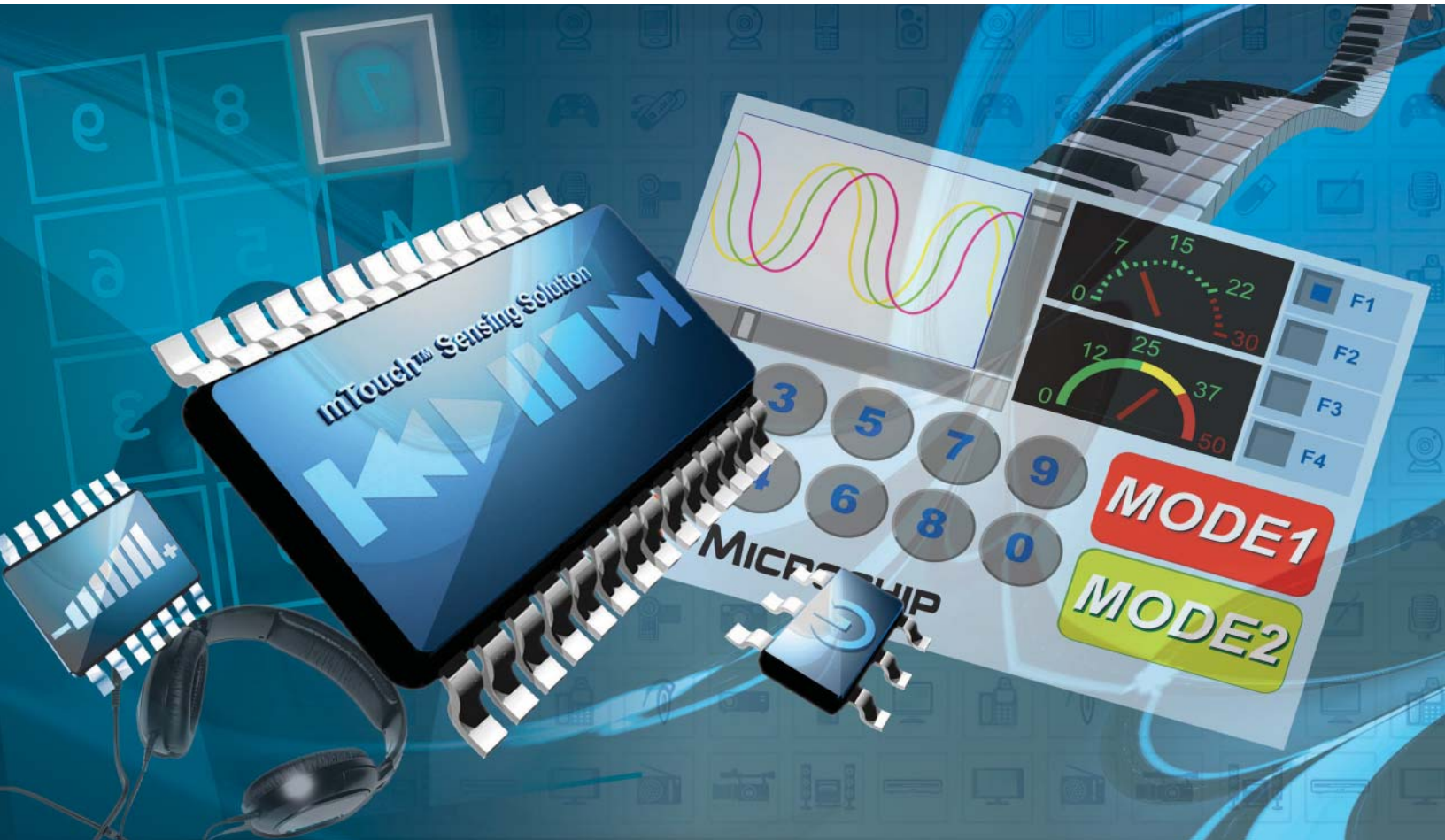# MICROCHIP

Human Interface Solutions
Touch Sensing, Display and Audio & Speech

Human Interface Solutions

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, D/A converters for audio and A/D converters for keyboard matrix implementations. In addition, Microchip offers a wide variety of stand-alone analog and interface products that provide added flexibility and performance.

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**.

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 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 mTouch Solution offers a number of solutions to suit the demands of any application:

- From 8 bits to 32 bits
- From 6-pins to 100-pins
- Up to 512 KB of Flash
- DFN and QFN packages

FREE Source Code and Diagnostic Software

Microchip provides free source code and libraries at the on-line mTouch Sensing Solution Design Center to enable touch sensing applications using PIC microcontrollers. The free mTouch Diagnostic Tool is a Windows®-based tool which provides an easy-to-use graphical user interface that gives engineers a platform to analyze application critical information in "real-time" as it relates to touch sensing behavior.

Touch Sensing

Capacitive Touch vs. Inductive Touch

In addition to the Capacitive Sensing solutions, Microchip also offers an Inductive Sensing solution. This gives designers more flexibility to choose the right touch technology for their application. The table below can help you decide between Capacitive and Inductive Touch based on your application requirements.

	Capacitive Touch	Inductive Touch
Keys	★★★	★★★
Slider	★★★	★
Power Consumption	★★★	★
Plastic Front Panel	★★★	★★★
Glass Front Panel	★★★	★
Metal Front Panel		★★★
Waterproof	★	★★★
Outdoor	★	★★★
Gloves	★	★★★
Braille Friendly		★★★
Continuous Touch	★★★	★★★
Soft/Hard Touch		★★★

★ Good　　★★ Better　　★★★ Best

Capacitive Touch Sensing
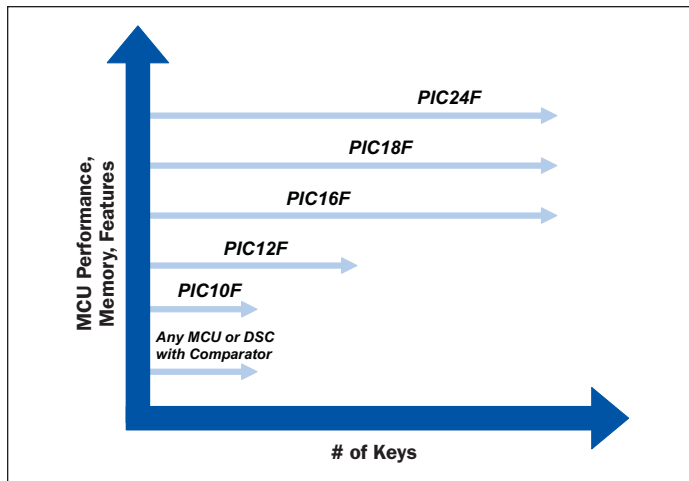
Microchip's Capacitive mTouch Solution offers a number of PIC MCUs to suit the demands of any application from the most basic single-button design using the incredibly small and cost-effective 6-pin PIC10F to the peripheral rich 8-bit Mid-Range and 16-bit microcontroller families.

Basic Principles

A capacitor is simply two electrically isolated conductors which are in close proximity to one another. The conductors can be wires, traces on a PCB or even the iron in the user's blood.

The capacitive touch sensor is just a copper pad area, that is capacitively coupled to grounds located elsewhere in the system creating a parasitic capacitance. A covering plate material such as glass is used to provide the user touch surface. The introduction of the user's finger then produces an increase in capacitance which will be detected by the system.

Low Power

In order to detect the capacitance value shift, you need to constantly scan the keypad, making the implementation of a low power solution crucial. Microchip's mTouch capacitive solution offers very low power operation, down to less than 10 µA.

How to Choose the Right Capacitive Touch Solution for Your Application

The application ultimately dictates which solution best suits your design. For example:

Application Requirement	Parts Recommendation
One key or proximity sensor	PIC10F204/6
Up to four keys	PIC16F610/6, PIC16F690 Family, PIC16F88X
More than eight keys with communication; Low power < 10 µA	PIC16F72X
More than 8 keys with MCU performance, memory features	PIC18F46J11, PIC18F46J50, PIC18F87J90, PIC24F16KA102, PIC24FJ64GA104/GB004, PIC24FJ256GA110/GB110

Getting Started with Touch Sensing

Inductive Touch Sensing

In addition to capacitive touch technology, Microchip also offers inductive touch sensing technology.

Microchip Inductive mTouch™ Sensing Solution is proprietary technology. It is available to customers free-of-charge under a license agreement permitting use and implementation of the technology on any PIC® microcontroller or dsPIC® digital signal controller.

Basic Principles

When the user presses the front panel, it deflects slightly. This deflection, on the order of microns, is inductively detected. The fundamental principle of operation is that the impedance of an inductor varies when a nearby magnetically permeable or electrically conductive material moves relative to the inductor. Some pressure is needed to trigger the key though accidental touch trigger is dramatically reduced.

The main advantages are:

- The front panel can be metal, such as stainless steel or aluminum, plastic or wood
  - Inked or etched panel
  - Vandal proof
  - No cut out or connector/harness required
  - Same electronic board with different front panel finishes
  - Robust in harsh environment as the metal front panel can be grounded
- The keys are unaffected by water droplets, humidity or liquids
  - Easy to clean
  - Well suited for wet or outdoor application
  - Immersion possible
- It can sense through thick gloves
  - Outdoor or industrial application
- It is Braille friendly
  - Access control, ATMs
  - To comply with governmental regulations
- It can differentiate a soft touch from a hard touch
  - Speeding up or slowing down accordingly to the pressure applied

Easy to Implement

The construction of an inductive touch sensor system is comprised of three main components: the fascia or front panel, the spacer layer and the PCB.

Common front panel construction includes sheet or formed metal, plastic sheet or plastic injection moldings. The spacer layer between the front panel and the PCB is needed to allow some deflection. It can be built using any mechanically stiff and electrically insulating material such as FR4, resin bonded paper or other plastic. Constructions which use an injection molded fascia typically do not require a spacer layer since it can be molded as an integral feature of the plastic. The inductive sensor coil is usually just a flat spiral coil etched into the copper layer of a PCB.

MCU Requirements for Inductive Touch Sensing

Microchip enables designers to integrate inductive touch-sensing functionality with their existing application code in a single standard 8-, 16- or 32-bit PIC microcontroller or 16-bit dsPIC digital signal controller, thus reducing total system costs. The only peripherals needed are a PWM and an A/D converter.

mTouch Sensing Solution Design Center
www.microchip.com/mtouch

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

Getting Started with Touch Sensing

Development Systems for Capacitive Touch Sensing

PIC10F Capacitive Touch Board (AC103003)

This board demonstrates the simple implementation of a single capacitive touch key or proximity sensor using a PIC10F204/6 MCU.

PICDEM™ Touch Sense 1 Development Kit (DM164125)

The dev kit cemonstrates touch sensing technology using keys and slides and the 8-bit PIC16F microcontroller with comparator S/R latch module.

PICDEM™ Touch Sense 2 Development Kit (DM164128)

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

PIC24F Starter Kit (DM240011)

The starter kit contains everything needed to begin exploring the high performance and versatility of the 16-bit PIC24F MCU family. It includes an integrated in-circuit debugger and programmer, USB device and host connectors, tri-color LED, capacitive CTMU touch pad and an OLED display.

mTouch™ Capacitive Touch Evaluation Kit (DM183026)

Includes two main boards: one populated with a PIC16F72X 8-bit MCU and the other with a PIC24F256GB110 16-bit MCU; and four daughter boards for developing keys, sliders and a matrix.

If your application requires capacitive or inductive 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

Overview of Charge Time Measurement Unit (CTMU)

Application Notes

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
AN1171	Using the Capacitive Sensing Module on the PIC16F72X
AN1202	Capacitive Sensing with a PIC10F MCU
AN1237	Inductive Touch Hardware Design
AN1239	Inductive Touch Sensor Design
AN1241	Inductive Touch Software Design
AN1250	Microchip CTMU for Capacitive Touch Applications

Manuals

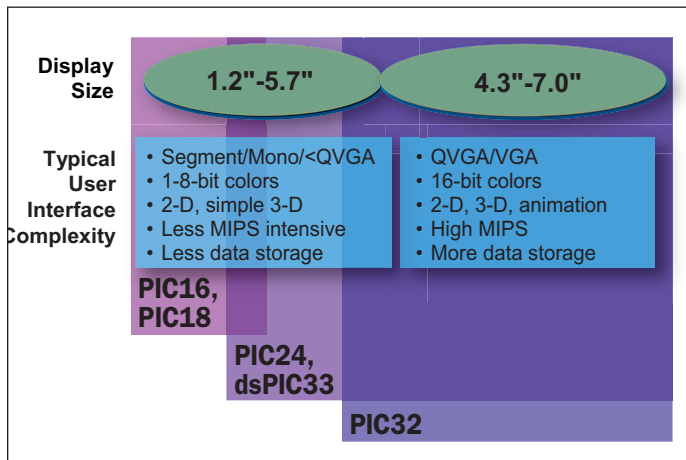|	
DS39724	CTMU Reference Manual
DS41328	mTouch™ Users Guide

Technical Brief

TB 3014	Low-Power Capacitive Sensing with the Capacitive Sensing Module

Display Solutions: Segmented LCD and Graphics Displays

The use of segmented and graphics displays continue to gain popularity in an increasing range of control and user interface applications in markets such as home automation, medical and industrial applications. Displays enhance the user experience and provide detailed information with sharper images. Additionally, 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. 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.

Display Size	1.2"-5.7"	4.3"-7.0"
Typical User Interface Complexity	• Segment/Mono/<QVGA • 1-8-bit colors • 2-D, simple 3-D • Less MIPS intensive • Less data storage	• QVGA/VGA • 16-bit colors • 2-D, 3-D, animation • High MIPS • More data storage

PIC16, PIC18

PIC24, dsPIC33

PIC32

Segmented LCD Displays

PIC MCUs with Segmented Display Drive

The demand for human interfaces in consumer and industrial products have fueled the market for liquid crystal display applications. Microchip has met this need with a broad portfolio of 8-bit PIC16 and PIC18 MCUs with on-chip LCD driver control supporting letters, numbers, characters and icons, providing the greatest breadth of direct drive for LCD segments up to 192 segments. These families offer a broad product portfolio with strong balance among price, LCD pixel count, package size and peripheral. Some of the main features may include:

- Up to 192 LCD segments
- Up to 128 KB Flash
- Up to 256B Data EEPROM
- Communications up to 2x: I^{2}C, SPI, UART
- Up to 12-bit ADC
- mTouch solution
- Real-time clock and calendar
- Voltage boost for contrast control

Learn more online at **www.microchip.com/LCD**.

Free Segment Display Designer GUI

Microchip offers a user friendly segmented display designer GUI as part of the MPLAB IDE. This GUI allows users to create, edit, delete and save components of various shape and sizes for easy code development.

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

Illustrates the main features of Microchip's 28-, 40-, 64- and 80-pin LCD PIC microcontrollers for segmented display applications. Separate Processor Plug-in Modules (PIMs) are available to evaluate all of the LCD products with the PICDEM LCD 2 board.

PIC18F87J90 PIM (MA180025)

Plug-In Module for PIC18F87J90 family with capacitive touch buttons.

PICDEM LCD 2 PIM Pack (MA180019)
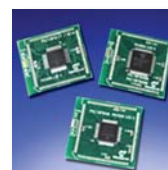
Plug-In Modules for PIC16F917, PIC16F946 and PIC18F8490 LCD families.

Display Solutions: Segmented LCD and Graphics Displays

Graphics Displays

PIC MCUs for Graphics

Many of our 16- and 32-bit MCUs include a Parallel Master Port (PMP) that allows easy support for the graphics LCD displays.

FREE Microchip Graphics Library

With Microchip's free Graphics Library 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. Learn more on-line at www.microchip.com/graphics.

Graphics Library Features

- 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
- Unicode fonts supported

Graphics PICtail™ Plus Daughter Board with 3.2" Display Kit (AC164127-3)
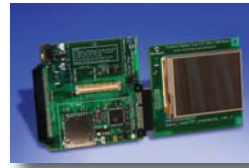
Provides a cost-effective method of evaluating and developing graphics display applications.

Third Party Tools Support

Find additional development systems supporting Microchip's graphics displays from our partners:

- Micrium (www.micrium.com)
- RAMTEX International (www.ramtex.dk)
- SEGGER Microcontroller Systeme GmbH (www.segger.com)

Getting Started with Graphics

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

Free Graphics Library

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

AN1128 Fonts in the Microchip Graphics Library
AN1136 How to Use Widgets in Microchip Graphics Library
AN1227 Using a Keyboard with the Microchip Graphics Library
AN1246 How to Create Widgets in Microchip Graphics Library

Training Class

Sign up for a half-day training course at your local Microchip Regional Training Center:
www.microchip.com/rtc

HIF2131 Designing with the Microchip Graphics Library

*Contact for availability.

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
- Graphic equalizer
- 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 trade-off between audio quality, storage space and CPU processing requirements.

Audio Application Software

Algorithm	Platform Support	Library/Graphic User Interface (GUI)
ADPCM	PIC16, PIC18	AN643 – Adaptive Differential Pulse Code Modulation
	PIC32	Audio Library for PIC32MX
G.711	PIC24, dsPIC30, dsPIC33	SW300026 – dsPIC DSC/PIC24 G.711 Speech Encoding/Decoding Library
G.726A	dsPIC30, dsPIC33	SW300090 – dsPIC DSC G.726A Speech Encoding/Decoding Library
Speex	PIC24, dsPIC30, dsPIC33	dsPIC DSC Speex Speech Encoding/Decoding Library
GUI-based Audio System Design	dsPIC30, dsPIC33	dsPIC DSC Speech & Audio Fast Forward
WAV	PIC32	Audio Library for PIC32MX
Acoustic Echo Cancellation	dsPIC30, dsPIC33	SW300060 – dsPIC DSC Acoustic Echo Cancellation Library
Line Echo Cancellation	dsPIC30, dsPIC33	SW300080 – dsPIC DSC Line Echo Cancellation Library
Noise Suppression	dsPIC30, dsPIC33	SW300040 – dsPIC DSC Noise Suppression Library
Graphic Equalizer	dsPIC30, dsPIC33	dsPIC DSC Equalizer 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 DSCs and PIC32 MCUs have DSP libraries included in their respective compilers to enable higher performance and more efficient processing of high quality audio.

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)
- Microchip also offers a wide portfolio of low power, high performance operational amplifiers which can be used to buffer audio signals or drive small speakers.
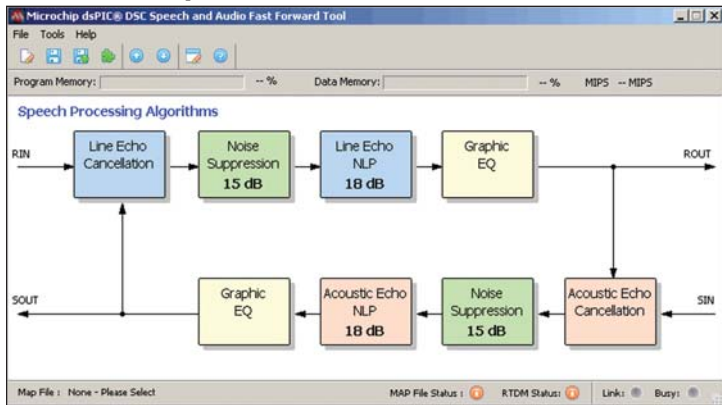
For easy selection of microcontrollers, digital signal controllers and analog products, use Microchip's on-line Advanced Parts Selector (MAPS) which enables user-defined filters to sort features for a parametric search of devices.

Getting Started with Audio and Speech Solutions

Development Systems

dsPIC DSC Speech & Audio Fast Forward GUI

The dsPIC DSC Speech & Audio Fast Forward GUI accelerates your development with graphical tools to configure audio libraries in your system design.

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

A low-cost evaluation platform for dsPIC DSCs 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. This board should be used in conjunction with either development board option listed below.

Option 1: 16-/32-bit Explorer 16 Development Board (DM240001) PLUS PIC32 Plug-in Modules (MA320001/2)

Option 2: PIC32 Starter Boards (DM320001/ DM320003) PLUS I/O Expansion Board (DM320002)

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

AN643　Adaptive Differential Pulse Code Modulation

AN1152 Achieving Higher ADC Resolution Using Oversampling

Hands-free Access Control Solutions

Application Notes

AN959　Using the PIC16F639 MCU for Smart Wireless Applications

AN1024 PKE System Design Using the PIC16F639

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

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

Analog and Interface Products and Memory

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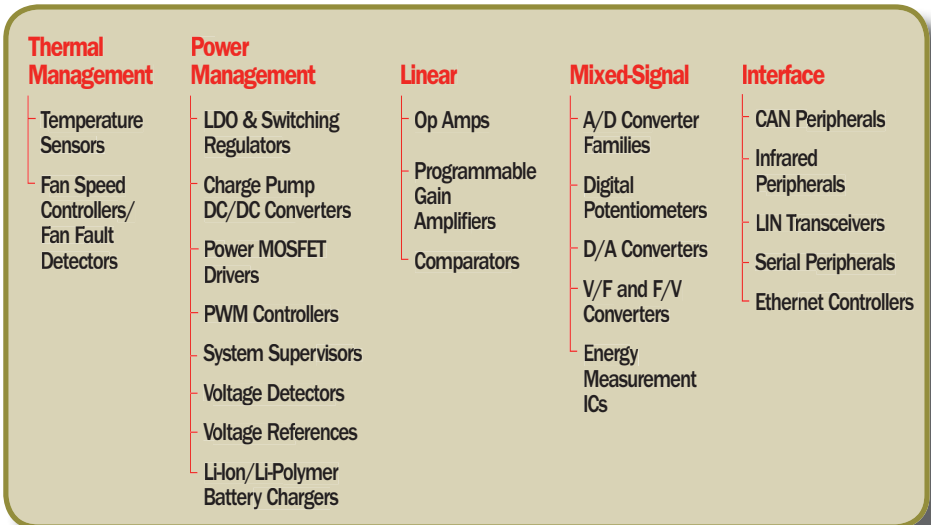
Our broad portfolio of stand-alone analog and interface devices offers highly integrated solutions that combine various analog functions in space-saving packages and support a variety of bus interfaces. Many of these devices support functionality that enhances the analog features currently available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

Microchip Technology's Stand-Alone Analog & Interface Portfolio

Thermal Management
- Temperature Sensors
- Fan Speed Controllers/ Fan Fault Detectors

Power Management
- LDO & Switching Regulators
- Charge Pump DC/DC Converters
- Power MOSFET Drivers
- PWM Controllers
- System Supervisors
- Voltage Detectors
- Voltage References
- Li-Ion/Li-Polymer Battery Chargers

Linear
- Op Amps
- Programmable Gain Amplifiers
- Comparators

Mixed-Signal
- A/D Converter Families
- Digital Potentiometers
- D/A Converters
- V/F and F/V Converters
- Energy Measurement ICs

Interface
- CAN Peripherals
- Infrared Peripherals
- LIN Transceivers
- Serial Peripherals
- Ethernet Controllers

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
MCP4725	12-bit DAC with Non-Volatile Memory

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 (I^2C^{TM}, 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.

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 family uses only ONE connection to the host microcontroller. This compares to two or three pins for I^2C, 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 Solution	Other Key Features
PIC10F206	6	8-bit	1	0.375-0.750	16-24	1 input	SOT-23 or 2x3 DFN packages
PIC16F616	14	8-bit	5	1.75-3.5	64-128	Up to 4 inputs	HV version, 10-bit A/D, ECCP
PIC16F690	20	8-bit	5	1.75-7.0	64-256	Up to 4 inputs	10-bit A/D, SPI/I2C™, USART, ECCP
PIC16F887	28/44	8-bit	5	3.5-14	128-368	Up to 4 inputs	EEPROM, 10-bit A/D, SPI/I2C, UART
PIC16F727	28/44	8-bit	5	3.5-14	128-68	Up to 16 inputs	mTouch Low power operation, SPI/I2C, UART, 2 CCPs
PIC16F1939†	28/44	8-bit	8	4-16	256-1024	Up to 16 inputs	Segmented LCD, 10-bit A/D, SPI/I2C, UART, 3 ECCPs
PIC18F46J11	28/44	8-bit	12	16-64	4K	Up to 13 inputs	Up to 13x 10-bit ADC, Deep Sleep
PIC18F46J50	28/44	8-bit	12	16-64	4K	Up to 13 inputs	Up to 13x 10-bit ADC, USB, Deep Sleep
PIC18F87J90	64/80	8-bit	12	64-128	4K	Up to 12 inputs	Up to 12x 10-bit ADC channels
PIC24F16KA102†	14/20/28	16-bit	16	4-16	0.5-1.5K	Up to 9 inputs	Segmented LCD with up to 48*4 (192) pixels.
PIC24FJ64GA104†	28/44	16-bit	16	32-64	8K	Up to 13 inputs	Up to 13x 10-bit ADC channels, Deep Sleep
PIC24FJ64GB004†	28/44	16-bit	16	32-64	8K	Up to 13 inputs	Up to 13x 10-bit ADC channels, Deep Sleep
PIC24FJ256GA110	64/80/100	16-bit	16	128-256	16K	Up to 16 inputs	Up to 16x 10-bit ADC channels, Deep Sleep
PIC24FJ256GB110	64/80/100	16-bit	16	128-256	16K	Up to 16 inputs	Up to 16x 10-bit ADC channels, USB
dsPIC33FJ128GP804	28/44	16-bit	40	32-128	4-16	Up to 16 inputs	Up to 16x 10-bit ADC channels, USB

Microcontrollers and Digital Signal Controllers for Graphics Applications

Product Family	Pins	CPU	MCU MIPS	Flash (Kbytes)	RAM (Kbytes)	PMP Port (bits)	USB OTG	CTMU	Other Features
PIC24FJ64GA004	28/44	16-bit	16	16-64	4-8	8	N	N	Output Compare/PWM, 16-bit Timers, UART, SPI, I2C™, 10/12-bit ADC, Analog Comparators, CAN, Audio Codec Interface, Audio DAC, Motor Control Peripherals
PIC24FJ128GA010	64/80/100	16-bit	16	64-128	8	8	N	N	
PIC24FJ256GA110	64/80/100	16-bit	16	128-256	16	8	N	Y	
PIC24FJ256GB110	64/80/100	16-bit	16	64-256	16	8	Y	Y	
PIC24H128GP504	28/44	16-bit	40	32-128	4-8	16	N	N	
dsPIC33FJ128GP804	28/44	16-bit	40	32-128	4-16	16	N	N	
dsPIC33FJ128MC804	28/44	16-bit	40	32-128	4-16	16	N	N	
PIC32MX3	64/100	32-bit	40/80	32-512	8-32	8/16	N	N	
PIC32MX4	64/100	32-bit	40/80	32-512	8-32	8/16	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	–
PIC16F946	64	8-bit	5	14	336	256	168	–
PIC16F1947†	28/44/64	8-bit	8	7-28	256-1K	256	60-184	CSM, Low power options
PIC18F8490	64/80	8-bit	10	8-16	768	–	128-192	–
PIC18F8493	64/80	8-bit	10	8-16	768	–	128-192	Up to 12x 12-bit ADC
PIC18F85J90	64/80	8-bit	10	8-32	1-2K	–	132-192	LCD Voltage Boost Regulator
PIC18F87J90	64/80	8-bit	12	64-128	4K	–	132-192	LCD Voltage Boost Regulator, RTCC, mTouch™

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 ksps 16-bit Audio DAC (2 channels)
dsPIC33FJ64GP804	44	16-bit	40	64	16K	DMA, 16-bit 100 ksps 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
PIC32MX3	64/100	32-bit	40/80	512	32K	DMA, 32-bit Framed SPI Mode for 16-bit, Stereo Codec Interface
PIC32MX4	64/100	32-bit	40/80	512	32K	DMA, USB

*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 dsPIC 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.

†Contact for availability.

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