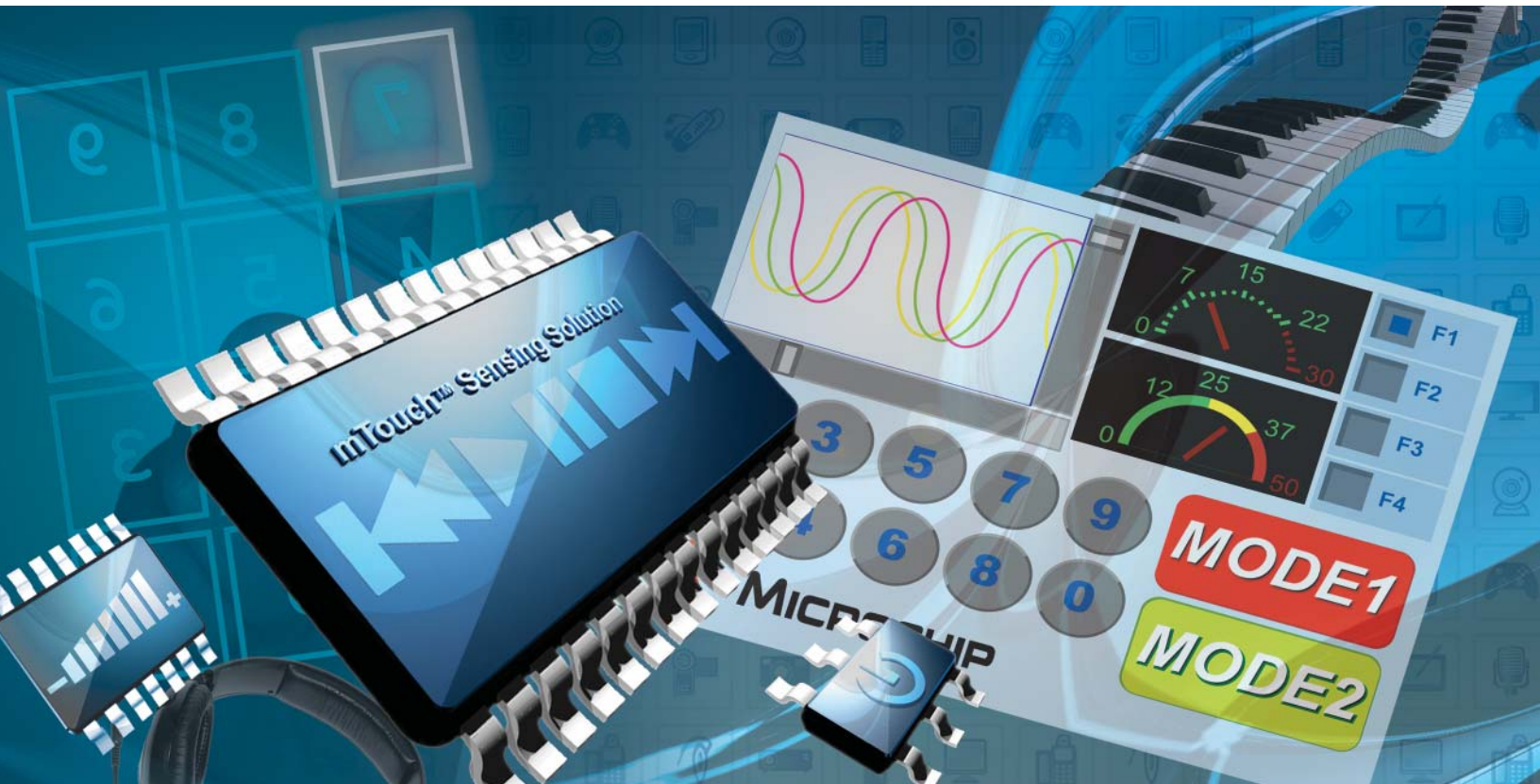




Human Interface Solutions:

Touch Sensing, Display/QVGA Graphics and Audio & Speech



Looking to Add New and Stylish Interfaces to Differentiate Your Product? Need to Get to Market Quicker with Proven, Turnkey Solutions?

Many organizations today are looking to add newer and feature-rich interfaces to their products, providing their customers with additional information in an aesthetically pleasing manner. This allows their end products to deliver more value to customers through product differentiation, regional customization and local-language translations.

If your design requires human interface capability, consider Microchip Technology. We have developed numerous innovations in touch sensing, graphics displays and audio & speech that can enhance the user interface functionality of your product. These advancements are complete, turnkey solutions, and many have license-free and royalty-free options to get your design to market faster at a lower total system cost.

Microchip's PIC® microcontrollers feature on-chip peripherals to suit a variety of traditional user interface functions: high drive I/Os to drive LEDs, wake-up on change and internal pull down/up resistors for push buttons, A/D converters and comparators for variable resistors and A/D converters for keyboard matrix implementations.

For easy device selection, use Microchip's on-line Advanced Parts Selector (MAPS) which enables user-defined filters to sort features for a parametric search of devices:

www.microchip.com/maps.

Capacitive Touch Sensing

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 aesthetics, maintenance, cost and cleanliness.



mTouch™ Sensing Solution and Methodology

Microchip's mTouch Sensing Solution provides a free and easy method for designers to add capacitive touch sensing to applications utilizing PIC microcontrollers without the cost of fee-based licensing and royalty agreements. Being a source-code solution further helps engineers quickly integrate touch sensing functionality with their existing application code in a single, standard microcontroller, thus reducing the total system cost associated with current solutions.

Maximum Design Flexibility

Microchip's Capacitive mTouch Solution offers a number of hardware solutions to suit the demands of any application from the most basic single button design using the incredibly small and cost-effective 8-bit PIC10F to the peripheral rich 8-bit Mid-Range and 16-bit PIC24FJ microcontroller families.

Microchip offers flexibility to choose your level of involvement in Capacitive mTouch Solution application specific firmware development:

- Intermediate solutions include the Code Module Librarian which provides “drag and drop” functionality with the microcontroller's code module organizer utility.
- A number of source code examples are also provided for designers who wish to get more involved in the programming of original designs.

The firmware can also easily implement a proximity sensor. Detecting the presence of an object, like a hand, can help reduce the standby power consumption or add the “Wow” factor to any application.

Capacitive Touch Sensing

Microchip's mTouch Sensing Solution Technology Employs Two Main Methods

Relaxation Oscillator

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

The Capacitive mTouch™ Sensing Solution can be readily implemented on any PIC Microcontroller or dsPIC® Digital Signal Controller featuring Comparator and Timer0 peripherals. With the addition of a few basic components, the designer can now take advantage of Microchip's wide portfolio of devices.

The PIC10F microcontroller is ideal for implementing one key or a proximity sensor (see Application Note AN1202).

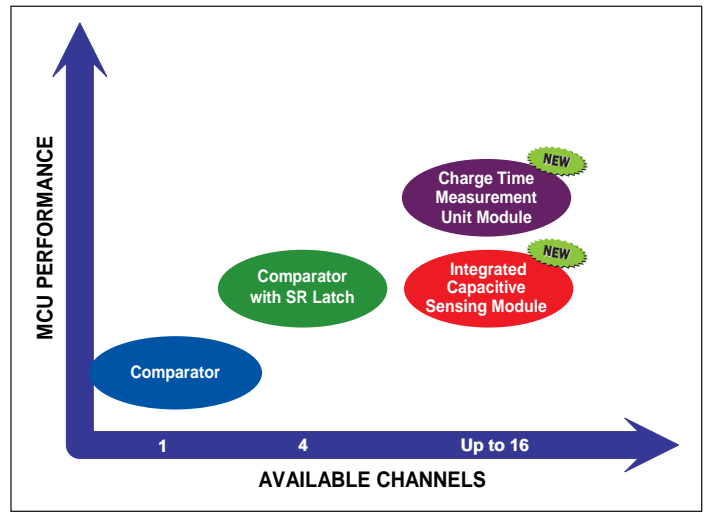
The PIC16F887, PIC16F690 and PIC16F616 8-bit Mid-Range family members offer the most cost-effective solution for applications up to 10 keys. They feature a comparator peripheral with SR Latch. So designers can take advantage of some of Microchip's smallest packaging options to optimize real estate on low channel requirement capacitive sensing applications.

The Capacitive Sensing Module (CSM) present on the PIC16F72X family simplifies the amount of hardware and software setup needed for capacitive sensing applications. It can manage up to 64 keys while offering low power consumption operation.

Direct Capacitance Measurement

This method charges a capacitance with a fixed current for a fixed time, and then it measures the voltage with the A/D converter. This is used by the Charge Time Measurement Unit (CTMU) peripheral allowing a measurement time as low as 4 μ S. The 16-bit PIC24F families with CTMU offer a one-chip solution for high-end human interface applications which require capacitive touch, QVGA display or USB communication.

Capacitive mTouch™ Sensing Solutions



FREE Source Code and Diagnostic Software

Microchip provides free source code and libraries at the online mTouch Sensing Solution Design Center to enable touch sensing applications using PIC microcontrollers.

As part of the PICDEM™ Touch Sense Demonstration Board, the royalty-free mTouch Sensing Solution Software Development Kit features the mTouch Diagnostic Tool. This Windows® based tool provides an easy-to-use graphical user interface that gives the user a platform to analyze application critical information in “real-time” as it relates to touch sensing behavior. Also included in the kit are libraries, source code and other support materials that come with the board to further shorten development time and reduce design costs. This provides designers with a complete platform for implementing capacitive touch-sensing interfaces.

Getting Started with Touch Sensing

Development Systems

PICDEM™ Touch Sense 1 Development Kit (DM164125)



Demonstrates touch sensing technology using keys and slides and the 8-bit PIC16F microcontroller with S/R latch module; PICkit™ Serial Analyzer included.

PICDEM™ Touch Sense 2 Development Kit (DM164128)



Demonstrates touch sensing technology using the 16-bit PIC24F family with Charge Time Measurement Unit (CTMU).

PIC24F Starter Kit (DM240011)



This low-cost kit includes a board, MPLAB® integrated development environment, MPLAB C30 C compiler and everything needed to start designing a touch sensing application. This inexpensive

kit includes an integrated in-circuit debugger and programmer, USB device and host connectors, tri-color LED, capacitive touch pad and an OLED display. Menu driven demonstration software supports data logging, thumb drive and graphics applications to test the PIC24F MCU.

If your application requires capacitive touch sensing, consider using Microchip. A significant amount of technical resources and training is available on-line at the mTouch Design Center to reduce your time to market and lower your total system cost.

Getting Started with Touch Sensing

Visit the mTouch Design Center to access these resources and much more.

Webinars

Introduction to mTouch™ Capacitive Touch Sensing
Capacitive mTouch™ Sensing Solutions: Design Guidelines

Application Notes

- AN1171 Using the Capacitive Sensing Module on the PIC16F72X
- AN1101 Introduction to Capacitive Sensing
- AN1102 Layout and Physical Design Guidelines for Capacitive Sensing
- AN1103 Software Handling for Capacitive Sensing
- AN1104 Capacitive Multi-Button Configurations
- AN1202 Capacitive Sensing with a PIC10F MCU

Manuals

- DS41328 mTouch™ Users Guide
- DS39724 CTMU Reference Manual

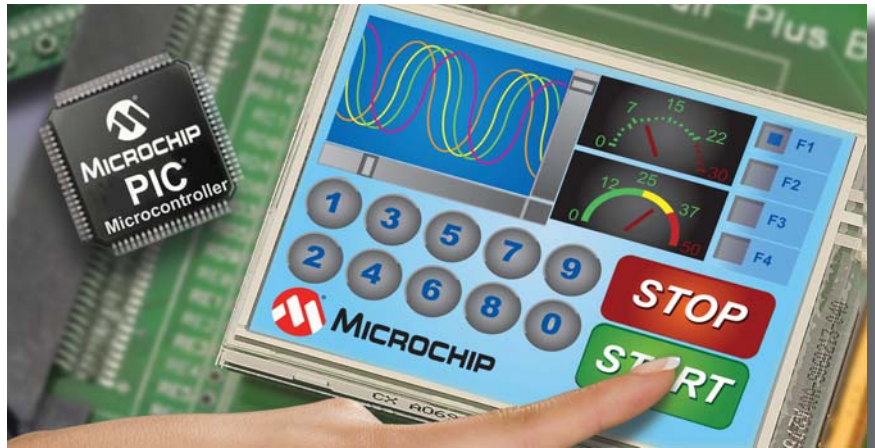
mTouch Sensing Solution Design Center

www.microchip.com/mtouch

- ▶ Circuit diagrams
- ▶ Application notes
- ▶ eLearning
- ▶ Development tools
- ▶ Free code libraries and diagnostic software
- ▶ Recommended products
- ▶ Free device samples

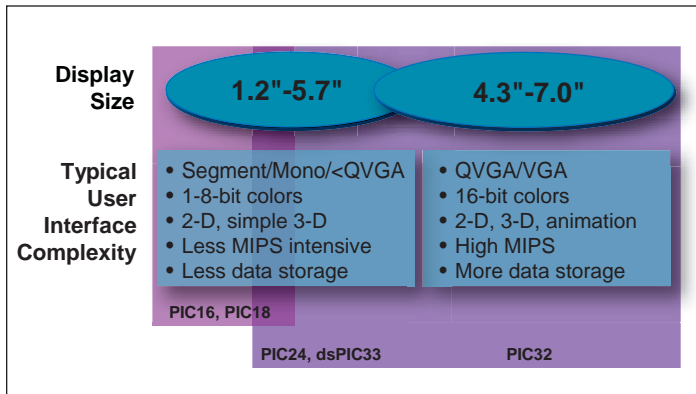
Display Solutions: Segmented LCD and QVGA Graphics

The use of displays – whether segmented LCD or Graphics – continues to gain popularity in an increasing range of control and user interface applications in markets such as home automation, small and medium medical and industrial applications. QVGA graphics displays, in particular, enhance the user experience and provide detailed information with sharper images. Additionally, graphics displays enable technologies such as touch screen, leading to more effective and efficient interfaces to the applications.



Display Size vs. User Interface Complexity

The complexity of the user interface drives the screen size, not the application complexity. The larger the screen, the more MIPS required to service the screen itself. This is separate from the CPU processing time needed to run the overall application. The chart below illustrates the display size versus the user interface complexity – along with the recommended Microchip solutions for each.



Microchip offers a broad range of 8-, 16- and 32-bit microcontrollers and 16-bit digital signal controllers that enable display applications. Many families feature on-chip LCD peripherals. A number of devices offer peripherals such as parallel master support and direct memory access.

FREE Licensed Microchip Graphics Library

With Microchip's free QVGA Graphics Library (including source code) and related development tools, you can quickly integrate graphics display functions into your application in a single microcontroller, thus reducing development risk, total system cost and time to market. The library includes all source code, schematics, drivers, documentation and utilities needed to complete your design quickly.

These libraries are modular – use only those sections required for the design in order to keep memory and MIPS requirements low.

QVGA Graphics Library Features

www.microchip.com/graphics

- ▶ Up to 480 x 272 (WQVGA) resolution
- ▶ Up to 16-bit or 65K colors
- ▶ 2D objects: line, circle, text, rectangle, polygon, bar
- ▶ 3D objects: button, slider, meter, progress bar, bar graph, pie chart
- ▶ Image, animation
- ▶ Resistive touch screen, keypad
- ▶ Multiple fonts supported

Getting Started with Display Solutions

Development Systems

PICDEM™ LCD 2 Demo Board (DM163030)



Illustrates the main features of Microchip's 28-, 40-, 64- and 80-pin LCD 8-bit PIC microcontrollers for segmented display applications.

Graphics PICtail™ Plus Daughter Board (AC164127)



Provides a cost-effective method of evaluating and developing QVGA graphics display applications in conjunction with either development board options listed below.

Option 1: 16-/32-bit Explorer 16 Development Board (DM240001)

32-bit Plug-in Module (MA320001/2)

Option 2: I/O Expansion Board (DM320002)

PIC32 Starter Boards (DM320001/
DM320003)

Processor Plug-in Modules

Microchip offers numerous plug-in modules that can be interchanged with a variety of PIC microcontrollers or dsPIC digital signal controllers when used with the 16-/32-bit Explorer 16 Board (DM240001).

MCP23X08/17 GPIO Expander Keypad/LCD Demo (GPIODM-KPLCD)



Demonstrates the use of MCP23X08 and MCP23X17 devices for LCD and keypad applications.

Product Family Cross Reference

	Segmented LCD	Graphics Display
8-bit MCU	PICDEM™ LCD 2 Demo Board	
16-bit MCU/DSC		<ul style="list-style-type: none"> – Graphics PICtail™ Plus Daughter Board – Explorer 16
32-bit MCU		<ul style="list-style-type: none"> – Graphics PICtail™ Plus Daughter Board – Explorer 16 – 32-bit Plug-in Module – I/O Expansion Board – PIC32 Starter Board

Third Party Tools Support

Find additional development systems supporting Microchip's graphics displays at the following partners.

Company	Web Site
Micrium	www.micrium.com
RAMTEX International	www.ramtex.dk
SEGGER Microcontroller Systeme GmbH	www.segger.com

Getting Started with QVGA/Graphics Displays

Visit the Graphics Design Center to access these resources and much more.

Webinars

Overview of Microchip Graphics Display Solution
How Does a Graphics LCD Work?
Graphics LCD System and PIC24 Interface
Microchip Graphics Display Library Architecture

Application Notes

AN1081 Interfacing a 4x4 Matrix Keypad with an 8-bit GPIO Expander
AN1136 How to Use Widgets in Microchip Graphics Library
AN1128 Fonts in the Microchip Graphics Library

Training Class

Sign up for a half-day training course at your local Microchip Regional Training Center.
HUT2131 Designing with the Microchip Graphics Library

Segmented LCD Design Center

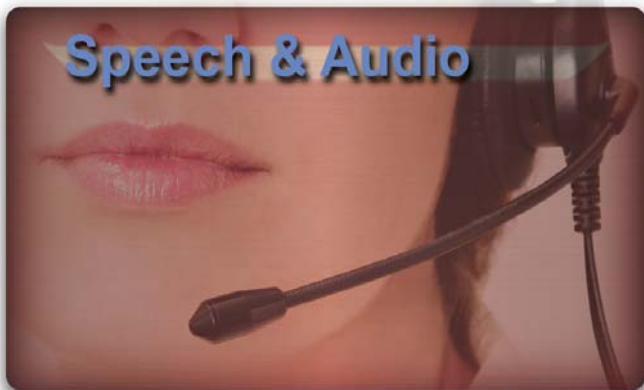
www.microchip.com/lcd

QVGA Graphics Design Center

www.microchip.com/graphics

- ▶ Circuit diagrams
- ▶ Application notes
- ▶ eLearning
- ▶ Development tools
- ▶ Free code libraries and diagnostic software
- ▶ Recommended products
- ▶ Free device samples

Audio and Speech Solutions



Voice continues to be a popular and natural medium of communication and human interface. Interfacing embedded applications using voice in local languages can help cater products to regional needs. Audio can also help interfacing electronics to the visually impaired. Microchip's analog, memory, microcontroller and digital signal controller products, software and tools allow the designer to include speech or audio interfaces into many types of products.

Microchip's hardware and software solutions enable these types of audio functions:

- Generation of tones, alarms and musical notes
- Playback of pre-recorded audio information
- Recording and playback of audio information
- Audio encoding and decoding
- Noise reduction and echo cancellation

Audio applications served by Microchip include: buzzers, alarms, public address systems, toys and gaming systems, musical instruments, hands-free phone kits, radar detectors, electronic stethoscopes, home appliances (microwave ovens, washing machines), security systems, baby monitors, telecommunication systems and walkie talkies.

Software Libraries

Microchip has a variety of software libraries that can be used for these audio functions. In particular there are multiple options for audio encoding and decoding, allowing the designer to select the best tradeoff between audio quality, storage space and CPU processing requirements.

Audio Application Software

Algorithm	Library
ADPCM	AN643 Adaptive Differential Pulse Code Modulation Audio Library for PIC32MX
G.711	SW300026 dsPIC/PIC24 G.711 Speech Encoding & Decoding Library
G.726A	SW300090 dsPIC G.726A Speech Encoding/Decoding Library
Speex	Audio Library for PIC32MX SW300070 Speex Speech Encoding/Decoding Library
WAV	Audio Library for PIC32MX
Noise and Echo	SW300060 Acoustic Echo Cancellation Library SW300080 Line Echo Cancellation Library SW300040 Noise Suppression Library

Silicon Solutions

Many 8-bit PIC microcontrollers can generate tones, alarms and musical notes in various applications. Microchip's 16-bit microcontrollers and digital signal controllers and 32-bit microcontrollers provide up to 512 Kbytes of Flash program memory and up to 32 Kbytes of RAM. On-chip direct memory access peripherals allow data to be streamed to and from memory with minimal CPU interaction. Software libraries are available to interface with a variety of external Flash storage devices if extra storage capacity is required.

The dsPIC digital signal controllers offer certain specialized peripherals for audio applications, namely:

- 16-bit D/A Converter
- Codec/Data Converter Interface module
- 1 nanosecond SMPS PWM (for Class D amplification)

For easy selection of microcontrollers and digital signal controllers, use Microchip's on-line Advanced Parts Selector (MAPS) which enables user-defined filters to sort features for a parametric search of devices.

Getting Started with Audio and Speech Solutions

Development Systems

MPLAB® Starter Kit for dsPIC® Digital Signal Controllers (DM330011)



A low-cost evaluation platform for dsPIC digital signal controllers in speech and audio applications. The kit comes complete with audio recording and playback features as well as a demo application.

Speech Playback PICTail™ Plus Daughter Board (AC164125)



This board implements a fourth-order Low Pass Filter (LPF), speaker amplifier, speaker and 1 Mb SPI serial EEPROM for playback-only applications.

Audio PICTail™ Plus Daughter Board (AC164129)



When used with the Explorer 16 Development Board (DV164033), this daughter board facilitates rapid implementation, development and testing of full duplex speech and audio applications. The card features

low-cost speech and audio playback circuitry, microphone and line pre-amp with adjustable gain control, headphone amplifier, 16-/24-bit Codec for high fidelity applications and 4 Mb serial Flash memory.

Audio & Speech Design Center www.microchip.com/audio

- ▶ Circuit diagrams
- ▶ Application notes
- ▶ eLearning
- ▶ Development tools
- ▶ Free code libraries and diagnostic software
- ▶ Recommended products
- ▶ Free device samples

Getting Started with Audio and Speech

Visit the Audio and Speech Design Center to access these resources and much more.

Webinars

16-bit Speech & Audio Solutions

A look at the dsPIC® DSC Audio and Speech Starter Kit

Audio DAC Peripheral on Digital Signal Controller Devices

dsPIC33F DMA

dsPIC30F 12-bit ADC Module (Part 1 & 2)

Introduction to the Motor Control PWM Module

MCP4725: 12-bit DAC with Non-Volatile Memory

Signal Chain Overview

Do I Filter Before, After or Never?

Application Notes

AN538 Using PWM to Generate Analog Output

AN1152 Achieving Higher ADC Resolution Using Oversampling

AN643 Adaptive Differential Pulse Code Modulation

Hands-free Access Control Solutions

Application Notes

AN959 Using the PIC16F639 MCU for Smart Wireless Applications

AN1024 PKE System Design Using the PIC16F639

Analog and Interface Products and Memory

Are you Looking for Complete Analog & Interface Design Solutions?

Microchip's integrated analog technology, peripherals and features are engineered to meet today's demanding design requirements. Our broad spectrum of analog products addresses thermal management, power management, battery management, mixed-signal, linear and interface solutions. Combined with "Intelligent Analog" microcontrollers, Microchip offers an extensive analog portfolio for thousands of high-performance design applications in the automotive, communications (wireless), consumer, computing and industrial control markets.

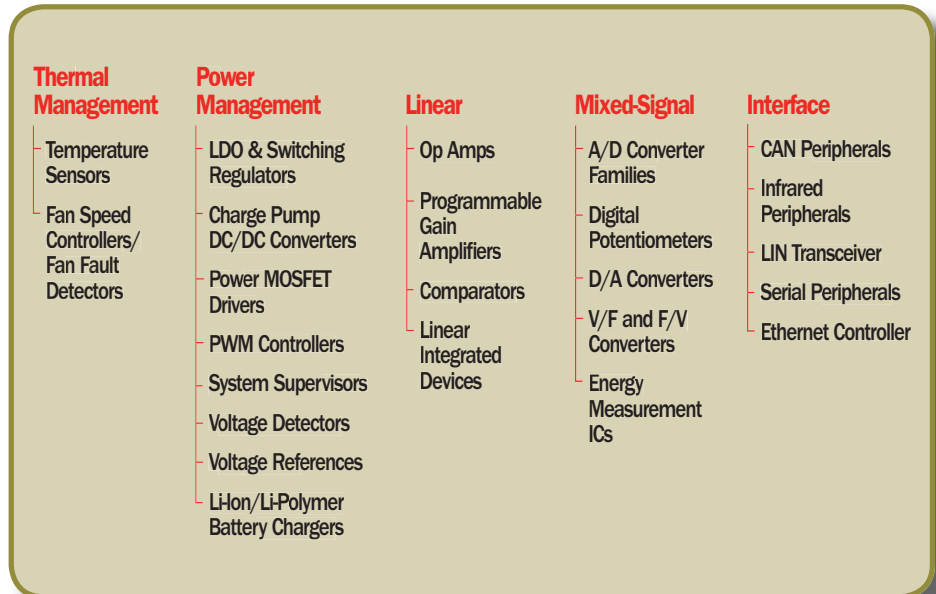
Our broad portfolio of stand-alone analog and interface devices offers highly integrated solutions that combine various analog functions in space-saving packages and support a variety of bus interfaces. Many of these devices support functionality that enhances the analog features currently available on PIC microcontrollers.

Visit www.microchip.com/analog to see all of Microchip's analog and interface product offerings.

Serial EEPROMS

Microchip also offers one of the broadest selections of serial EEPROMs in densities from 128 bits to 1 Mbit, with operating voltages down to 1.7V, in all popular bus protocols (I²C™, Microwire and SPI compatible). Our memory products are available in all standard temperature ranges from -40°C to +125°C and packaged in the world's smallest standard packaging: up to 16 Kbits in a 5-lead SOT-23 package and up to 256 Kbits in 8-lead MSOP package.

Microchip Technology's Stand-Alone Analog & Interface Portfolio



Introducing the UNI/O™ EEPROM Family



**Need more microcontroller pins for new features?
Want to stay with a low pin-count microcontroller rather than switching to a more expensive one?**

Microchip's new UNI/O serial EEPROM uses only ONE connection to the host microcontroller. This compares to two or three pins for I²C, and three to six pins for Microwire or SPI buses. This new, proprietary bus offers advanced features like a status register and write protection on demand, along with all I/O, memory array and command functions through a single pin.

Product Tables*

Microcontrollers with mTouch™ Sensing Solution Features

Product Family	Pins	CPU	MCU MIPS	Flash (Kbytes)	RAM (Bytes)	mTouch Features
PIC10F206	6	8-bit	1	0.375-0.750	16-24	Comparator, SOT-23 or 2x3 DFN packages
PIC16F616	14	8-bit	5	1.75-3.5	64-128	4 Inputs Mux, Comparator module with SR Latch
PIC16F690	20	8-bit	5	1.75-7.0	64-256	4 Inputs Mux, Comparator module with SR Latch
PIC16F887	28/44	8-bit	5	3.5-14	128-368	4 Inputs Mux, Comparator module with SR Latch
PIC16F727	28/44	8-bit	5	3.5-14	128-68	Capacitive Sensing Module, Up to 16 inputs, Low power operation
PIC24FJ256GA110	64/80/100	16-bit	16	128-256	16K	CTMU, up to 16 channels
PIC24FJ256GB110	64/80/100	16-bit	16	64-256	16K	CTMU, up to 16 channels, USB

Microcontrollers and Digital Signal Controllers for Graphics Applications

Product Family	Pins	CPU	MCU MIPS	Flash (Kbytes)	RAM (Kbytes)	PMP Port	USB OTG	CTMU	Other Features
PIC24FJ64GA004	28/44	16-bit	16	16-64	4-8	Y	N	N	Output Compare/PWM, 16-bit Timers, UART, SPI, I ² C™, 10/12-bit ADC, Analog Comparators, CAN, Audio Codec Interface, Motor Control Peripherals
PIC24FJ128GA010	64/80/100	16-bit	16	64-128	8	Y	N	N	
PIC24FJ256GA110	64/80/100	16-bit	16	128-256	16	Y	N	Y	
PIC24FJ256GB110	64/80/100	16-bit	16	64-256	16	Y	Y	Y	
PIC24H128GP504	28/44	16-bit	40	32-128	4-8	Y	N	N	
dsPIC33FJ128GP804	28/44	16-bit	40	32-128	4-16	Y	N	N	
dsPIC33FJ128MC804	28/44	16-bit	40	32-128	4-16	Y	N	N	
PIC32MX360F512	64/100	32-bit	80	128-512	8-32	Y	N	N	
PIC32MX460F512	64/100	32-bit	80	128-512	8-32	Y	Y	N	

Microcontrollers for Segmented LCD Applications

Product Family	Pins	CPU	MCU MIPS	Flash (Kbytes)	RAM (Bytes)	EEPROM (Bytes)	# of LCD Segments	Other Features
PIC16F917	28/44	8-bit	5	7-14	256-336	256	60-96	Capture/Compare/PWM, 16-bit Timer, 10-bit ADC, EUSART, I ² C™, SPI, BOR/LVD
PIC16F946	64	8-bit	5	14	336	256	168	
PIC18F8490	64/80	8-bit	10	8-16	768	-	128-192	
PIC18F8493 (12-bit ADC)	64/80	8-bit	10	8-16	768	-	128-192	
PIC18F85J90	64/80	8-bit	10	8-32	1-2K	-	132-192	

Microcontrollers and Digital Signal Controllers for Audio Applications

Product Family	Pins	CPU	MCU MIPS	Flash (Kbytes)	RAM (Bytes)	Audio Features
dsPIC33FJ64GP802	28	16-bit	40	64	16K	DMA, 16-bit 100 kbps 16-bit Audio DAC (2 channels)
dsPIC33FJ64GP804	44	16-bit	40	64	16K	DMA, 16-bit 100 kbps 16-bit Audio DAC (2 channels)
dsPIC30F2023	44	16-bit	30	12	512	High-Speed PWM Peripheral for Class D Amplification
dsPIC33FJ256GP710	100	16-bit	40	256	32K	DMA, Audio Codec Interface
PIC32MX360F512	64/100	32-bit	80	512	32K	DMA
PIC32MX460F512	64/100	32-bit	80	512	32K	DMA, USB

Analog Products for Audio Applications

Product Family	Description
MCP602X	10 MHz GBWP Rail-to-Rail Op Amp
MCP6S9X	8-Step Programmable Gain Amplifier with SPI Interface and Analog Input Multiplexer
MCP4X61	8-bit Non-Volatile Digital Potentiometer with SPI Interface, Single or Dual

*These tables represent a sampling of device solutions recommended for human interface designs. Microchip's broad portfolio of 8-, 16- and 32-bit microcontrollers, 16-bit digital signal controllers, analog and interface, serial EEPROMs and related development systems contains hundreds of products that could potentially be used for human interface designs, depending upon the application requirements. For easy device selection, use Microchip's on-line Advanced Parts Selector (MAPS) which enables user-defined filters to sort features for a parametric search of devices: www.microchip.com/maps.

Additional Resources

Getting Started

The Microchip web site (www.microchip.com) provides a wealth of information that can help you get started with your human interface design.

Human Interface Design Center

If you would like more information about any of the solutions presented here, please visit the Microchip Human Interface Design Center (www.microchip.com/humaninterface) for further details. The Design Center contains links to application notes, user manuals and software referenced in this brochure.

Development Tools

Visit www.microchip.com/tools to learn more about all of Microchip's software and hardware development tools.

Webinars

Microchip Webinars provide technical training on your schedule 24 hours a day, 7 days a week. More than 100 presentations are available on the Microchip web site with both audio and visual training elements to make learning even easier. These short training modules have become very popular with designers. Visit www.microchip.com/webseminars for a complete list of classes.

Regional Training Centers

To meet customers' demands for more training more often, Microchip has established a global network of Regional Training Centers (RTCs) that provide workshops and seminars on a year-round basis. Each RTC offers a variety of courses on a regular basis to fit with your demanding schedule. You can benefit by learning in small hands-on classroom settings that focus on your specific needs. Visit www.microchip.com/RTC for the latest list of RTC locations and classes.

Support

If you need quick answers to your technical questions, please contact our Technical Support site 24 hours a day, 7 days a week at <http://support.microchip.com>.

In addition Microchip has a growing number of field applications support personnel in your area that can work with you on your individual needs. For more information, please contact your nearest Microchip sales office listed on the back cover.

Third-Party Design Resources

If you require assistance with your product design, Microchip has many third-party resources to help you. These resources include a large selection of consultants that are screened by Microchip and rated based on the number of Microchip designs. You can find a list of these consultants, resumes and ratings on the Microchip web site at www.microchip.com/thirdparty.

Samples

Free evaluation samples of any Microchip device can be obtained at <http://sample.microchip.com>.

Purchase

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 all the products you need on a easily opened Microchip line of credit. Visit www.microchipdirect.com for more information.

Support

Microchip is committed to supporting its customers in developing products faster and more efficiently. We maintain a worldwide network of field applications engineers and technical support ready to provide product and system assistance. In addition, the following service areas are available at www.microchip.com:

- **Support** link provides a way to get questions answered fast: <http://support.microchip.com>
- **Sample** link offers free evaluation samples of any Microchip device: <http://sample.microchip.com>
- **Training** link offers webinars, registration for local seminars/workshops and information on annual MASTERS events held throughout the world: www.microchip.com/training
- **Forum** link provides access to knowledge base and peer help: <http://forum.microchip.com>

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Purchase



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 an easily opened Microchip line of credit.

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China - Hong Kong SAR

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China - Nanjing

Tel: 86-25-8473-2460

China - Qingdao

Tel: 86-532-8502-7355

China - Shanghai

Tel: 86-21-5407-5533

China - Shenyang

Tel: 86-24-2334-2829

China - Shenzhen

Tel: 86-755-8203-2660

China - Wuhan

Tel: 86-27-5980-5300

China - Xiamen

Tel: 86-592-2388138

China - Xian

Tel: 86-29-8833-7252

China - Zhuhai

Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore

Tel: 91-80-4182-8400

India - New Delhi

Tel: 91-11-4160-8631

India - Pune

Tel: 91-20-2566-1512

Japan - Yokohama

Tel: 81-45-471-6166

Korea - Daegu

Tel: 82-53-744-4301

Korea - Seoul

Tel: 82-2-554-7200

Malaysia - Kuala Lumpur

Tel: 60-3-6201-9857

Malaysia - Penang

Tel: 60-4-227-8870

Philippines - Manila

Tel: 63-2-634-9065

Singapore

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