 100-year calendar, clock and alarm functions</td>
</tr>
<tr>
<td><strong>Analog</strong></td>
<td></td>
</tr>
<tr>
<td>Charge Time Measurement Unit (CTMU)</td>
<td>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.</td>
</tr>
<tr>
<td>10/12-bit A/D converter</td>
<td>Up to 32 channels on PIC24H</td>
</tr>
<tr>
<td>10-bit A/D converter</td>
<td>Up to 16 channels on PIC24H</td>
</tr>
<tr>
<td>Comparators</td>
<td>With on-chip programmable reference voltage</td>
</tr>
<tr>
<td>Integrated Voltage Regulator with Power-on Reset and Brown-out Reset</td>
<td>Power-on Reset and Brown-out Reset provide stable system operation</td>
</tr>
</tbody>
</table>
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 (RTC). 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.

**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>
<th>PICtail™ Plus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Libraries</td>
<td>Class B Safety Software Library for PIC MCUs and dsPIC DSCs.</td>
</tr>
<tr>
<td>Graphics</td>
<td>Microchip Graphics library enables 16- and 32-bit products to design and run GUI interfaces on a color graphics displays.</td>
</tr>
<tr>
<td>USB</td>
<td>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.</td>
</tr>
<tr>
<td>ZigBee®</td>
<td>Microchip’s ZigBee 2006 stack enables our 8-bit and 16-bit controller for connection to a ZigBee wireless network. ZigBee PRO also available.</td>
</tr>
<tr>
<td>MiWi™ &amp; MiWi P2P</td>
<td>Microchip’s MiWi wireless stack enables our 8, 16- and 32-bit products with a light wireless networking protocol.</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>Microchip’s TCP/IP stacks enable connection to the internet on the Microchip 8-, 16- and 32-bit products.</td>
</tr>
<tr>
<td>File Systems</td>
<td>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.</td>
</tr>
<tr>
<td>Speech Playback</td>
<td>Microchip’s speech solutions enable our 8- and 16-bit products for speech playback.</td>
</tr>
<tr>
<td>IrDA® Stack</td>
<td>Microchip’s IrDA stack allows 16-bit Microchip products to communicate using IrDA protocol.</td>
</tr>
<tr>
<td>EEPROM Emulation</td>
<td>Microchip EEPROM Emulation application note allows a user to utilize program Flash as data EEPROM.</td>
</tr>
<tr>
<td>Bootloaders</td>
<td>Microchip bootloaders allow for field software upgrades and are available to support all 16-bit products.</td>
</tr>
<tr>
<td>Encryption</td>
<td>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.</td>
</tr>
</tbody>
</table>

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](http://support.microchip.com)
- **Sample** link offers evaluation samples of any Microchip device: [http://sample.microchip.com](http://sample.microchip.com)
- **Forum** link provides access to knowledge base and peer help: [http://forum.microchip.com](http://forum.microchip.com)
- **Buy** link provides locations of Microchip Sales Channel Partners: [www.microchip.com/sales](http://www.microchip.com/sales)

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Tel: 905-673-0699

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Tel: 49-89-627-144-0

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Netherlands - Drunen
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Spain - Madrid
Tel: 34-91-708-08-90

UK - Wokingham
Tel: 44-118-921-5869

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China - Chengdu
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China - Hong Kong SAR
Tel: 852-2401-1200

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-5407-5533

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8203-2660

China - Wuhan
Tel: 86-27-5980-5300

China - Xiamen
Tel: 86-592-2388138

China - Xian
Tel: 86-29-8833-7252

China - Zhuhai
Tel: 86-756-3210040

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India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-2566-1512

Japan - Yokohama
Tel: 81-45-471-6166

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

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Malaysia - Penang
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Philippines - Manila
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Singapore
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Taiwan - Kaohsiung
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Taiwan - Taipei
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Thailand - Bangkok
Tel: 66-2-694-1351

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