



**MICROCHIP**

**8-bit PIC® Microcontrollers**



**Small  
Packages**

**Peripheral  
Rich**

**Low Power**

*Did you know? – Microchip Technology is the #1 supplier of 8-bit microcontrollers worldwide. In fact, we've recently surpassed 6 billion devices shipped – That's one PIC® microcontroller for every person on earth!*

## QUICK & EASY SOLUTIONS

### THE MICROCHIP ADVANTAGE



With over 400 microcontrollers (MCUs) in the product portfolio, Microchip can provide solutions for the entire performance range of 8-bit MCUs. Microchip offers flexible memory technologies, easy-to-use development tools, comprehensive technical

documentation and design support with a worldwide sales and distribution network.

Customers have made PIC® microcontrollers a worldwide standard with over 6 billion microcontrollers shipped and more than 600,000 development systems delivered since 1990.

#### Market Leader in 8-bit Microcontrollers

##### 8 reasons why Microchip's 8-bit PIC microcontroller solutions are quick and easy:

- Microchip offers more than 250 8-bit PIC microcontrollers
- Finding the perfect MCU for your application is just a mouse click away using our Microchip Advanced Part Selector (MAPS) tool
- MPLAB® IDE is absolutely FREE and supports ALL of Microchip's 8-, 16- and 32-bit microcontrollers
- A wide range of low cost development tools help speed up prototyping efforts
- Moving from one PIC microcontroller to another is easy with pin and code compatibility
- Wide product availability with the shortest lead times in the industry
- Microchip is the only supplier to bring integrated USB, LCD, CAN, Ethernet and Capacitive Touch Sensing to the 8-bit market
- Excellent value and lower overall system cost



#### Start to Finish in 8 Easy Steps!

- 1) Use the MAPS product selection tool and design centers on-line to find the perfect PIC microcontroller for your application
- 2) Order free samples at: <http://sample.microchip.com>
- 3) Download technical documentation and FREE MPLAB IDE
- 4) Watch helpful webinars at: <http://techtrain.microchip.com>
- 5) Purchase a low-cost 8-bit development kit
- 6) Leverage our resources – internet forums, code examples, application notes, software libraries and contact other developers at: <http://forum.microchip.com>
- 7) Add your unique ideas to customize your application
- 8) Utilize our worldwide network of associates for sales and 24/7 technical support

*Did you know? – The Microchip Advanced Part Selector (MAPS) and Development Tool Selector (DTS) can help you find the perfect product or tool for your application.*

## PIC® MICROCONTROLLER OVERVIEW

### EMBED WITH CONFIDENCE

Why do our customers choose us?

It's because 8-bit PIC® microcontrollers are powerful, while remaining quick and easy to design into a wide variety of applications. High functionality and reduced risk during the development cycle gives our customers the confidence to focus their time and energy on innovating their end product.

### INTEGRATION

#### Looking to optimize your project?

A broad product portfolio allows Microchip to offer engineers an appropriate integration of both analog and digital peripherals, ranging from simple digital to sophisticated analog modules. These integrated peripherals minimize component count and thereby lower total system cost while increasing reliability.

#### Advantages:

- Instructions and data are on separate buses, increasing speed and overall performance
- Diverse Flash memory offerings with industry leading endurance and retention
- Self-write Flash with remote programmability
- Data EEPROM option for frequent data changes on secure, non-volatile memory
- Wide range of packages and pin counts

#### On-chip Peripheral Features:

##### Communication Protocols

- RS-232/RS-485
- SPI/I<sup>2</sup>C™
- USB
- Ethernet
- CAN
- LIN

##### Control and Timing

- Capture/Compare/PWMs
- Counters/Timers

##### Display Drivers

- LED, LCD

##### Analog Peripherals

- Analog-to-Digital Converters
- Op amps, comparators
- Oscillators
- Voltage detectors
- Voltage regulators
- Voltage references
- Temperature sensors
- Touch sensors



### SUPPORT

#### Need a partner from start to finish?

Microchip's 24/7 global technical support resources are available to help you with your next design. Hundreds of dedicated field application engineers located in more than 50 sales offices and our authorized distributors worldwide are also here to help. Standard code libraries, reference designs, application notes and seminars are offered on-line and at Microchip Regional Training Centers. These options support the demands of a diversified customer base and a wide range of end product applications.

### QUALITY

#### Is stability a concern in the design?

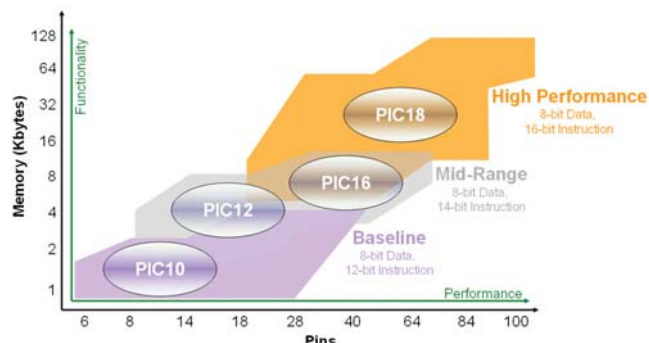
Microchip has a long history of providing dependable product delivery. The company's quality systems for semiconductor products are ISO/TS-16949:2002 certified, and the quality system for development tools is designed, manufactured and certified to ISO-9001:2000.



*Did you know? – 8-bit PIC Microcontrollers are designed into diverse applications, including consumer, industrial, medical and automotive.*

## 8-BIT PIC® MICROCONTROLLER ARCHITECTURES

Microchip's 8-bit PIC microcontrollers fall into three product architecture categories providing a variety of options for any application requirement. The specific families include: Baseline – PIC10F and some PIC12F and PIC16F; Mid-Range – PIC12F and PIC16F; and High Performance – PIC18F with J and K-Series. All device families have low power capability, flexible Flash program memory, and separate instruction and data buses to enable single cycle execution\*.



### **BASILINE ARCHITECTURE**



- **Smallest form factor**
- **Most cost sensitive**
- **6-pin to 40-pin**

Baseline devices utilize 12-bit program word architecture and enables the most cost-effective product solutions. Low operating voltages make this architecture ideal for battery operated applications. These MCUs allow engineers to use microcontrollers in applications that have historically been void of such devices. Whether it is cost or space constraints, Baseline PIC microcontrollers address these concerns by providing a pricing structure that makes them nearly disposable, with form factors that can easily be implemented into the most space constrained designs.

### **MID-RANGE ARCHITECTURE**



- **5 MIPS operating performance**
- **Rich peripheral set**
- **Optimal cost-to-performance ratio**

Mid-Range devices feature 14-bit program word architecture and are available in 8 to 64-pin packages that offer an operating voltage range of 1.8-5.5V, small package footprints, interrupt handling, an 8-level hardware stack, multiple A/D channels and EEPROM data memory. Mid-range devices offer a wide range of package options and a wide range of peripheral integration. These devices feature various serial analog and digital peripherals, such as: SPI, I<sup>2</sup>C™, USART, LCD and A/D converters.

### **PIC18 ARCHITECTURE**



- **Up to 16 MIPS performance with advanced peripherals**
- **J-Series for cost-sensitive applications with high levels of integration**
- **K-Series for low power, high-performance applications**

The PIC18 family utilizes a 16-bit program word architecture and incorporates an advanced RISC architecture with 32 level-deep stack, 8x8 hardware multiplier, and multiple internal and external interrupts. With the highest performance in Microchip's 8-bit portfolio, the PIC18 family provides up to 16 MIPS and linear memory. PIC18 is the most popular architecture for new 8-bit designs where customers want to program in C. Choose from over 150 PIC18 products supporting both 3V and 5V applications with packages ranging from 18 to 100 pins. Integration is key on the PIC18 devices, with support for connectivity and human interface peripherals including: USB, Ethernet, touch sensing, LCD display drivers and CAN – all with free supporting software and application notes to help you get to market faster.

\*Except for program branches, which may require two cycles.

*Did you know? – Many everyday electronic devices use our low pin count MCUs as a primary building block. Toys, kitchen appliances, smoke detectors, security systems and more!*

## LOW PIN COUNT AND SPACE-CONSTRAINED



### A Complete Low Pin Count Solution

Microchip offers the most complete family of low pin count Flash microcontrollers available. These devices range from easy-to-use 6-pin MCUs, which can replace discrete logic functions, to 20-pin MCUs with advanced analog and communications peripherals that can serve as the central processor in an application. Microchip continues to push the 8-bit MCU limits with the PIC10F family of 6-pin MCUs. This family offers 384-764 bytes of Flash memory and 16-24 bytes of data RAM memory with basic functionality and options for comparators, A/D converters and Flash data memory.

### The PIC16F61X Family (PIC12F609/615 and PIC16F610/616)

With integrated PWM modules (ECCP) and high voltage variants (HV), this family is the most cost effective MCU for PWM, and includes features like 10-bit A/D, S/R latch and comparators in low-pin counts and small packages.

### The PIC10F Family

(PIC10F222/220/206/204/202/200)

This family expands into territory not traditionally served by MCUs for any space-constrained application with its small form, performance and extremely low cost.

- **“Electronic Glue”** – Design in a PIC10F from the start to accommodate bug fixes and last-minute changes. Avoid costly, time-consuming silicon revisions or board changes.
- **Logic Control** – Optimize board space and cost with a PIC10F MCU for a more sophisticated solution that can take the place of passive discrete logic functions such as delays, smart gates, signal conditioning, simple state machines, encoders/decoders, etc.
- **Intelligent Disposable Electronics** – Given the small form factor and economical cost, it's ideal for emerging “disposable” applications such as drug or pregnancy testers, dialysis monitoring (blood sugar) and more.
- **Waveform Generation** – Replace traditional 555 timers, PWMs, remote control encoders, pulse generation, programmable frequency source, resistor programmable oscillators and more.
- **Mechatronics** – Traditional mechanical functions like smart switches, remote I/Os, LED flashers and other forms of mechanical timers and switches can be replaced easily.

### FEATURED DEVELOPMENT TOOL

#### PIC10F2XX Universal Programmer (AC163020)



This adapter provides PIC10F socket support for 2x3 mm DFN, SOT-23 and DIP-8 packages and interfaces to our low cost family of programmers: PICKit™ 1, PICKit 2, MPLAB® ICD 3 and PICSTART® Plus.

### APPLICATION EXAMPLES

| Consumer                                                                                               | Communications                                                                     | Industrial                                                                                                                                                       | Automotive                                                                                                                      | Appliance                                                                   |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Motion Detectors<br>Thermostats<br>Remote Controls<br>Battery Management<br>CO/Smoke Detectors<br>Toys | Telephone Handsets<br>Microphone Controls<br>UART Replacements<br>Handset Displays | Utility Metering<br>Portable Instruments<br>Data Acquisition<br>Motor Control:<br>Stepper, Fan Control,<br>Brushless DC, AC<br>Induction, Switched<br>Reluctance | Light Dimmers<br>Intelligent Sensors<br>Proximity Detectors<br>Keyless Entry<br>Tire Pressure Monitors<br>Dash and Seat Control | Refrigerator Control<br>Smart Relays<br>Delay Timers<br>Temperature Sensors |

*Did you know? – The PIC16LF726 has industry leading low power performance.*

## MEDIUM PIN COUNT: 20, 28 and 40-PIN EMBEDDED DESIGNS



Many embedded systems have evolved from being single-function “islands of control” to multi-dimensional entities that perform a number of tasks capable of communicating with other systems. Microchip's latest 20-, 28- and 40-pin Mid-Range families aim to satisfy the demands of these complex systems.

### The PIC16F690 Family (PIC16F690/689/687/685/677/631)

With six variants ranging from 3.5K-14 Kbytes of Flash memory, up to 256 bytes of RAM and a mix of peripherals including EUSART, CCP and onboard analog comparators. These devices are well suited for designers with applications that need more code space or I/O than 14-pin variants supply, and are looking to increase system performance and code efficiency by employing hardware motor control and communications capability.

### The PIC16F887 Family (PIC16F887/886/884/883/882)

The five devices in the family are available with 3.5K, 7K or 14K of self-write Flash memory, up to 256 bytes of data EEPROM and up to 368 bytes of RAM. All feature 10-bit ADC, dual comparators, Master SPI/I<sup>2</sup>C, EUSART and ECCP. The PIC16F887 family is an excellent choice for systems whose control code fits within a small footprint, but requires more extensive communication or actuation capability than 8-bit MCUs traditionally offer.

### The PIC16F72X Family (PIC16F727/726/724/723/722)

Microchip's latest 28- and 40/44-pin Mid-Range product family offers a unique combination of low cost and market leading performance. With new low power Watchdog functionality and a minimum operating voltage of just 1.8V, these devices are ideal for battery powered applications. The PIC16F72X family features up to 8 KB of program Flash memory, 368 bytes of RAM and several new peripherals including the 16-input mTouch™ capacitive sensing module.

### Continuous Product Improvement

Microchip continues to increase functionality and performance of its products with each successive generation, providing features that help simplify the design of embedded control systems. The families share several enhancements that make designing control architectures for multi-dimensional, interconnected systems easier.

- **Enhanced Hardware Serial Communications** – It is often necessary to interface the main MCU with external memories, digital sensor ICs, display devices or other controllers in a system. Our EUSART and Master SPI/I<sup>2</sup>C peripherals allow flexibility in configuration to many of the common communication protocols.
- **Advanced Analog Peripherals** – Our precision 10-bit ADCs and dual comparators with S/R Latch mode can replace costly external ADCs, 555 timers, simple op amps, delta-sigma ADCs and other analog function ICs.
- **Miniaturized Package Options** – The 4x4 mm 20-pin QFN, 6x6 mm 28-pin QFN and the 8x8 mm 44-pin QFN allow designers to squeeze high levels of performance into space-constrained applications.

### FEATURED DEVELOPMENT TOOL

#### PICKit™ 2 Starter Kit (DV164120)

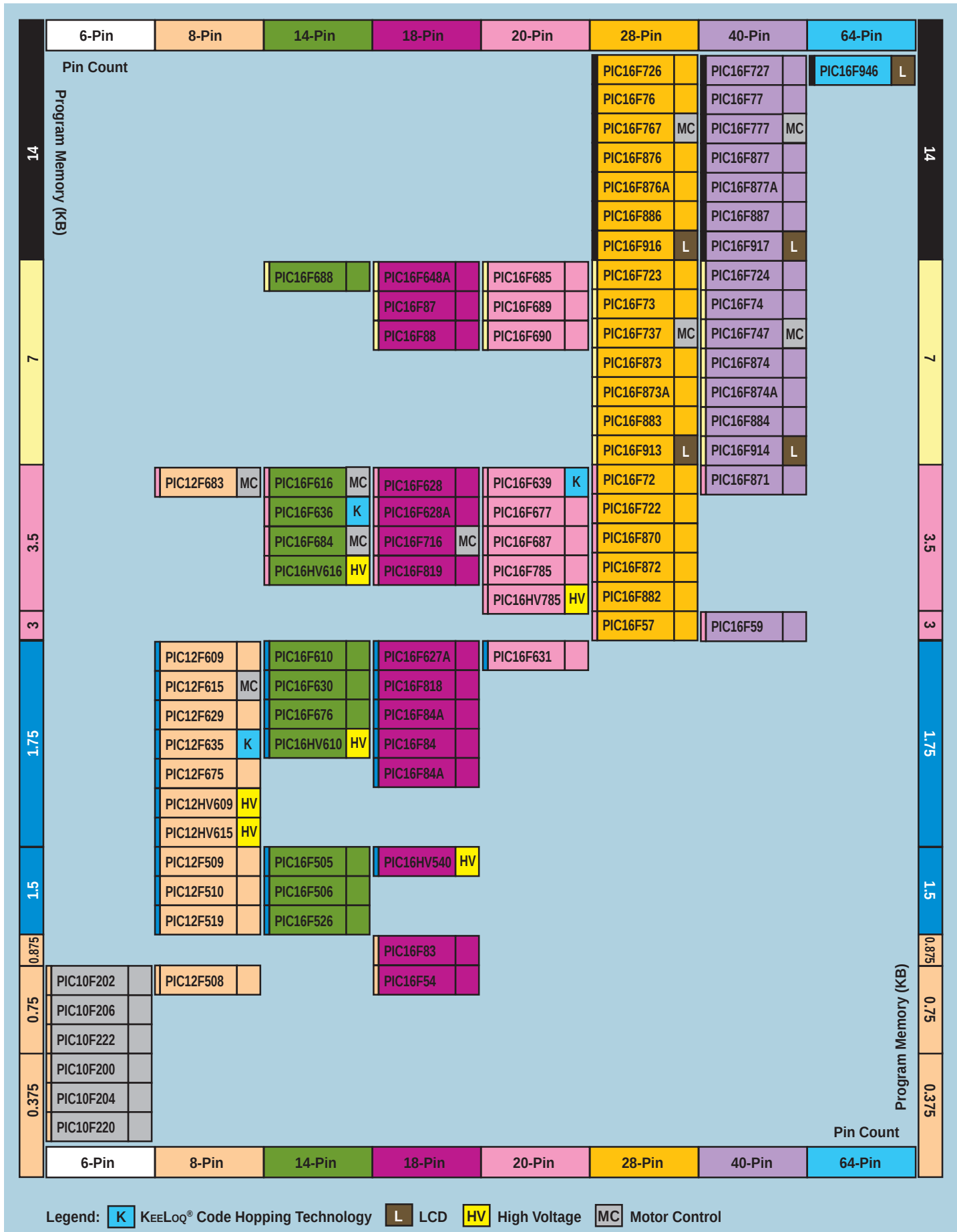


This kit contains a PICKit 2 programmer and a PICKit 2 low pin count demo board containing a PIC16F690 PDIP to get started programming baseline and Mid-Range Flash MCUs. PICKit 2 takes advantage of Microchip's full-speed USB device to speed up development. The PICKit 2 low pin count board supports 8-, 14- and 20-pin PIC MCUs.

### APPLICATION EXAMPLES

| Consumer                                                                                                                                      | Communications                          | Industrial                                                | Automotive                                                                                                  | Appliance                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------|
| Uninterruptible Power Supplies (UPS)<br>“Networked” Smoke Detectors<br>Home Automation Controller<br>E-Bike Controller<br>Swimming Pool Alarm | RFID Tag Reader<br>Telecom Base Station | Remote Flow Meter<br>Commercial Deep Fryer<br>Gate Opener | LED Lighting Control<br>Power Management Module<br>Cooling Fan Control<br>Tire Pressure Monitor<br>Receiver | Corded Drill<br>Electrical Relay |

# PIC10/PIC12/PIC16 FAMILIES



## HIGH-PERFORMANCE PIC18 FAMILY

| Pin Count           |               | 18-Pin        | 20-Pin        | 28-Pin        | 40-Pin        | 64-Pin        | 80-Pin        | 100-Pin       |  |
|---------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--|
| Program Memory (KB) | 128           |               |               |               |               | PIC18F6722    | PIC18F8722    | PIC18F97J60 E |  |
|                     |               |               |               |               |               | PIC18F6723    | PIC18F8723    |               |  |
|                     |               |               |               |               |               | PIC18F67J10   | PIC18F87J10   |               |  |
|                     |               |               |               |               |               | PIC18F67J11   | PIC18F87J11   |               |  |
|                     |               |               |               |               |               | PIC18F67J50 U | PIC18F87J50 U |               |  |
|                     |               |               |               |               |               | PIC18F67J60 E | PIC18F87J60 E |               |  |
|                     |               |               |               |               |               | PIC18F67J90 L | PIC18F87J90 L |               |  |
|                     |               | PIC18F2685 C  |               | PIC18F4685 C  | PIC18F6627    | PIC18F8627    | PIC18F96J65 E |               |  |
|                     |               |               |               |               | PIC18F6628    | PIC18F8628    |               |               |  |
|                     | 96            |               |               |               | PIC18F66J15   | PIC18F86J15   |               |               |  |
|                     |               |               |               | PIC18F66J16   | PIC18F86J16   |               |               |               |  |
|                     |               |               |               | PIC18F66J55 U | PIC18F86J55 U |               |               |               |  |
|                     |               |               |               | PIC18F66J65 E | PIC18F86J65 E |               |               |               |  |
| 80                  |               |               | PIC18F2682 C  | PIC18F4682 C  | PIC18F6622    | PIC18F8622    | PIC18F96J60 E |               |  |
|                     |               | PIC18F2610    | PIC18F4610    | PIC18F6680 C  | PIC18F8680 C  |               |               |               |  |
|                     |               | PIC18F2620    | PIC18F4620    | PIC18F66J10   | PIC18F86J10   |               |               |               |  |
|                     |               | PIC18F2680 C  | PIC18F4680 C  | PIC18F66J11   | PIC18F86J11   |               |               |               |  |
|                     |               | PIC18F26J11   | PIC18F46J11   | PIC18F66J50 U | PIC18F86J50 U |               |               |               |  |
|                     |               | PIC18F26J50 U | PIC18F46J50 U | PIC18F66J60 E | PIC18F86J60 E |               |               |               |  |
|                     |               | PIC18F26K20   | PIC18F46K20   | PIC18F66J90 L | PIC18F86J90 L |               |               |               |  |
|                     |               |               |               | PIC18F6527    | PIC18F8527    |               |               |               |  |
|                     |               | PIC18F2515    | PIC18F4515    | PIC18F6585 C  | PIC18F8585 C  |               |               |               |  |
|                     |               | PIC18F2525    | PIC18F4525    | PIC18F65J15   | PIC18F85J15   |               |               |               |  |
|                     |               | PIC18F2585 C  | PIC18F4585 C  | PIC18F6520    | PIC18F8520    |               |               |               |  |
|                     |               | PIC18F2510    | PIC18F4510    | PIC18F65J10   | PIC18F85J10   |               |               |               |  |
|                     |               | PIC18F2520    | PIC18F4520    | PIC18F65J11   | PIC18F85J11   |               |               |               |  |
|                     |               | PIC18F2523    | PIC18F4523    | PIC18F65J50 U | PIC18F85J50 U |               |               |               |  |
|                     |               | PIC18F2550 U  | PIC18F4550 U  | PIC18F65J90 L | PIC18F85J90 L |               |               |               |  |
|                     |               | PIC18F2553 U  | PIC18F4553 U  |               |               |               |               |               |  |
|                     |               | PIC18F2580 C  | PIC18F4580 C  |               |               |               |               |               |  |
|                     |               | PIC18F25J10   | PIC18F45J10   |               |               |               |               |               |  |
|                     |               | PIC18F25J11   | PIC18F45J11   |               |               |               |               |               |  |
|                     |               | PIC18F25J50 U | PIC18F45J50 U |               |               |               |               |               |  |
|                     |               | PIC18F25K20   | PIC18F45K20   |               |               |               |               |               |  |
|                     |               | PIC18F2455 U  | PIC18F4455 U  |               |               |               |               |               |  |
|                     |               | PIC18F2458 U  | PIC18F4458 U  | PIC18F6410    | PIC18F8410    |               |               |               |  |
|                     | PIC18F14K50 U | PIC18F2410    | PIC18F4410    | PIC18F6490 L  | PIC18F8490 L  |               |               |               |  |
|                     | PIC18F14K22   | PIC18F2420    | PIC18F4420    | PIC18F6493 L  | PIC18F8493 L  |               |               |               |  |
|                     |               | PIC18F2423    | PIC18F4423    | PIC18F64J11   | PIC18F84J11   |               |               |               |  |
|                     |               | PIC18F2431 MC | PIC18F4431 MC | PIC18F64J90 L | PIC18F84J90 L |               |               |               |  |
|                     |               | PIC18F2450 U  | PIC18F4450 U  |               |               |               |               |               |  |
|                     |               | PIC18F2480 C  | PIC18F4480 C  |               |               |               |               |               |  |
|                     |               | PIC18F24J10   | PIC18F44J10   |               |               |               |               |               |  |
|                     |               | PIC18F24J11   | PIC18F44J11   |               |               |               |               |               |  |
|                     |               | PIC18F24J50 U | PIC18F44J50 U |               |               |               |               |               |  |
|                     |               | PIC18F24K20   | PIC18F44K20   |               |               |               |               |               |  |
|                     |               | PIC18F2320    | PIC18F4320    | PIC18F6310    | PIC18F8310    |               |               |               |  |
|                     |               | PIC18F2321    | PIC18F4321    | PIC18F6390 L  | PIC18F8390 L  |               |               |               |  |
|                     |               | PIC18F2331 MC | PIC18F4331 MC | PIC18F6393 L  | PIC18F8393 L  |               |               |               |  |
|                     |               | PIC18F23K20   | PIC18F43K20   | PIC18F63J11   | PIC18F83J11   |               |               |               |  |
|                     |               |               |               | PIC18F63J90 L | PIC18F83J90 L |               |               |               |  |
|                     |               |               |               |               |               |               |               |               |  |
|                     | PIC18F1320    | PIC18F13K50 U |               |               |               |               |               |               |  |
|                     | PIC18F1330 MC | PIC18F13K22   |               |               |               |               |               |               |  |
|                     |               |               |               |               |               |               |               |               |  |
|                     | PIC18F1220    |               | PIC18F2220    | PIC18F4220    |               |               |               |               |  |
|                     | PIC18F1230 MC |               | PIC18F2221    | PIC18F4221    |               |               |               |               |  |
| Pin Count           |               | 18-Pin        | 20-Pin        | 28-Pin        | 40-Pin        | 64-Pin        | 80-Pin        | 100-Pin       |  |
| Program Memory (KB) |               |               |               |               |               | Pin Count     |               |               |  |
| 4                   |               |               |               |               |               | 4             |               |               |  |

Items in blue - check for availability.

Legend: **C** CAN **E** Ethernet **L** LCD **MC** Motor Control **U** USB

*Did you know? – The PIC18F family provides economical embedded solutions for many market segments including automotive, industrial, motor and instrumentation controls.*

## HIGH PERFORMANCE 8-BIT MICROCONTROLLERS

### The PIC18 Family



Preserve your code investment by migrating within over 150 products in the PIC18 family. All PIC18 families use the same MPLAB IDE, instruction set and C18 C compiler which is ideal for applications requiring:

- C-Compiler efficiency
- Flexibility of self programming Flash
- Socket and peripheral compatibility for complex embedded design
- Industry leading integrated peripherals and firmware including:
  - Segmented LCD drivers – up to 192 segments
  - mTouch™ Touch Sensing
  - Full-speed USB – up to 12 Mbps
  - Ethernet MAC and PHY (10Base-T) – with FREE TCP/IP stack
  - CAN interface – CAN 2.0B Active
  - LIN interface – LIN 2.1
  - Peripheral Pin Select for flexible pin mapping

#### PIC18 J-Series

The PIC18 J-series products include devices ranging from 28-100 pins, 8-128 KB Flash, 10-12 MIPS and operating voltage range from 2.0-3.6V with 5V tolerant digital I/O. The J-series portfolio targets cost sensitive applications as well as those that require integrated Ethernet MAC and PHY, full-speed USB or segmented LCD. For application notes, webinars and more information on the J-series products, visit: [www.microchip.com/PIC18J](http://www.microchip.com/PIC18J)

#### PIC18 K-Series

The PIC18 K-series products set a new benchmark for low power, low cost and high performance 16 MIPS (64 MHz). Products range from 20-44 pins with 8-64 KB Flash and up to 1 KB of EEPROM. The K-series devices are ideal for battery operated applications that require low power consumption. Peripherals include a precision internal oscillator, lower power Timer 1, rail-to-rail comparators, on-chip fixed voltage reference and USB. For more information on the K-series products, visit: [www.microchip.com/PIC18K](http://www.microchip.com/PIC18K)

#### Traditional PIC18

This low power family includes devices ranging from 28-80 pins, 4-128 KB Flash, EEPROM, 10 MIPS and operating voltage ranges from 2.0-5.5V. The traditional PIC18 family includes integrated peripherals like 12-bit ADC, USB, segmented LCD, motor control and CAN. In addition to the traditional products, the PIC18 family now has more to offer with J-series and K-series devices for very cost-sensitive applications.

### FEATURED DEVELOPMENT TOOLS

#### PICDEM™ PIC18 Explorer Demo Board (DM183032)



This board supports all the high-pin count PIC18 and general purpose J-series MCUs through Plug-In Modules (PIMs). It works with both 3V and 5V devices and includes the 5V-PIC18F8722 and 3V-PIC18F87J11. It has easy connection to MPLAB ICD 3 or REAL ICE™ debugging and programming tools.

#### PIC18F4XK20 Starter Kit (DM164124)



This kit includes a PICkit 2 Development Programmer and Debugger. The board highlights key features of the new PIC18F K-series MCUs and breaks out all pins to a header for prototyping development.

### APPLICATION EXAMPLES

| Consumer                                                                                                                  | Medical                                                                                                             | Industrial                                                                                     | Automotive                                                                                                           | Appliance                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Exercise Equipment<br>Universal Remote Controls<br>Toys/Games<br>Computer Peripherals<br>Battery Chargers<br>Spa Controls | Defibrillators<br>Blood Pressure Monitors<br>Glucose Monitors<br>Diagnostic Equipment<br>Biometrics<br>Thermometers | Motion Control<br>UPS Power Supplies<br>HVAC<br>Power Meters<br>Factory Automation<br>Security | Rain Sensors<br>Windows/Locks/Doors Immobilizers<br>Power Steering<br>Tire Pressure Monitors<br>Wiper Motor Controls | White Goods<br>Robotic Controls<br>HVAC<br>Air Conditioners<br>Thermostats/Sensors<br>Motor Control |

*Did you know? – Microchip's Capacitive mTouch™ Solution offers a number of different hardware options including sliders, single button and large keypads.*

## PIC® MICROCONTROLLERS WITH TOUCH SENSE

### Solutions for Touch Sense



Touch sensing is fast becoming an alternative to traditional push-button-switch user interfaces, because it requires no mechanical movement, and it enables a completely sealed and modern-looking design. Expanding beyond the consumer market, touch sensing is beginning to take hold in medical, industrial and automotive applications for reasons such as improved aesthetics, reduced maintenance and lower cost.

Microchip's mTouch™ Sensing Solution is a free and easy method which enables designers to add this leading-edge user interface to applications utilizing PIC® microcontrollers, without the cost of fee-based licensing and royalty agreements. This source code solution helps engineers quickly integrate touch sensing functionality with their existing application code in a single PIC microcontroller, thus reducing the total system cost associated with current solutions.

### How the mTouch™ Solution Works

#### Relaxation Oscillator

The relaxation oscillator measures frequency based on a capacitance. The frequency of the oscillator is then measured, and any shift due to a user's touch is detected and validated in software.

The relaxation oscillator method can be implemented using any PIC MCU with an on-board comparator.

The Capacitive Sensing Module (CSM), present on the PIC16F72X family, represents an extension of the relaxation oscillator method. It simplifies the amount of external hardware and software setup needed for many capacitive sensing applications. It can manage up to 64 keys while maintaining an overall low current consumption.

#### Direct Capacitance Measurement

Direct Capacitance Measurement utilizes a reference capacitor, which is charged for a fixed period of time. Using the Charge Time Measurement Unit (CTMU), the reference capacitor's 'charge time' is then compared to that of the input keys (buttons, sliders, or proximity sensors) to determine a touch.

### FEATURED DEVELOPMENT TOOLS

#### PICDEM™ Touch Sense 1 Development Kit (DM164125)



This kit introduces users to Microchip's Capacitive mTouch Sensing Solutions. The board is a completely sealed application example using three different touch sensor configurations in the form of a directional pad, keypad and slider section. A factory programmed firmware application provides immediate access to all of the board's features using the accompanying Windows® based Diagnostic Tool and PICKit Serial Analyzer.

#### PICDEM™ Touch Sense 2 Development Kit (DM164128)



The PICDEM Touch Sense 2 board features the Charge Time Measurement Unit (CTMU) peripheral. The board implements a slider, 20-button matrix keypad and a wheel with center button and a soft power button. The board also works with the mTouch Diagnostic Tool, which is a Graphic User Interface

tool use to develop, debug and diagnose the Capacitive Touch application.

For more information visit: [www.microchip.com/mtouch](http://www.microchip.com/mtouch)

### APPLICATION EXAMPLES

| Consumer                                                                   | Medical                                                 | Industrial                                                 | Automotive                                                                               | Appliance                                                         |
|----------------------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Set-top boxes<br>Toys/Games<br>Audio/Video Equipment<br>Exercise Equipment | Mobile Telephones<br>Diagnostic Equipment<br>Biometrics | Clean Room Interfaces<br>Motion Control<br>Security/Alarms | Car Radio/GPS<br>Occupant Sensors<br>Climate Control<br>Interface<br>Windows/Locks/Doors | White Goods<br>Thermostats<br>Motion Control<br>Proximity Sensing |

*Did you know? – Many LCD PIC microcontrollers can drive displays while in Sleep mode, providing maximum power savings for your application.*

## PIC® MICROCONTROLLERS FOR LCD DISPLAY



Microchip supports several families of microcontrollers with on-chip LCD driver control including the Mid-Range PIC16 and High Performance PIC18 families. The breadth of LCD segment drivers, package sizes and integrated features for embedded control application gives the designer flexibility to create different solutions based on the demand of varying market segments all from a single design.

### High Performance Solutions

The PIC18F8490 and PIC18F8XJ90 families of LCD MCUs offer greater memory density and higher pin counts to meet the demands of more complex segmented LCD applications with features including:

- 128-192 LCD segments
- 8-128 KB Flash program memory
- Low-power nanoWatt technology
- Advanced instruction set optimized for code efficiency, performance and use with C
- Internal oscillator for flexible clock system, fail safe clock
- Integrated analog peripherals such as A/D converters and comparators
- I<sup>2</sup>C™, SPI, UART serial communications
- 64 and 80-pin package options
- PIC18F8XJ90 family includes LCD voltage boost regulator

| LCD PIC® Microcontrollers                            |                                                                                                                                                        |                                                               |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| High Performance                                     |                                                                                                                                                        | Mid-Range                                                     |
| 5V<br>8-16 KB Flash                                  | 3V<br>8-128 KB Flash                                                                                                                                   | 5V<br>7-14 KB Flash                                           |
| PIC18F8490<br>PIC18F8390<br>PIC18F6490<br>PIC18F6390 | PIC18F87J90*<br>PIC18F86J90*<br>PIC18F85J90<br>PIC18F84J90<br>PIC18F83J90<br>PIC18F67J90*<br>PIC18F66J90*<br>PIC18F65J90<br>PIC18F64J90<br>PIC18F63J90 | PIC16F913<br>PIC16F914<br>PIC16F916<br>PIC16F917<br>PIC16F946 |

\*Check for availability.

### Mid-Range Solutions (PIC16F913/914/916/917/946)

These LCD MCUs provide a strong balance between price and LCD pixel count. Features:

- 60-168 LCD segments
- 7/14 Kbytes Flash program memory
- 256 bytes data EEPROM
- Low-power nanoWatt Technology
- 35 easy-to-learn instructions
- 32 kHz to 8 MHz internal oscillator for flexible clock systems, fail safe clock
- Integrated analog peripherals such as A/D converters I<sup>2</sup>C/SPI/AUSART serial communications

### FEATURED DEVELOPMENT TOOL

#### PICDEM™ LCD 2 Demo Board (DM163030)



This kit features the PIC18F85J90. There are plug-in modules available for evaluating the PIC18F8490, PIC16F917 and PIC16F946 families (MA160011). This board has battery operation with a 3V button cell and features 3V LCD glass with icons, numbers and support for alphanumeric and starburst display. The booster capability also supports contrast control and dimming. Parts are pre-programmed with demonstration software.

### APPLICATION EXAMPLES

| Consumer                                                        | Medical                                                                   | Industrial                                                              | Automotive                                                                   | Appliance                                                            |
|-----------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Thermostat<br>Sprinkler Controller<br>Baby Alarms<br>Lawn Mower | Temperature Reader<br>Fertility Computer<br>Drug Injector<br>Medical Pump | Utility Meter<br>Portable Instruments<br>Gas Detection<br>Gasoline Pump | Dashboard<br>Tire Pressure Sensor<br>Battery Vehicle Display<br>Audio System | Refrigerator<br>Stove/Oven/Microwave<br>Coffee Maker<br>Washer/Dryer |

*Did you know? – Microchip has the most 8-bit MCUs with integrated full-speed USB. Our USB MCUs can perform as the sole controller in embedded applications due to their highly integrated feature set.*

## PIC® MICROCONTROLLERS WITH INTEGRATED USB



Microchip offers USB solutions capable of full-speed USB operation (up to 12 Mbits/s) with the PIC18F family of devices. Check our 16- and 32-bit line for integrated USB On-The-Go or embedded host support.

### Full-Speed USB 2.0 (PIC18FXX5X)

USB communication is growing in popularity for remote upgrades, downloading data and other portable serial communication applications. Microchip's USB PIC MCUs bring the benefits of full-speed USB to a broad range of embedded designs that can operate in various environments and locations, enabling easy access to other USB devices such as printers, handheld devices or PCs. Features include:

- Performance: 12-16 MIPS
- 8-128 KB Program Flash
- Up to 4 KB Data RAM
- Analog features: 10-bit ADC, 2 comparators
- Up to 2 SPI/I<sup>2</sup>C™, 2 UARTs, 5 PWMs

### Free USB Drivers

No need to become an expert in USB drivers. Get your old serial port application up and running with our free USB drivers. Download the USB Framework which includes a variety of USB related PIC18 firmware projects, related drivers and PC resources at: [www.microchip.com/USB](http://www.microchip.com/USB)

### FEATURED DEVELOPMENT TOOLS

#### PICDEM™ Full-Speed USB 5V Demo Kit (DM163025)



This kit features the PIC18F4550 family of Flash MCUs with full-speed USB 2.0 interface. The board has a PIC18F4550 MCU in a 44-pin TQFP package, representing the superset for the 28- and 40/44-pin PIC18 USB devices.

| Traditional PIC18F<br>28-40/44 pin<br>2.0-5.5V<br>Full-speed                     | J-series PIC18F<br>28-80 pin<br>2.0-3.6V<br>Full-speed                                                                                                                                                               | K-series PIC18F<br>18 pin<br>1.8-3.6V<br>Full-speed |
|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|
| 8 KB-32 KB                                                                       | 16 KB-128 KB                                                                                                                                                                                                         | 8 KB-16 KB                                          |
| PIC18F4550<br>PIC18F4455<br>PIC18F4450<br>PIC18F2550<br>PIC18F2455<br>PIC18F2450 | PIC18F87J50<br>PIC18F86J55<br>PIC18F86J50<br>PIC18F85J50<br>PIC18F67J50<br>PIC18F66J55<br>PIC18F66J50<br>PIC18F65J50<br>PIC18F46J50*<br>PIC18F45J50*<br>PIC18F44J50*<br>PIC18F26J50*<br>PIC18F25J50*<br>PIC18F24J50* | PIC18F14K50<br>PIC18F13K50                          |

\*Check for availability.

#### PIC18F87J50 FS USB Demo Board (MA180021)

The PIC18F87J50 FS USB demo board can be used either as a standalone board or as a plug-in to the PIC18 Explorer board for evaluating the 64/80-pin PIC18 USB devices.

#### Low Pin Count USB Development Kit (DV164126/DM164127)



This kit provides an easy-to-use, low-cost way to evaluate Microchip's PIC18F14K50/13K50 20-pin USB microcontrollers. Created with the USB novice in mind, the kit contains the hardware, software and code examples needed to bring your USB design from concept to prototype. The kit includes self-directed course and lab materials designed to ease the learning curve associated with adding USB connectivity to embedded systems.

Download free USB drivers, bootloader and application notes at: [www.microchip.com/USB](http://www.microchip.com/USB)

## APPLICATION EXAMPLES

| Consumer                                                                                          | Communications                                                                            | Industrial                                                                                     | Automotive                                                                                 | Battery Powered                                                                          |
|---------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| Business Card Scanners<br>White-board Digitizers<br>Voice Recorders<br>MP3 Players<br>Fire Alarms | Voice-activated Applications<br>Advanced Wheel Chairs<br>Research Equipment<br>Automation | Manufacturing Tools<br>Data Loggers<br>Smart Displays<br>Micro Fuel Cells<br>Robot Controllers | Vehicle Network Buses<br>Diagnostic Tools<br>Vehicle Trace Recorders<br>Ultrasonic Sensors | Handheld Tools<br>Sensors<br>Security Applications<br>Remote Controls<br>Home Automation |

*Did you know? – Microchip is the only 8-bit MCU supplier offering integrated Ethernet MAC and PHY. Our free TCP/IP stack source code makes it easy for you to develop your Ethernet application.*

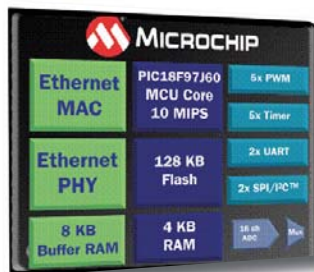
## PIC® MICROCONTROLLERS FOR EMBEDDED ETHERNET



Microchip offers Ethernet solutions designed specifically for the embedded control market, capable of 10 Mbps. In addition to the single chip PIC18F MCU with integrated Ethernet MAC and PHY, a stand alone Ethernet controller can be matched with many of our other PIC microcontrollers for additional flexibility.

### Integrated Ethernet

Microchip's feature-rich PIC18F97J60 family comes with up to 128 Kbytes of Flash program memory, 4 Kbytes of SRAM, 8 Kbytes of Ethernet buffer RAM and are packaged in 64-, 80- and 100-pin QFP options.



Additional features include:

- Integrated Ethernet MAC and PHY
- 10-bit ADC
- Two analog comparators
- 2 x UART
- 2 x SPI/I<sup>2</sup>C™

### Stand-Alone Ethernet Controller

Microchip's ENC28J60 is a 28-pin IEEE 802.3 compliant stand-alone Ethernet controller with on-board MAC and PHY (10 Mbps), 8 Kbytes of buffer RAM and SPI interface. Available in a small QFN package, the ENC28J60 provides a low pin count solution for remote communication with embedded applications. Match this controller with any PIC18, PIC24, PIC32 or dsPIC® controller for a completely flexible Ethernet solution.

### Ethernet Family (10 Mbps)

|             |                                      |
|-------------|--------------------------------------|
| PIC18F96J60 | 64 to 128K Flash, 64-, 80-, 100-pins |
| ENC28J60    | Ethernet Controller with SPI         |

No matter the application requirement, Microchip offers cost-effective, easy-to-use solutions for remote communication with embedded applications. Combined with Microchip's free TCP/IP software stack, a complete Ethernet solution is provided for adding remote monitoring and control to embedded applications.

### FEATURED DEVELOPMENT TOOLS

#### PICDEM.net™ 2 Demo Board (DM163024)



This Ethernet demo board supports both the popular ENC28J60 Ethernet Controller and the PIC18F97J60 single-chip Ethernet MCU family. Using this board and Microchip's free TCP/IP stack, a web server can be developed showcasing the capability to remotely monitor and control embedded applications over the Internet.

#### PICtail™ Daughter Board (AC164121)



This board plugs into PIC18 Explorer board, features the ENC28J60 and enables added Ethernet capability to existing PIC18 Explorer boards.

#### Internet Radio Demo Board (DM183033)



This board uses the PIC18F67J60 with integrated Ethernet MAC and PHY to connect to SHOUTcast servers and stream MP3 data to an audio decoder.

### APPLICATION EXAMPLES

| Consumer                                                       | Communications                                                     | Industrial                                                  | Security                                                                          | Appliance          |
|----------------------------------------------------------------|--------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------|--------------------|
| Vending Machines<br>Hotel Mini Bars<br>Home Control/Automation | VoIP Phone Adapters<br>Point-of-Sale Terminals<br>Servers/Networks | Power Supplies<br>Lighting Control<br>Environmental Control | Asset Monitoring<br>Fire and Safety<br>Security Panels<br>Fingerprint Recognition | General Appliances |

*Did you know? – Microchip's broad portfolio of low power MCUs are ideal for battery-powered products. Integrated power management features keep your embedded design energy efficient.*

## PIC® MICROCONTROLLERS FOR LOW POWER



### What is nanoWatt Technology?

Microchip developed a unique blend of process technology, design techniques and flexible power management features that give users the ability to design systems with extremely constrained power budgets. Very often, the limiting factor in low power operation of any MCU is static current consumption. Microchip developed its process technology and design methodologies to keep leakage current to a minimum. In fact, the typical PIC MCU with nanoWatt Technology draws less than 100 nA in Sleep mode.

Realizing that voltage is also a hurdle to reducing power consumption, Microchip has designed many of its nanoWatt Technology MCUs to be fully operable with supplies rated between 1.8V and 5.5V.

PIC MCUs with nanoWatt Technology support up to nine oscillator modes. These include:

- **Clock frequency can be switched on the fly**
  - Allowing no delay in code execution on transitions between external clocks and the internal oscillators.
- **Advantageous two-speed start-up feature**
  - Allows seamless transition by running from either of the internal oscillators while an external clock source stabilizes on start-up. After the external source has stabilized, the MCU automatically makes a clock switch, saving precious “up” time.
- **Configurable Idle, Sleep and Deep Sleep modes**
  - Let designers tailor current consumption levels and clocking options to fit any power budget.
- **Ultra Low Power Wake-up (ULPW) mode**
  - Reduces current draw during wake-up.

### APPLICATION EXAMPLES

| Consumer                                                                                              | Communications                                                                            | Industrial                                                                 | Medical                      | Battery Powered                                                                          |
|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|------------------------------|------------------------------------------------------------------------------------------|
| Business Card Scanners<br>White-board Digitizers<br>Voice Recorders<br>MP3 Players<br>Smoke Detectors | Voice-activated Applications<br>Advanced Wheel Chairs<br>Research Equipment<br>Automation | Manufacturing Tools<br>Data Loggers<br>Smart Displays<br>Robot Controllers | Glucose Meters<br>Pedometers | Handheld Tools<br>Sensors<br>Security Applications<br>Remote Controls<br>Home Automation |

### Featured Low Power Products

|             |               |
|-------------|---------------|
| PIC18F46J11 | PIC18LF8493   |
| PIC18F45K20 | PIC16F63X/690 |
| PIC18LF8722 | PIC16LF726    |

**nanoWatt Technology**

Microchip has developed the industry's most comprehensive power management technology spanning static low power, active power and fast wake-up. We call it nanoWatt Technology because it is made up of more than 30 features which allow you to manage all of the components of power including static, active and average power consumption.

Static low power features include Sleep currents as low as 100 nA, Real Time Clock currents of 1  $\mu$ A, and low power system voltage monitors; ideal for battery powered applications.

Fast wake-up power management features include ultra fast 1  $\mu$ s wake-up and on the fly clock frequency change with two-speed startup, all helping reduce average power and to maintain battery life.

Active power management maximizes performance and power by allowing the CPU core to run a different speed than the peripherals. The CPU can run slower, faster, or not at all, while the peripherals such as ADCs or timers continue to function. For systems that can never power down, active power management is essential.

Use the Battery Life Calculator on-line at:  
[www.microchip.com/lowpower](http://www.microchip.com/lowpower)

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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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