MICROCHIP

8-bit PIC® Microcontroller Solutions

8-bit
PIC® Microcontroller Solutions

Lead (Pb)-Free Packaging

Microchip has converted from tin-lead (SnPb)-plated product packaging to lead (Pb)-free product packaging across the entire portfolio of PIC® microcontrollers, dsPIC® digital signal controllers, serial EEPROMs, stand-alone analog and other devices. This enables our customers to achieve compliance with new regulations around the world such as the European Union Restrictions on Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive.

Microchip Technology, *a leading provider of microcontroller and analog semiconductors, offers complete embedded control solutions that combine time-to-market advantages with high performance and increased functionality. Microchip's broad family of 8-bit microcontrollers features a proprietary RISC-based architecture and is marketed under the PIC microcontroller brand name.*

THE MICROCHIP ADVANTAGE

With more than 290 microcontrollers in the product portfolio, Microchip can provide solutions for the entire performance range of 8-bit microcontrollers. The PIC microcontroller solution features a powerful architecture, flexible memory technologies, comprehensive easy-to-use development tools, complete technical documentation and post design-in support through a worldwide sales and distribution network.

Microchip's proprietary PIC microcontrollers have quickly become a worldwide standard with more than four billion devices shipped and more than 400,000 development systems delivered since 1990. Microchip is recognized as the #1 supplier of 8-bit microcontrollers, based on worldwide unit shipments*.

Low-Risk Product Development

PIC microcontrollers achieve low-risk product development by providing seamless program size expansion. Pin compatibility facilitates drop-in replacements of package types as well as variations of reprogrammable (Flash) and one-time programmable (OTP) program memories without having to completely re-write code.

Microchip's MPLAB® Integrated Development Environment (IDE), a simple yet powerful development environment, supports low-risk product development by providing a complete management solution for all development systems in one tool. Whether programming a 6 or 80-pin device, learn and utilize one environment for all PIC microcontroller design activities.

Faster Time to Market

Microchip's seamless migration path with standard pin schemes and code compatibility allows engineers to reuse verified code and a proven printed circuit board layout. Adding higher memory options, incremental I/O and analog peripherals can be accomplished without losing their software investment, reducing time to market.

Lower Total System Cost

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. Microchip's flexible Flash and OTP memory options streamline product development and promote even greater cost savings.

Dependable Delivery and Quality

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.

Outstanding Support

Microchip's 24/7 global technical support line offers technical support resources any time help is needed. Also available are hundreds of dedicated field applications engineers located in more than 45 sales offices and through authorized distributors worldwide. Standard code libraries, reference designs, application notes and seminars are offered online and at Microchip Regional Training Centers. These options support the demands of a diversified customer base and a wide range of end product applications.

*Gartner Dataquest, 2003 Microcontroller Market Share & Unit Shipments, Tom Starnes, June 2003

Microchip's 8-bit PIC microcontrollers provide the performance required for 4, 8 and 16-bit microcontroller applications. Microchip's PIC microcontrollers, available in 6 to 80-pin packages, offer the best price/performance ratio in the industry. Flexible memory technologies such as Flash, OTP, read-only memory (ROM) and ROM-less ensure an ideal PIC microcontroller for any application.
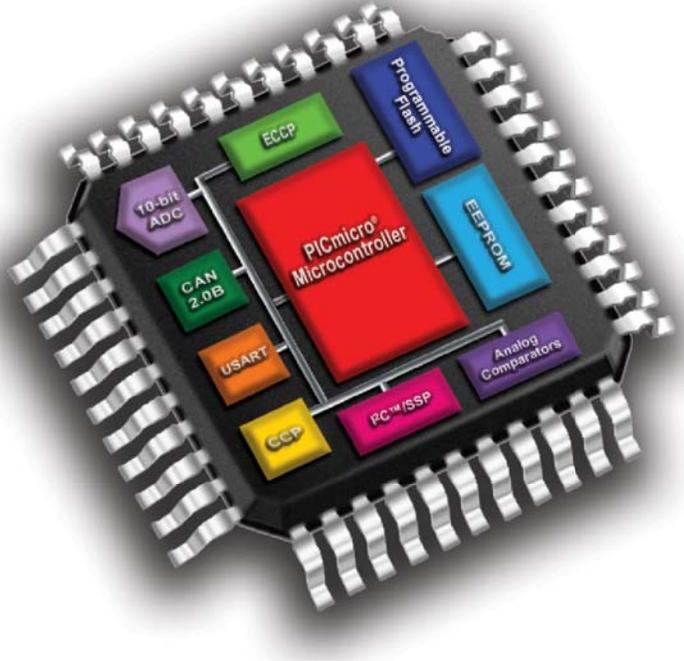
PIC® MICROCONTROLLER OVERVIEW

RISC-based Architecture

The PIC microcontroller architecture is based on a modified Harvard RISC instruction set that provides an easy migration path from 6 to 80 pins and from 384 bytes to 128 Kbytes of program memory.

By combining RISC features with a modified Harvard dual-bus architecture, Microchip's fast and flexible 10 MIPS PIC18F core is the most popular architecture for new microcontroller designs. A simple instruction set and seamless migration between product families make PIC microcontrollers the logical choice for designs requiring flexibility and performance.

ADVANTAGES

- 12, 14 and 16-bit wide instructions are upward compatible and tailored to maximize processing efficiency and boost performance.

- Instructions and data are transferred on separate buses, avoiding processing bottlenecks and increasing overall system performance.

- Two-stage pipelining enables one instruction to be executed while the next instruction is fetched.

- Single wide word instructions increase software code efficiency and reduce required program memory.

- With only 33-79 instructions, programming and debugging tasks are easy to learn and perform.

- Upward device compatibility allows designers to retain their capital investment in code development and development tool resources.

- Diverse Flash memory offering provides industry standard to industry leading endurance and retention. Devices with the self-write option have the ability to remotely program and upgrade the MCU application in the field.

- Data EEPROM is an available option for those applications which require secure, non-volatile memory for data that changes frequently.

ON-CHIP PERIPHERAL SET

PIC microcontrollers offer a wide range of products with broad on-chip peripheral features including:

- **Communications Peripherals and Protocols:**
  – RS232/RS485
  – SPI
  – I2C™
  – CAN
  – USB
  – LIN
  – Radio frequency
  – TCP/IP
  – Ethernet

- **Control and Timing Peripherals:**
  – Capture/Compare
  – Pulse Width Modulators (PWMs)
  – Counters/timers
  – Watchdog timers

- **Display Peripherals:**
  – LED drivers
  – LCD drivers

- **Analog Peripherals:**
  – Up to 12-bit analog-to-digital (A/D) converters
  – Comparators and op amps
  – Brown-out detectors
  – Low-voltage detectors
  – Temperature sensors
  – Oscillators
  – Voltage references
  – Digital-to-Analog (D/A) converters
  – Voltage regulators

Microchip offers flexible programming options that allow engineers to choose the most appropriate memory technology for their applications. These programming options address procurement issues by reducing and limiting work-in-process liability and facilitating finished goods code revisions. Microchip's worldwide distributors stock Flash and OTP device inventory, allowing designers to respond to immediate sales opportunities or accommodate engineering changes off the shelf.

FLEXIBLE PROGRAMMING OPTIONS
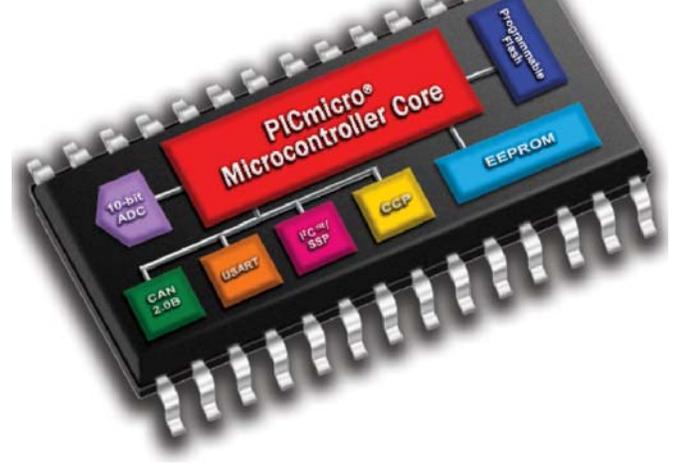
PRODUCTION PROGRAMMING OPTIONS

In-Circuit Serial Programming™ (ICSP™) Technology

Microchip's Flash and OTP PIC microcontrollers feature Microchip's proprietary ICSP capability. ICSP technology allows the microcontroller to be programmed after being placed on a circuit board, offering tremendous flexibility, reduced development time, increased manufacturing efficiency and improved time to market. This popular technology enables cost-reduced field upgrades, system calibration during manufacturing and the addition of unique identification codes to the system. Microchip offers the most non-intrusive programming methodology in the industry requiring only two I/O pins for most devices.

Self Programming

Some of Microchip's Flash microcontroller families feature a self-programming capability. Self programming enables remote upgrades to the Flash program memory and the end equipment through a variety of mediums, ranging from Internet and modem to RF and infrared. Microchip's Self-Write Flash allows for easy code revisions in the end user's application.

One-Time Programmable (OTP)

OTP PIC microcontrollers are manufactured in high volumes without specific software and can be shipped immediately for custom programming.

Quick-Turn Programming (QTP)

Microchip offers a QTP programming service for factory production orders. This service is ideal for designers who choose not to program devices in their own factories and whose production code patterns have stabilized.

Serialized Quick-Turn Programming (SQTP^SM)

The SQTP service is a unique, flexible programming option that allows Microchip to program serialized, random or pseudo-random numbers into each device. Serial programming allows each device to have a unique number that can serve as an entry code, password or identification number.
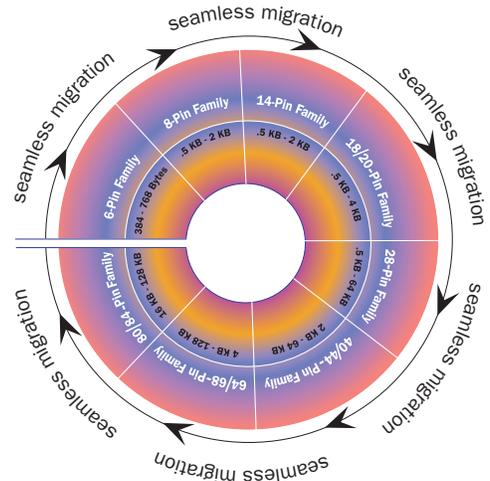
Read-Only Memory (ROM)

Microchip offers masked ROM versions of many of its most popular PIC microcontrollers, providing engineers with the lowest cost option for high-volume products with stable firmware.

Compatibility is key to re-using and re-inventing PIC microcontroller designs. The standardized pin schemes of the PIC microcontroller families support building a code library not traditionally available from other suppliers. This unique feature provides socket, software and peripheral compatibility, making it possible for new features to be added to existing applications. Each pin is capable of accommodating several peripheral functions, allowing designers to add or swap functionality without changing the printed circuit board, thus minimizing or eliminating costly re-design.
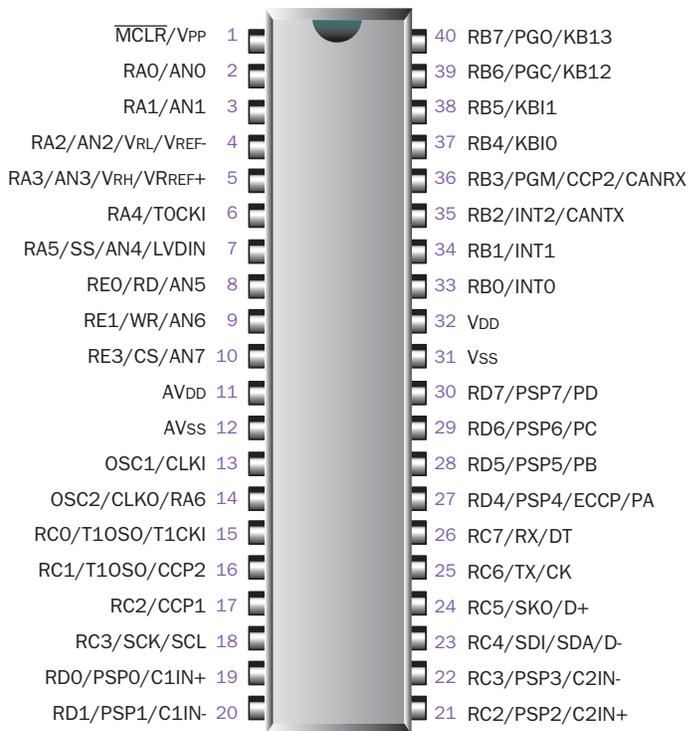
PIC® MICROCONTROLLER MIGRATION STRATEGY

As part of an inherent strategy to offer customers a low-risk development environment, the PIC microcontroller family offers easy migration within the complete range of products. Migration between the different PIC microcontrollers enables several advantages such as future cost reductions, feature enhancements and late development changes with minimal impact to the existing hardware, software and the engineering development environment.

The PIC microcontroller family is pin compatible within a given pin count as well as code compatible between the different architectures. This offers a seamless migration path between the different PIC microcontrollers that protects investments made in software development and design tools.

EXAMPLE OF PIC® MICROCONTROLLER MIGRATION

Pin	Left		Pin	Right
1	$\overline{MCLR}$/VPP		40	RB7/PGO/KB13
2	RA0/AN0		39	RB6/PGC/KB12
3	RA1/AN1		38	RB5/KBI1
4	RA2/AN2/VRL/VREF-		37	RB4/KBI0
5	RA3/AN3/VRH/VRREF+		36	RB3/PGM/CCP2/CANRX
6	RA4/T0CKI		35	RB2/INT2/CANTX
7	RA5/SS/AN4/LVDIN		34	RB1/INT1
8	RE0/RD/AN5		33	RB0/INT0
9	RE1/WR/AN6		32	VDD
10	RE3/CS/AN7		31	VSS
11	AVDD		30	RD7/PSP7/PD
12	AVSS		29	RD6/PSP6/PC
13	OSC1/CLKI		28	RD5/PSP5/PB
14	OSC2/CLKO/RA6		27	RD4/PSP4/ECCP/PA
15	RC0/T1OSO/T1CKI		26	RC7/RX/DT
16	RC1/T1OSO/CCP2		25	RC6/TX/CK
17	RC2/CCP1		24	RC5/SKO/D+
18	RC3/SCK/SCL		23	RC4/SDI/SDA/D-
19	RD0/PSP0/C1IN+		22	RC3/PSP3/C2IN-
20	RD1/PSP1/C1IN-		21	RC2/PSP2/C2IN+

Example device list:

|	
PIC16CR65	PIC18C442
PIC16C65B	PIC18C452
PIC16C662	PIC18F4220
PIC16C67	PIC18F4320
PIC16C74B	PIC18F4331
PIC16C765	PIC18F4420
PIC16C77	PIC18F4431
PIC16C774	PIC18F4480
PIC16F74	PIC18F4520
PIC16F747	PIC18F4580
PIC16F77	PIC18F4685
PIC16F777	
PIC16F871	
PIC16F874	
PIC16F874A	
PIC16F877	
PIC16F877A	
PIC16F914	
PIC16F917	

2 KB ROM

96 KB Flash

Pin and Code Compatibility also for 8, 14, 18, 28, 64 and 80/84-pin packages

See Microchip Technology's Product Selector Guide (DS00148) for similar microcontroller family migration paths.

Microchip's 8-bit PIC microcontrollers fall into three product architecture categories providing a variety of options for any application requirement:

- **Baseline 8-bit Architecture: 12-bit program word**
- **Mid-Range 8-bit Architecture: 14-bit program word**
- **High Performance 8-bit Architecture: 16-bit program word**

PIC® MICROCONTROLLER PRODUCT ARCHITECTURES
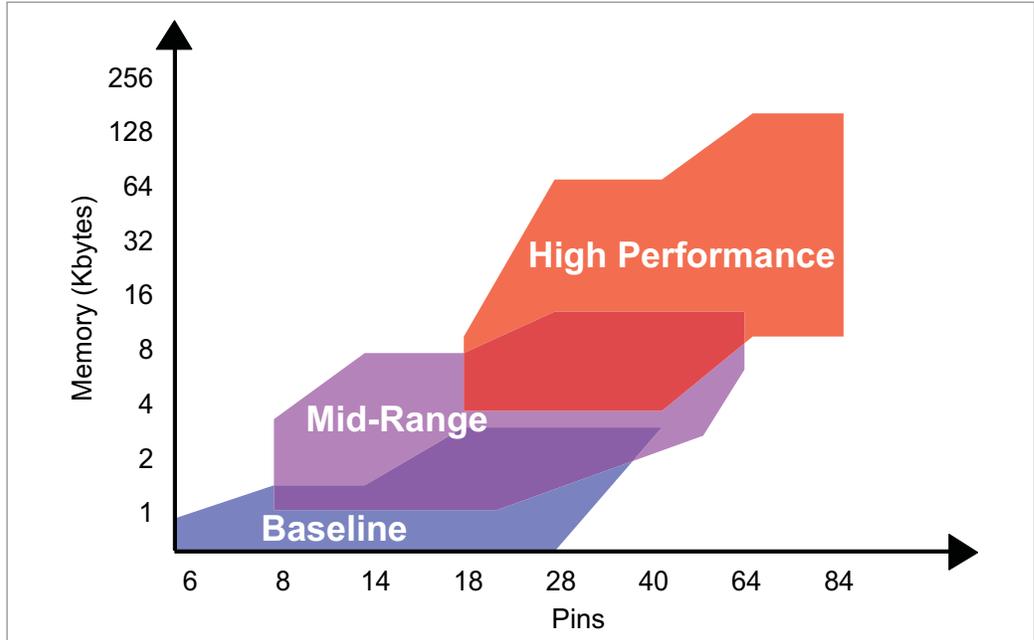
BASELINE ARCHITECTURE

The Baseline Architecture includes the PIC10F family and portions of the PIC12 and PIC16 families. These devices utilize a 12-bit program word architecture with 6 to 28-pin package options. The concisely defined feature set of the Baseline Architecture enables the most cost-effective product solutions. A range of low operating voltages makes this architecture ideal for battery-operated applications.

The PIC10F family is Microchip's latest addition to the product portfolio. The PIC10F200 series provides another industry first, an inexpensive 8-bit Flash microcontroller in a 6-pin package. With only six pins, they are extremely easy to use and have a short learning curve for anyone not experienced in designing with microcontrollers. In addition, they can be used for a number of design challenges not traditionally solved by a microcontroller.

The PIC12 family packs Microchip's powerful RISC-based PIC microcontroller 12-bit program word architecture into 8-pin DIP or SOIC packages with Flash or OTP program memory options.

The PIC16C5X and PIC16F5X are well-established Baseline products, offered in 14, 18, 20 and 28-pin SOIC and SSOP packages.

Baseline Product Features

- Low pin count and small form factor
- Flexible Flash program memory
- Low power capability
- Cost sensitive
- Ease of use
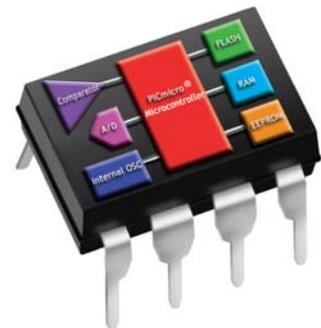
MID-RANGE ARCHITECTURE

The Mid-Range Architecture includes members of the PIC12 and PIC16 families that feature a 14-bit program word architecture. These families are available with 8 to 64-pin package options.

The PIC microcontrollers featuring Microchip's Mid-Range 14-bit program word architecture are available in higher pin count packages with Flash and OTP program memory options. The Flash products offer an operating voltage range of 2.0V to 5.5V, small package footprints, interrupt handling, a deeper hardware stack, multiple A/D channels and EEPROM data memory. All of these features provide the Mid-Range microcontrollers with an intelligence level not previously available because of cost or size considerations.

The Mid-Range PIC16 devices offer a wide range of package options, as well as low-to-high levels of peripheral integration. These PIC16 devices feature various serial analog and digital peripherals, such as USB, SPI, I²C™, USART, LCD and A/D converters. The Mid-Range PIC16 microcontrollers have interrupt handling capability with an 8-level hardware stack.
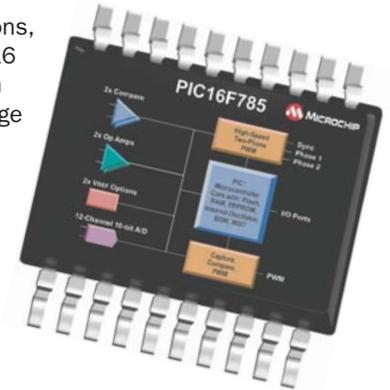
Mid-Range Product Features

- Expansive package offerings – 8 to 64 pins
- Flexible Flash program memory
- Low power capability
- Rich peripheral set
- 5 MIPS operating performance
- Optimal cost-to-performance ratio

HIGH PERFORMANCE ARCHITECTURE

Microchip's High Performance Architecture encompasses the PIC18 family of devices. These microcontrollers utilize a 16-bit program word architecture with 18 to 80-pin package options.

The PIC18 devices are high performance microcontrollers with integrated A/D converters. All PIC18 microcontrollers incorporate an advanced RISC architecture that supports Flash and OTP devices. The PIC18 has enhanced core features, 32 level-deep stack and multiple internal and external interrupts. The separate instruction and data buses of the Harvard architecture allow a 16-bit instruction word with separate 8-bit data. The two-stage instruction pipeline enables all instructions to execute in a single cycle, except for program branches, which require two cycles. A total of 79 instructions (reduced instruction set) are available. The PIC18 family has special features to reduce external components, thus minimizing cost, enhancing system reliability and reducing power consumption. The PIC18 family builds on the foundation established by the other 8-bit PIC microcontrollers and provides engineers with a smooth, easy migration to these higher levels of performance and feature sets.

High Performance Product Features

- Expansive package offerings – 18 to 80 pins
- Flexible Flash program memory
- Low power capability on devices with nanoWatt technology
- Linear program memory space up to 2 Mbytes
- 10 MIPS operating performance
- Hardware 8 x 8 multiplier
- Advanced communication peripherals and protocols (CAN, USB, ZigBee™ and TCP/IP)
- J-Family for competitive cost-sensitive applications

To meet the increasing demand for integrated features coupled with processing capabilities in battery-powered products, Microchip's family of low power microcontrollers provides extensive power management options. These devices offer a cost-effective solution for intelligent systems that require extended battery life and energy-efficient operation.

nanoWatt
Technology

LOW-POWER nanoWatt TECHNOLOGY

Microchip's nanoWatt Technology

Take control of overall system power consumption with Microchip's Power-Managed PIC microcontrollers featuring nanoWatt Technology.

Microchip's proprietary nanoWatt Technology provides industry leading low-power operating voltage ranges and flexible power-managed technology from DC up to 40 MHz.

What is nanoWatt Technology?

nanoWatt Technology is Microchip's 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 has developed its process technology and design methodologies to keep leakage current to a minimum. In fact, the typical PIC microcontroller with nanoWatt Technology draws less than 50 nano-Amps in Sleep mode.

Realizing that voltage is also a hurdle to reducing power consumption, Microchip has designed many of its nanoWatt Technology microcontrollers to be fully operable with any supply rated between 2 Volts and 5.5 Volts.

PIC microcontrollers with nanoWatt Technology support up to nine oscillator modes. These include the option to select from two internal clock sources – a software configurable 8 MHz oscillator for normal operation and a 31 KHz oscillator for use when low power consumption is a necessity. Clock frequency can be switched on the fly, allowing the user to transition between external clocks and the internal oscillators with no delay in code execution. A two-speed start-up feature takes advantage of this 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 microcontroller automatically makes a clock switch, saving precious "up" time in applications with low power budgets.

nanoWatt Technology microcontrollers allow design engineers to fine tune their system power consumption with several new power managed modes. These include configurable Idle and Sleep modes that let designers tailor current consumption levels and clocking options to fit any power budget, as well as an Ultra Low Power Wake-up (ULPW) mode that drastically reduces current draw during wake-up.

nanoWatt Technology provides excellent intrinsic performance, combined with flexibility in supply voltage selection, clock frequency and power modes.

Complementing a broad portfolio of nanoWatt Technology PIC microcontrollers, Microchip also offers a wide range of low-power analog devices, enabling engineers to select a complete system power consumption solution from one source. A table of the PIC microcontrollers with nanoWatt Technology appears in the Product Selector Guide.

FEATURED DEVELOPMENT TOOLS

PICDEM™ Low Power Solutions Demonstration Board

The PICDEM™ Low Power Solutions Demonstration Board (DM163026) gives designers a convenient and fun way to explore the nanoWatt technology features of PIC microcontrollers within a functional ultrasonic range-finder application using the PIC18F4620.

This tool is ideal for learning nanoWatt Technology features and implementing system power reduction techniques. This board is part of the *Workshop-in-a-Box 2*, a complete nanoWatt Technology training kit designed for self-paced and instructor led training.

The Low Power Solutions Demonstration Board CD-ROM includes three self-paced, step-by-step lab exercises, using the PIC18F4620, which illustrate the following concepts:
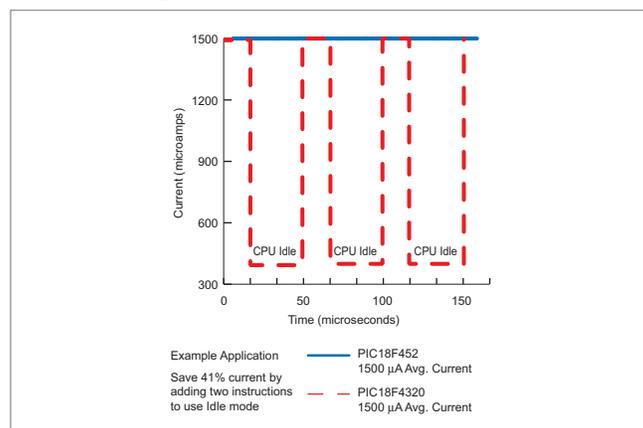
- nanoWatt Technology features to reduce power consumption
- Improving system power consumption
- Improving board performance

PICDEM™ 4 Demonstration Board

The PICDEM™ 4 Demonstration Board (DM163014) provides a simple, low-cost learning tool for evaluating Microchip's Power-Managed PIC microcontrollers. The board supports PIC12F, PIC16F and PIC18F Flash microcontrollers in 8, 14 and 18-pin packages.

Power-Saving Application Example

Example Application
Save 41% current by adding two instructions to use Idle mode

— PIC18F452 1500 µA Avg. Current
--- PIC18F4320 1500 µA Avg. Current

APPLICATION EXAMPLES

Consumer	Communications	Industrial	Automotive	Appliance
Motion Detectors	Telephone Handsets	Utility Metering	Light Dimmers	Refrigerator Control Units
Thermostats	Microphone Controls	Portable Instruments	Intelligent Sensors	Smart Relays
Remote Controls	UART Replacements	Data Acquisition	Proximity Detectors	Delay Timers
Battery Management	Handset Displays	Motor Control	Keyless Entry	Temperature Sensors
			Tire Pressure Monitors	

Based on Microchip's High Performance Arthitecture, the PIC18F family provides economical embedded solutions which address many market segments, including: automotive, industrial control, motor control, instrumentation, monitoring and consumer. These devices feature socket, software and peripheral compatibility, providing scalability for complex embedded designs.

HIGH PIN COUNT, HIGH-DENSITY MEMORY

The high pin count, high-density memory, Flash PIC18F microcontroller family continues to expand, offering larger memory sizes, higher pin count packages, more communications interfaces and higher performance. These devices also feature socket, software and peripheral compatibility, providing scalability for complex embedded designs. The PIC18F family is ideally suited for applications requiring scalable large memory and higher pin counts, offering designers added I/Os, timers, a feature-rich peripheral set and the flexibility of field self-programmability with Flash program memory. The PIC18F microcontrollers can serve as cost-efficient solutions for general-purpose applications and for applications that are written in C, require an RTOS or use a complex communications protocol stack, such as TCP/IP, DeviceNet™ or ZigBee™ protocols.
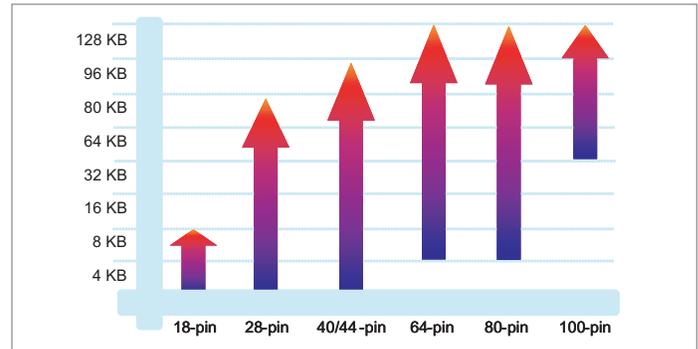
The high pin count, high-density memory PIC18F family supports:

- LCD displays: up to 192 segments
- USB interfaces: speeds up to 12 Mbits/s
- CAN interfaces: CAN 2.0B Active
- LIN interfaces: LIN 1.2
- ZigBee technology capable: PIC18F > 16K Word
- Ethernet capable: 10BASE-T, TCP/IP stack

High Pin Count, High-Density Memory Microcontroller Features

- Up to four serial interfaces (2x EUSART, 2x MI^{2}C/SPI)
- Up to five timers/counters
- Up to five Capture/Compare/PWM (CCP) modules
- nanoWatt Technology Power Management
- Hardware 8 x 8 multiplier
- 40 MHz operation, 10 MIPS
- Flash program memory: up to 128 Kbytes
- EEPROM memory: up to 1 Kbyte
- RAM memory: up to 4 Kbytes
- I/O pins: range from 16 to 70
- Voltage ranges targeting 5V or 3V applications

A Complete High Pin Count, High-Density Memory Solution

	18-pin	28-pin	40/44-pin	64-pin	80-pin	100-pin
128 KB						
96 KB						
80 KB						
64 KB						
32 KB						
16 KB						
8 KB						
4 KB						

FEATURED DEVELOPMENT TOOLS

PICDEM™ HPC Explorer Board

The PICDEM™ HPC Explorer Board (DM183022) is a low-cost tool ideally suited for evaluating the performance of Microchip's high memory and high pin count PIC18F 8-bit microcontrollers. This board can be used to demonstrate many PIC18F devices, including PIC18F8722 and PIC18F87J10 families.

The MPLAB Visual Device Initializer (VDI) makes it easy to configure the PIC18F devices by simply dropping icons onto the chip diagram and setting up operational parameters in a dialog box. This tool graphically configures the microprocessor and peripherals and when complete, a mouse click generates code usable in assembly language or C programs.

APPLICATION EXAMPLES

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

Low pin count microcontrollers have emerged as one of the fundamental building blocks for any electronic application. Kitchen appliances, smoke detectors, toys, power supplies, security systems, PC motherboards and almost any other electronic device which people take for granted in their everyday lives can use a microcontroller as a primary building block in the design.

LOW PIN COUNT AND SPACE-CONSTRAINED

A Complete Low Pin Count Solution
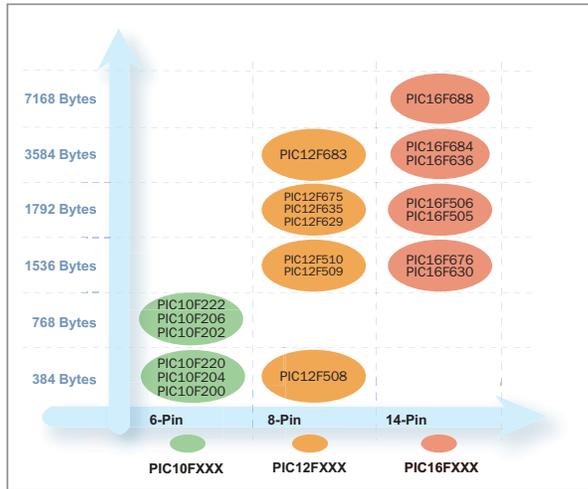
Microchip offers the most complete family of low pin count Flash microcontrollers available. These devices range from easy-to-use 6-pin microcontrollers, which can replace discrete logic functions, to 20-pin microcontrollers with advanced analog and communications peripherals that can serve as the central processor in an application.

The 8-bit PIC microcontroller architecture is easy to learn, and users can easily move from the Baseline (x12) Architecture to the Mid-Range (x14) or High Performance (x16) Architectures as their design changes or as additional features that these architectures support are required, such as interrupts, additional memory or interfacing to advanced hardware peripherals.

6-Pin PIC® Microcontrollers

Microchip continues to push the limits of the 8-bit microcontroller with the PIC10F family of 6-pin microcontrollers. The family now consists of six members (PIC10F200, PIC10F202, PIC10F204, PIC10F206, PIC10F220 and PIC10F222) that offer 384 bytes to 768 bytes of Standard Flash program memory and 16 bytes to 24 bytes of data RAM memory. Current offerings include options with basic functionality as well as comparators or A/D converters.

While the PIC10F family is ideal for any space-constrained application, its combination of small form factor, high performance and extremely low cost is creating new applications for the PIC10F that are not traditionally served by microcontrollers:

"Electronic Glue" – Design in a PIC10F microcontroller from the start to accommodate bug fixes and last-minute changes. This can avoid costly and time-consuming silicon revisions or board changes.

Logic Control – Optimize board space and cost by incorporating a PIC10F microcontroller for logic control. A PIC10F allows implementation of a more complex solution and 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, the PIC10F family is ideal for many emerging "disposable" applications incorporating electronics intelligence, such as pregnancy testers, dialysis monitoring (blood sugar), drug testers and much more.

Waveform Generation – A PIC10F microcontroller can replace traditional 555 timers, PWMs, remote control encoders, pulse generation, programmable frequency source, resistor programmable oscillators and much more.

"Mechatronics"/Mechanical Functions – Replace traditional mechanical functions, such as smart switches, mode selectors, remote I/Os, timers, LED flashers and any other form of mechanical timers and switches with a PIC10F microcontroller, which provides the power and flexibility advantages of a microcontroller solution.

FEATURED DEVELOPMENT TOOLS

PIC10F2XX Universal Programmer Adapter

The PIC10F2XX Universal Programmer Adapter (AC163020) provides PIC10F socket support for both the SOT-23 and DIP-8 packages. It allows interfacing to Microchip's low cost family of programmers: PICkit™ 1, PICkit 2, MPLAB ICD 2, PICSTART® Plus and the BFMP.

PIC10F2XX SOT-23 to DIP-8 Programmer Adapter

This Programmer Adapter Kit (AC163021) consists of five PIC10F206 SOT-23, five-pin scramble boards and DIP pins. Once assembled, this acts like a standard 8-pin DIP and can be used directly in standard development tool sockets. Note that the PIC10F 8-pin DIP pin-out is family specific and differs from the standard 8-pin DIP pin-out. This kit is NOT intended for production applications and should be used only as a method of early evaluation.

APPLICATION EXAMPLES

Consumer	Communications	Industrial	Automotive	Appliance
Motion Detectors	Telephone Handsets	Utility Metering	Light Dimmers	Refrigerator Control Units
Thermostats	Microphone Controls	Portable Instruments	Intelligent Sensors	Smart Relays
Remote Controls	UART Replacements	Data Acquisition	Proximity Detectors	Delay Timers
Battery Management	Handset Displays	Motor Control:	Keyless Entry	Temperature Sensors
CO/Smoke Detectors		stepper, fan control,	Tire Pressure Monitors	
Toys		brushless DC, AC induction,	Dash Controllers	
		switched reluctance	Seat Controllers	

The first PIC microcontroller of its kind, the 14-pin PIC16F616 provides an increased feature set inclusive of comparators with controllable hysteresis. High voltage variations are also available and provide an integrated shunt voltage regulator making it ideal for cost-sensitive applications. The PIC16HV616 offers the ability to run as low as 2.0V and up to an unspecified user-defined maximum voltage.

# PIC® MICROCONTROLLERS WITH HIGH VOLTAGE SUPPORT AND FAN CONTROL CAPABILITIES

Designing the simplest solution to a complex problem such as fan/motor control on a system board is often challenging. Microchip simplifies both design and implementation with the new PIC16F616 and PIC16F785 microcontrollers.

Both devices are also available as high voltage variations, PIC16HV616 and PIC16HV785, providing an integrated shunt voltage regulator allowing high voltage support. Both offer the ability to run as low as 2.0V, and up to an unspecified user-defined maximum voltage. These high voltage variations are ideal for cost-sensitive applications with high voltage power rails, as they eliminate the additional expense required in stepping down the input voltage.

As with most PIC microcontrollers, the PIC16F616 and PIC16F785, as well as the high voltage variants, can easily be utilized in a wide array of general purpose applications. Additional unique features do however make them particularly well suited for focused applications such as motor or fan control. The comparators on the PIC16F616 and PIC16HV616 are steerable and designed with greater hysteresis, providing the ability to use a Hall Effect sensor for speed monitoring of a fan or motor.

Due to the differential signaling of the Hall Effect sensor, traditional comparators do not always provide the ability to accurately translate the varying frequency of the Hall Effect sensor into a manageable digital signal. With the addition of hysteresis, these newly designed comparators will in effect provide a trigger window and ultimately greater ease in such translations. This paired with the integrated PWM makes these products a robust fan-control solution that is more cost effective and flexible than traditional dedicated fan control methods. For those not wanting or requiring the hysteresis, the ability to shut this down and use as a traditional comparator is also provided.

Comparator with Hysteresis (PIC16F616 and PIC16HV616)
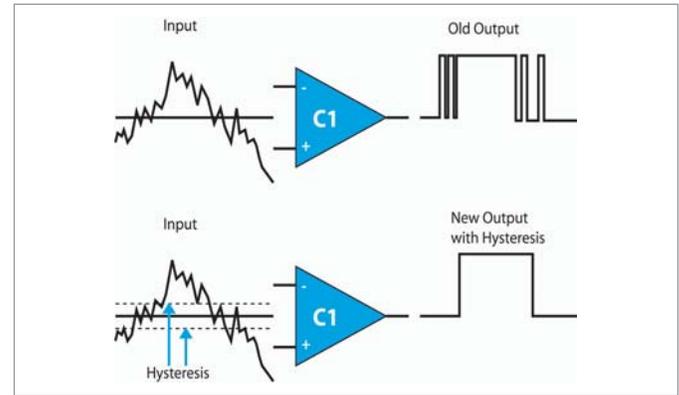
Microchip's Fan Control Solution

Component Cost Savings Versus Traditional Methods

- Voltage regulator
- Input signal conditioning
- Hall Effect sensor

System Advantages

- Cost effective
- Supports direct 12V power supply through integrated shunt regulator
- Meets latest industry fan control specifications
- Easily upgraded and customized
- Simplicity through reduction in component count
- Can interface directly to a Hall Effect element

In addition, Microchip offers a full line of fan controllers and fan fault detectors.

Fan Control Solution
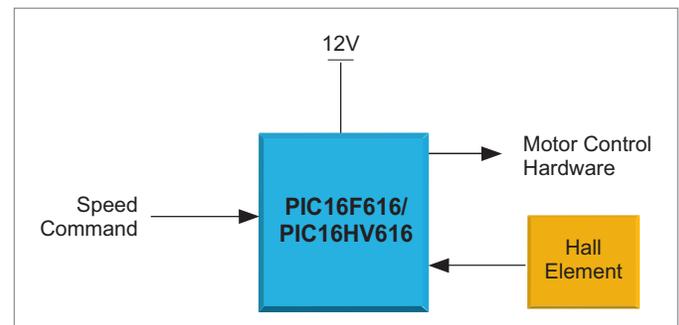
APPLICATION EXAMPLES

Consumer	Industrial	Automotive	Appliance
Personal Computers	Fan Control	Power Windows	Blenders
Battery Chargers	Motor Control	Interior Light Dimmer Controls	Toasters
	Power Supplies	Keyless Entry	Power Drills
		Seat Controls	

The benefits of integrating LCD control modules within a Flash-based PIC microcontroller are numerous and can be quickly appreciated by any design engineer.

PIC® MICROCONTROLLERS WITH AN INTEGRATED LCD MODULE

Microchip's new series of PIC microcontrollers with on-chip LCD driver control consists of the PIC16F913/914/916/917/946 and the PIC18F6390/6490/8390/8490/65J90/85J90. These new Flash-based, power-managed devices add to an existing LCD microcontroller family. The breadth of LCD segment drivers, package sizes and integrated features for embedded control applications gives the designer flexibility to create different solutions based on the demand of varying market segments all from a single design.

High Performance LCD Solutions

The PIC18F6390/6490/8390/8490/65J90/85J90 LCD microcontrollers offer greater memory density and higher pin counts to meet the demands of more complex LCD applications.

The PIC18F6390/6490/8390/8490/65J90/85J90 feature set includes:

- 128-192 LCD segments
- 8/16/32 Kbytes Flash program memory
- Low-power nanoWatt Technology
- Advanced instruction set optimized for code efficiency, performance and use with C
- 32 kHz to 32 MHz internal oscillator for flexible clock system, fail-safe clock
- Integrated analog peripherals such as A/D converters and comparators
- I2C™/SPI/AUSART/EUSART serial communications
- 64 and 80-pin package options
- PIC18F65J90/85J90 include LCD voltage contrast regulator

LCD PIC Microcontrollers

High Performance		Mid-Range
PIC18F6390	PIC18F8390	PIC16F913
PIC18F63J90	PIC18F83J90	PIC16F914
PIC18F6490	PIC18F8490	PIC16F916
PIC18F64J90	PIC18F84J90	PIC16F917
PIC18F65J90	PIC18F85J90	PIC16F946

Mid-Range LCD Solutions

The PIC16F913/914/916/917/946 LCD microcontrollers provide a strong balance between price and LCD pixel count.

The PIC16F913/914/916/917/946 feature set includes:

- 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 system, fail safe clock
- Integrated analog peripherals such as A/D converters and comparators
- I2C/SPI/AUSART serial communications

FEATURED DEVELOPMENT TOOLS

PICDEM™ LCD Demonstration Board

The PICDEM™ LCD Demonstration Board (DM163028) shows the main features of the 28, 40, 64 and 80-pin LCD Flash PIC microcontrollers. It is populated with the PIC18F8490. Other devices are supported via a transition socket. A sample LCD glass display is included for custom prototyping.

PICDEM™ LCD Plug-In Modules

The PICDEM LCD Plug-In Module (MA160011) allows easy development on the LCD demonstration board with PIC16F913/914/916/917/946 microcontrollers.

APPLICATION EXAMPLES

Consumer	Medical	Industrial	Automotive	Appliance
Thermostat	Temperature Reader	Utility Meter	Dashboard	Refrigerator
Battery Management	Fertility Computer	Portable Instruments	Tire Pressure Sensor	Stove/Oven
Sprinkler Controller	Drug Injector	Data Acquisition	Battery Vehicle Display	Microwave
Security System	Nurse Call System	Gasoline Pump	Audio System	Coffee Maker
Exercise Equipment	Medical Pump	Air Conditioner		Bread Maker
Baby Alarm		Payment System		Washing Machine
Lawnmower		Gas Detection		Clothes Dryer
Clock Radio		Solor Power Measurement		

Microchip's full-speed USB PIC microcontroller family can perform as the sole controller in embedded applications thanks to the performance of its powerful 12 MIPS RISC core, self-programmable Flash memory and the power-saving features of nanoWatt Technology.

PIC® MICROCONTROLLERS WITH INTEGRATED USB
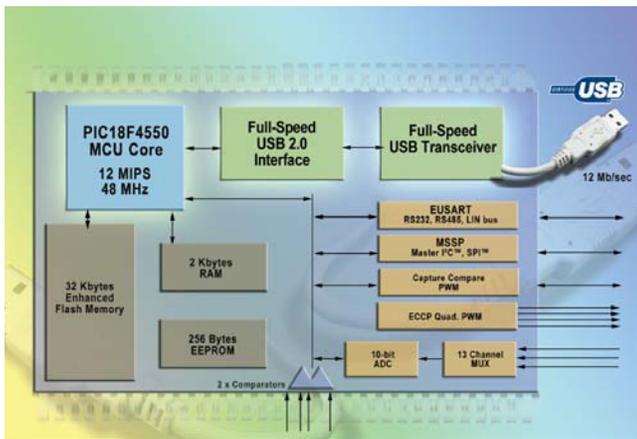
Microchip offers USB solutions capable of full-speed USB operation (up to 12 Mbits/s) in a new PIC18F family of devices, as well as low-speed operation (1 Mbits/s) in PIC16C devices.

Full-Speed USB 2.0: PIC18F4X5X, PIC18F2X5X

The majority of USB-capable microcontrollers are optimized exclusively for applications in the personal computing (PC) peripherals and consumer markets, leaving a real void for embedded engineers. Microchip's new full-speed USB PIC microcontrollers, PIC18F4450 and PIC18F4550 families, make the benefits of full-speed USB available to a broader range of embedded applications that operate in harsh environments and only occasionally connect to PCs.

The devices are based on Enhanced Flash technology and provide 100,000 E/W cycles and 40 years retention.

The USB family of microcontrollers offer:

- Performance: 12 MIPS
- Memory: 16 to 32 Kbytes Enhanced Flash
- Data EEPROM: 256 bytes
- Analog features:
  - 10-bit A/D converter
  - Two analog comparators
  - Low Voltage Detector (LVD)
  - Brown-Out Reset (BOR)

USB PIC Microcontrollers	
Full-speed	**Low-speed**
PIC18F2450	PIC16C745
PIC18F2455	PIC16C765
PIC18F2550	
PIC18F4450	
PIC18F4455	
PIC18F4550	

Low-Speed USB: PIC16C745/765

Microchip also offers CMOS OTP-based 8-bit microcontrollers in 28 and 40-pin packages that are certified for the low-speed USB standard.

The PIC16C745/765 offer:

- 5 channel, 8-bit A/D converters
- Universal Asynchronous Receiver Transmitter (USART) (also known as the Serial Communication Interface)
- Easily adapted for PC-related peripherals, as well as UPS, joysticks and medical applications

FEATURED DEVELOPMENT TOOLS

PICDEM™ Full-Speed USB Demonstration Board

The PICDEM FS-USB (DM163025) is a demonstration and evaluation board for the PIC18F4550 family of Flash microcontrollers with full-speed USB 2.0 interface. The board contains a PIC18F4550 microcontroller in a 44-pin TQFP package, representing the superset of the entire family of devices.

Additional software resources are also available for the PIC18F4550 family of devices (download free at www.microchip.com/USB).

APPLICATION EXAMPLES

Consumer	Medical	Industrial	Automotive	Battery Powered
Business Card Scanners	Voice-activated Applications	Manufacturing Tools	Vehicle Network Buses	Handheld Tools
White-board Digitizers	Advanced Wheel Chairs	Data Loggers	Diagnostic Tools	Sensors
Voice Recorders	Research Equipment Automation	Smart Displays	Vehicle Trace Recorders	Security Applications
Uninterruptible Power Supplies		Micro Fuel Cells	Ultrasonic Sensors	Remote Controls
MP3 Players		Gambling-machine Peripheral		Home Automation
Fire Alarms		RFID Readers		
Security-system Programmers		Robot Controllers		
		Industrial Timers		
		Gas-flow Analyzers		

The advantages of Ethernet connectivity for data distribution, remote monitoring and remote control of embedded applications are widely acknowledged. Ethernet's infrastructure, performance, interoperability, scalability and ease of development are unrivaled among communication standards. Microchip is unveiling embedded Ethernet solutions that meet market demands and requirements.

PIC® MICROCONTROLLERS WITH ETHERNET CAPABILITIES

Microchip offers Ethernet solutions capable of 10 Mbps. In addition to single chip PIC18F microcontrollers with an Ethernet peripheral, Ethernet interface devices are offered. 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 for PIC18 microcontrollers, a whole-product Ethernet solution is provided for embedded applications.

Ethernet Family	
Single Chip*	Stand Alone
PIC18F66J60	ENC28J60
PIC18F66J65	
PIC18F67J60	
PIC18F86J60	
PIC18F86J65	
PIC18F87J60	
PIC18F96J60	
PIC18F96J65	
PIC18F97J60	

*Contact Microchip for device and tool availability.

Stand-Alone

Microchip's ENC28J60 is a 28-pin, IEEE 802.3 compliant stand-alone Ethernet controller with on-board MAC and PHY, 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.

Single Chip

Micrchip's feature-rich PIC18F97J60 family comes with up to 128 Kbytes of Flash program memory, 3 Kbytes of SRAM, 8 Kbytes of Ethernet buffer RAM and are packaged in 64, 80 and 100-pin TQFP options. The PIC18F97J60 family of micrcontrollers also offers:

- 10-bit ADC
- Two analog comparators
- 2x EUSART
- 2x SPI/I2C™
- Six Ethernet interrupts
- 2 LEDs

FEATURED DEVELOPMENT TOOLS

Ethernet PICtail™ Daughter Board

The Ethernet PICtail™ Daughter Board (AC164121) provides a cost-effective method of evaluating and developing Ethernet control applications. The board is designed for flexibility and can be plugged into the popular PICDEM™ HPC Explorer board. The development board is populated with the 28-pin ENC28J60 Ethernet controller which interfaces to the RJ-45 female connector. With a standard 28-pin PICtail pin out, the board is easily interfaced to Microchip demonstration boards. Additionally, Microchip plans to offer Ethernet PICtail Plus module plug-ins for 16-bit PIC24 microcontrollers.

Development Tools for the ENC28J60 Family	
Description	Part Number
Ethernet PICtail™ Daughter Board Featuring ENC28J60	AC164121
TCP/IP Stack Software (download from www.microchip.com)	TCP/IP Stack
MPLAB® Integrated Development Environment Software	SW007002
PICDEM™ HPC Explorer Board	DM183022
MPLAB® C18 C Compiler for PIC18 Microcontrollers	SW006011
MPLAB® ICD 2 In-Circuit Debugger for PIC® Microcontrollers	DV164005

APPLICATION EXAMPLES

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

MICROCHIP TECHNOLOGY'S PRODUCT PORTFOLIO

- 8-bit PIC Microcontrollers
- 16-bit PIC Microcontrollers
- 16-bit dsPIC Digital Signal Controllers
- Battery Management ICs
- Thermal Management ICs
- Power Management ICs
- Linear ICs
- Mixed-Signal ICs
- Interface Devices
- Radio Frequency Products
- KEELOQ® Security Devices
- Serial EEPROMs
- MPLAB Development Tools

Development Tools

Microchip has established a reputation for its comprehensive set of world-class, low-cost, easy-to-use application development tools. These tools help systems designers quickly design, debug and program PIC microcontrollers and dsPIC® digital signal controllers for specific applications.

The following documents and additional information are available on the Microchip web site (www.microchip.com).

- Low Cost Development Tools Guide, DS51560
- Development Systems Ordering Guide, DS30177

Memory Products

128-bit to 1 Mbit Serial EEPROMs

Microchip offers a broad portfolio of high performance serial EEPROMs in extremely small package sizes, including a new 2x3 millimeter DFN (Dual Flat No leads) package option, across the entire product line of I^{2}C™ and Microwire serial EEPROMs. With the new 64-Kbit I^{2}C and 16-Kbit Microwire serial EEPROMs now featured in this tiny DFN package, Microchip offers the highest-density memory serial EEPROMs in the smallest standard package available today. Specialty/ID EEPROMs for PC monitors, DIMM modules and riser cards, as well as serial EEPROM development tools that include the SEEVAL® 32 Serial EEPROM Evaluation Kit (DV243002) and Total Endurance™ Model software version 4.0.

COMPLETE EMBEDDED CONTROL SOLUTIONS
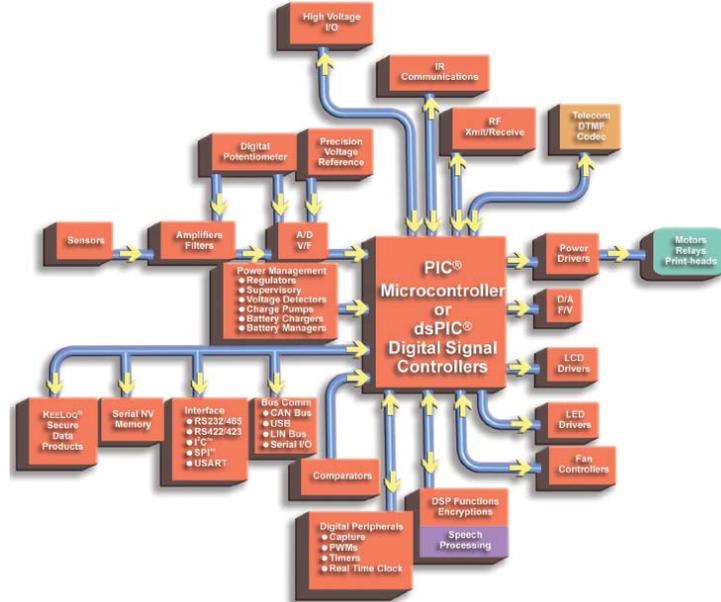
16-bit Family of Products

As embedded applications grow in complexity and performance requirements increase, Microchip has introduced several new 16-bit devices. The PIC24F and PIC24H 16-bit microcontroller families enable an easy migration from the other 8-bit PIC microcontrollers, with higher performance, more memory and faster peripherals. The PIC24F products are cost effective 16-bit microcontrollers with up to 16 MIPS and the high performance PIC24H microcontrollers provide up to 40 MIPS; both have a rich set of Flash memory and peripherals.

For additional power and performance, consider Microchip's dsPIC digital signal controllers (DSC), including the dsPIC30 and dsPIC33 families, for up to 40 MIPS. A digital signal controller is a single chip embedded controller that seamlessly integrates the control attributes of a microcontroller with the computation and throughput capabilities of a digital signal processor. The dsPIC products feature a fully implemented DSP engine, C compiler friendly design with familiar tools and ease-of-use. Microchip is a leader in 16-bit performance and C code efficiency, with development tools and application libraries enabling faster time to market and ease-of-use.

All of these 16-bit solutions have compatible software, development tools, and many of the devices have shared pin-outs and peripherals. These solutions target motor control and power conversion, sensor control, automotive, speech, audio and general purpose applications.

Analog and Interface Products

Microchip is a leader in low power analog solutions with a growing portfolio of stand-alone analog and interface products that complement our broad microcontroller product lines.

Thermal Management	Power Management	Linear	Mixed-Signal	Interface
Temperature Sensors	LDO & Switching Regulators	Op Amps	A/D Converter Families	CAN Peripherals
Fan Speed Controllers/ Fan Fault Detectors	Charge Pump DC/DC Converters	Programmable Gain Amplifiers	Digital Potentiometers	Infrared Peripherals
	Power MOSFET Drivers	Comparators	D/A Converters	LIN Transceiver
	PWM Controllers	Linear Integrated Devices	V/F and F/V Converters	Serial Peripherals
	System Supervisors		Energy Measurement ICs	Ethernet Controller
	Voltage Detectors			
	Voltage References			

Battery Management

- Li-Ion/Li-Polymer Battery Chargers
- Smart Battery Managers

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.
- **Sample** link offers free evaluation samples of any Microchip device.
- **Training** link offers webinars, registration for local seminars/workshops and information on annual MASTERs events held throughout the world.

Purchase

microchip DIRECT
www.microchipdirect.com

microchipDIRECT is a web-based purchasing site that gives you 24-hour-a-day access to all Microchip devices and tools, including pricing, ordering, inventory and support. You can buy the products you need on a easily opened Microchip line of credit.

Sales Office Listing

Technical Support: http://support.microchip.com

AMERICAS

Atlanta
Tel: 770-640-0034

Boston
Tel: 774-760-0087

Chicago
Tel: 630-285-0071

Dallas
Tel: 972-818-7423

Detroit
Tel: 248-538-2250

Kokomo
Tel: 765-864-8360

Los Angeles
Tel: 949-462-9523

San Jose
Tel: 650-215-1444

Toronto
Mississauga, Ontario
Tel: 905-673-0699

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8528-2100

China - Chengdu
Tel: 86-28-8676-6200

China - Fuzhou
Tel: 86-591-8750-3506

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

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 - Shunde
Tel: 86-757-2839-5507

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

China - Xian
Tel: 86-29-8833-7250

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-4182-8400

India - New Delhi
Tel: 91-11-5160-8631

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

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

Korea - Gumi
Tel: 82-54-473-4301

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

Malaysia - Penang
Tel: 60-4-646-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-572-9526

Taiwan - Kaohsiung
Tel: 886-7-536-4818

Taiwan - Taipei
Tel: 886-2-2500-6610

Thailand - Bangkok
Tel: 66-2-694-1351

EUROPE

Austria - Wels
Tel: 43-7242-2244-399

Denmark - Copenhagen
Tel: 45-4450-2828

France - Paris
Tel: 33-1-69-53-63-20

Germany - Munich
Tel: 49-89-627-144-0

Italy - Milan
Tel: 39-0331-742611

Netherlands - Drunen
Tel: 31-416-690399

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

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

2/16/06

MICROCHIP

www.microchip.com

Microchip Technology Inc. · 2355 W. Chandler Blvd. · Chandler, AZ 85224-6199

Microcontrollers • Digital Signal Controllers • Analog • Serial EEPROMs

DS39630C