16-bit Microcontrollers and Digital Signal Controllers

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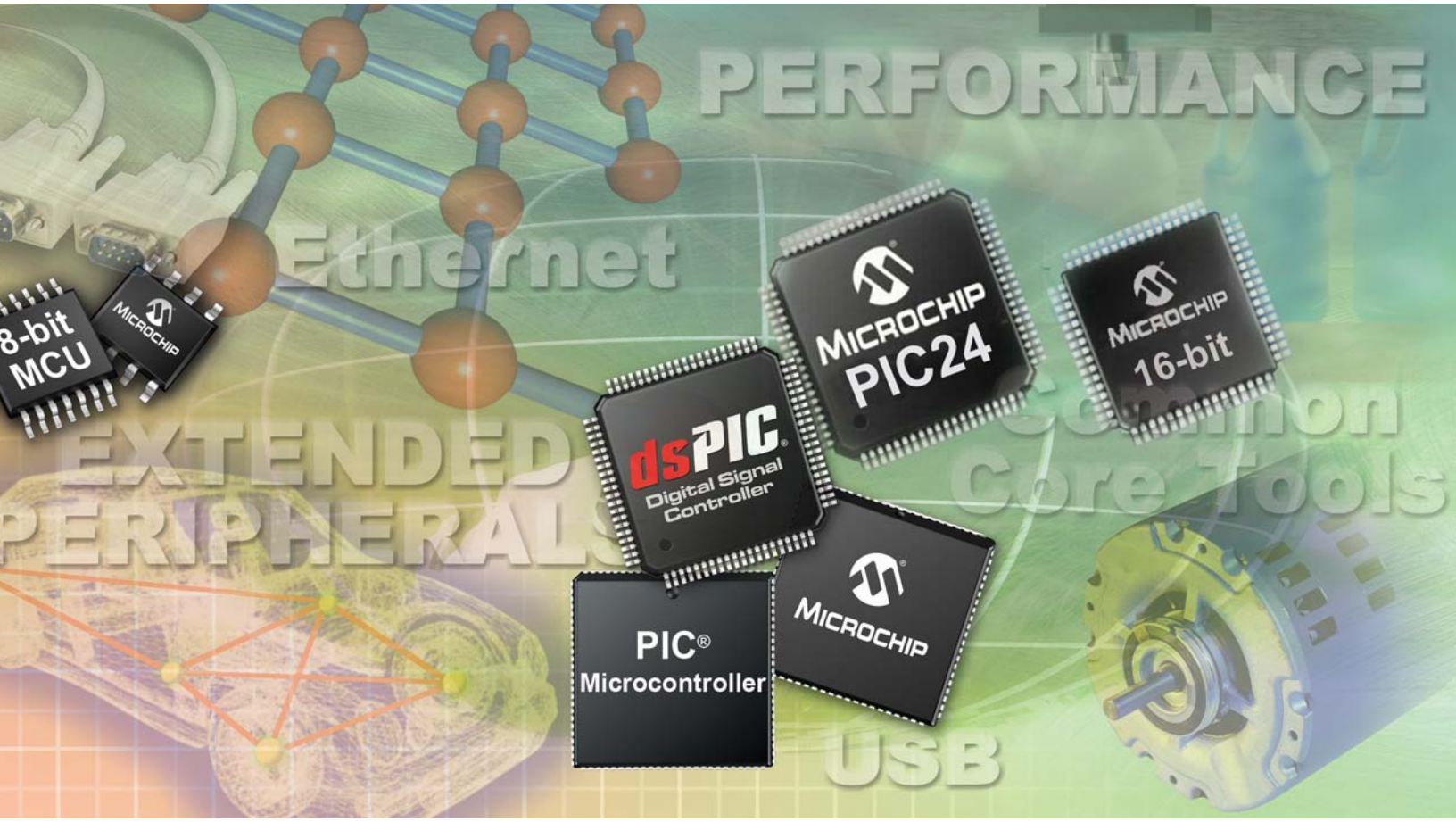
16-bit Embedded Control Solutions

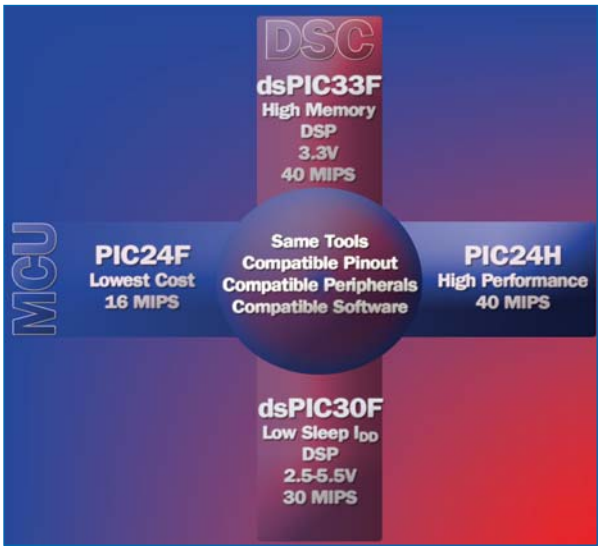
- PIC24 Microcontrollers
- dsPIC® Digital Signal Controllers



www.microchip.com/16bit

16-bit Embedded Control Solutions

Do you need to add more performance or additional features to your products? Do you need more on-chip memory? Are you concerned with tight schedules and cost goals? How do you decide which embedded control solution will bring the most value to your overall embedded design?



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Microchip's 16-bit solutions are designed to be a broad platform which can serve your needs for many years. If you have designed using our 8-bit PIC® microcontrollers (MCUs) you will be pleased to see that the same MPLAB® Integrated Development Environment used on our smallest 6-pin MCUs and our largest 32-bit PIC32 microcontrollers also supports our 16-bit controllers. Plus our commitment for peripheral and pinout compatibility has been carried forward to our 16-bit product families. If you are new to Microchip's control solutions, we offer powerful, low cost development tools, a compatible lineup of products that range from low cost to high performance, and a Company dedicated to serving your needs.

Since 2002, Microchip has been #1 in worldwide 8-bit microcontroller shipments* with a product portfolio that continues to expand to meet the demands of our customers while solving many of their key business issues. With more than 140 16-bit products in our portfolio today and many more on the way, we are committed to offer similar value in the 16-bit realm.

One Architecture, Four Families

Microchip offers two 16-bit Microcontroller (MCU) families plus two 16-bit Digital Signal Controller (DSC) families that give you compatible options across a wide spectrum of price, performance and feature sets. Common attributes among all 16-bit MCU and DSC families are:

- Pinout compatibility
- Software compatibility
- Peripheral compatibility
- Common development tools

Whether your solution requires the lowest cost 16-bit solution, the most powerful 16-bit MCU in the industry, or DSP capability, Microchip offers a broad range of products while preserving the compatibility that helps save you time and money on subsequent designs.

What's New . . .

Resources available at www.microchip.com/16bit:

- Product Information
- Application Solutions
- Design Tools
- Web Seminars
- Application Notes & Reference Designs

**Gartner Dataquest, Top Companies Revenue from Shipments of 8-bit MCU - All Applications" April 2005.*

The Capability You Need

16-bit Microcontroller (MCU) Portfolio

Are cost or performance important considerations for your next design? PIC24 MCUs offer the variety of peripherals, memory sizes and packaging choices you have come to expect from our 8-bit products. Microchip offers two compatible Flash-based 16-bit PIC24 MCU families. The 16 MIPS PIC24F family is designed for cost- or power-sensitive applications. The 40 MIPS PIC24H family is designed for high performance applications. Both families have the same instruction set, share basic peripherals, have common pinouts and use the same tools for development. The PIC24 families are compatible with dsPIC DSCs for easy migration when additional performance or DSP capability is required.

16-bit Digital Signal Controller (DSC) Portfolio

Are you looking to add new features or performance to your application? DSCs blend the features of both MCUs and DSPs into a single-chip solution enabling you to incorporate DSP resources into your embedded application. Microchip offers two compatible Flash-based 16-bit DSC families. The 30 MIPS dsPIC30F family is designed for applications where 5V operation is important, and the 40 MIPS dsPIC33F family is suited for applications preferring 3.3V or need more on-chip memory. Both DSC families and the PIC24 families have the same base instruction set (DSCs add DSP instructions), share basic peripherals, have common pinouts and use the same tools for development.

Optimized C Compiler

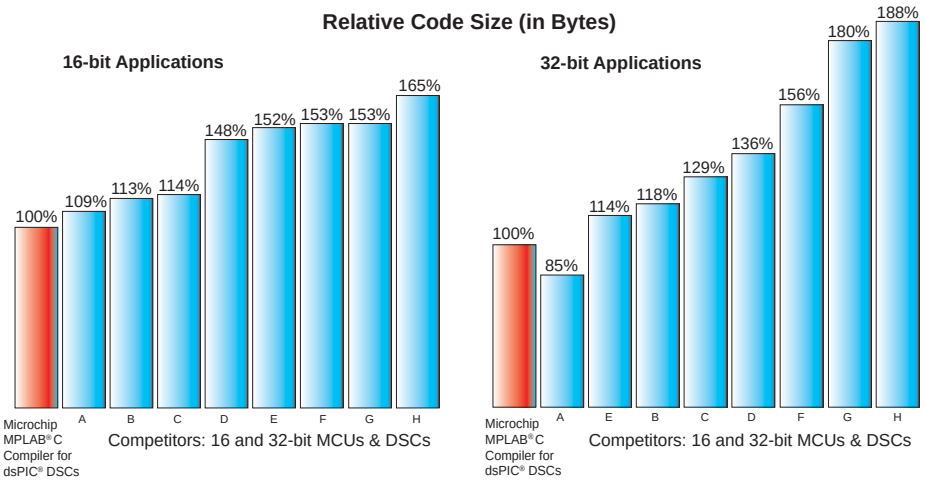
Supporting the PIC24 MCU and dsPIC DSC families, Microchip's 16-bit architecture was designed to optimize C language code size. The architecture was co-developed by compiler writers who emphasized the need for an orthogonal instruction set, many general-purpose registers, powerful indirect with offset addressing and a software stack. Now you can achieve leadership code size in applications, helping your project team hit schedule and code size targets. Reduced code size provides the opportunity to use a smaller memory device, spend less time optimizing code size and respond to those marketing requests for "just one more feature."

Powerful 16-bit CPU

The PIC24 MCU and the dsPIC DSC families execute most instructions in one cycle. Interrupts are serviced quickly and are deterministic. Bit manipulation is accomplished in a single cycle. Add latest generation features, such as zero overhead looping, single-cycle multiply and a single-cycle multi-bit shifter, and you have the most powerful 16-bit MCU for your embedded control designs.

Migration Options

Once you have designed our 16-bit products into your application, future designs are simplified. You can select from a broad range of memory, pin count, peripheral, performance and price options without changing architecture or development tools. The pinout, software and tool compatibility helps make stepping to different performance or memory points very straightforward. This is also beneficial if you design in an environment of rapidly evolving requirements.



Looking to Add DSP?

If you are an MCU user looking to add DSP features to your embedded design, the dsPIC DSCs make the process easy. The dsPIC DSC retains an MCU look and feel from the architecture to the tools used for development. If you don't have the time to learn about DSP technology, you can use one of the many libraries or filter design tools developed by DSP experts. For DSP experts, Microchip includes the true DSP features you expect: dual 40-bit accumulators, single cycle 16x16 MAC, dual operand fetches, saturation and rounding modes, and zero overhead looping.

Small Packages

Now devices with up to 128 Kbytes of Flash are available in packages as small as 6x6 mm. It has never been easier to reduce board space or shrink product size. Peripheral Pin Select (PPS) permits digital peripherals to be remapped other pins to resolve I/O conflicts or optimize board layout.

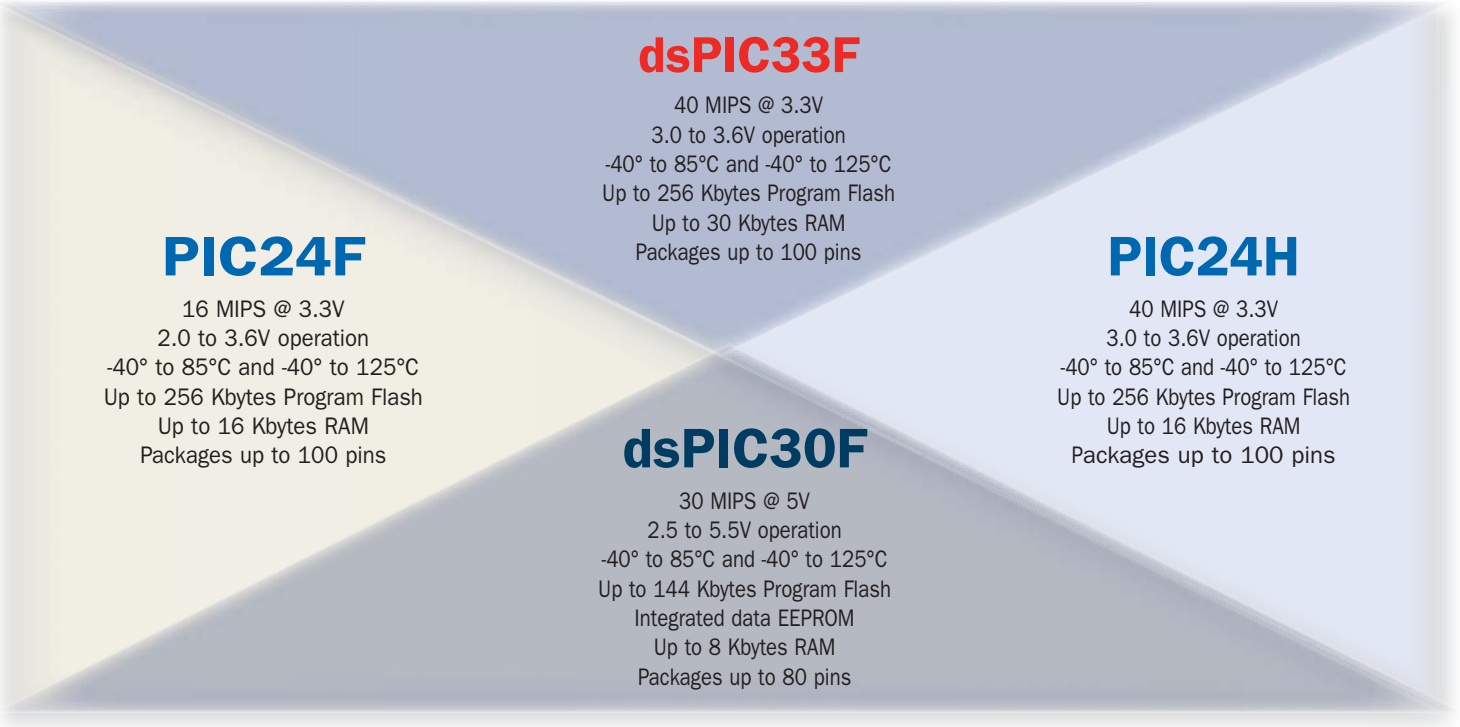
Flexible Flash

All of Microchip's 16-bit products employ flexible and secure Flash memory. You can use the Flash memory to store programs or data tables. Additionally, all devices can self-program their own Flash memory in a finished product. The PIC24H and dsPIC DSC families offer advanced security features that enable you to secure your base code and allow OEMs to "customize" the application or alternatively enhance work with encrypted data.

Power Saving Options

Microchip's 16-bit products have sophisticated power management capability. The lowest power "sleep" mode has options for rapid start-up. Other power-saving modes provide options to reduce speed or disable the CPU while selected peripherals continue to operate. An internal PLL permits clock speeds to be altered by software to further modulate power consumption. The PIC24F MCU family offers the lowest operating power while the dsPIC30F and the PIC24F family offer the lowest sleep mode power.

One Architecture: Four Compatible Families



Highly Cost-Effective PIC24F 16-bit MCUs

With 16 MIPS performance and an extensive peripheral set, including USB and capacitive touch sense interface, the PIC24F MCUs are a highly cost-effective solution for all but the most demanding 16-bit applications. The PIC24F also offers an easy migration path for design engineers whose applications have outgrown the performance offered by 8-bit MCUs.

Highest Performance PIC24H 16-bit MCUs

For more demanding applications, the PIC24H offers 40 MIPS performance, more memory and additional peripherals. The PIC24H family adds up to 2 CAN communication modules, and a user-selectable 10/12-bit Analog-to-Digital Converter (ADC). Integrated Direct Memory Access (DMA) between peripherals and dual-port RAM provides zero overhead data transfers, optimizing CPU throughput.

Versatile 5 Volt dsPIC30F DSCs

The 30 MIPS dsPIC30F family is developed for applications that benefit from a wide operating voltage (2.5 to 5.5V), extremely low standby current, integrated EEPROM, and for those that prefer 5V operation due to system considerations.

High Performance, Cost Effective 3.3 Volt dsPIC33F DSCs

The 40 MIPS dsPIC33F family is developed for high performance embedded control applications. Compared to the dsPIC30F family, the dsPIC33F family offers more performance, larger RAM and Flash memory options, a lower price particularly for large memory configurations, DMA and additional peripheral options.

16-bit Family Comparison

	PIC24F	PIC24H	dsPIC30F	dsPIC33F
Best in Class C Compiler Efficiency	√	√	√	√
Same Instruction Set	√	√	Adds DSP	Adds DSP
Same Base Peripherals	√	√	√	√
Same Pinout	√	√	√	√
Same Development Tools	√	√	√	√
Fixed Fast Interrupt Latency	√	√	√	√
Universal Bit Manipulation	√	√	√	√
Full Speed from Flash	√	√	√	√
Single-Cycle Multiply	√	√	√	√
32/16 & 16/16 Divide	√	√	√	√
Deterministic Instruction Execution	√	√	√	√

16-bit Product Features Overview

CPU, Systems & Memory

Operating Range PIC24F

- DC to 16 MIPS
- VDD range: 2.0 to 3.6V
- Ind. (-40° to 85°C) Ext. (-40° to 125°C)

Operating Range PIC24H & dsPIC33F

- DC to 40 MIPS
- VDD range: 3.0 to 3.6V
- Ind. (-40° to 85°C) Ext. (-40° to 125°C)

Operating Range dsPIC30F

- DC to 30 MIPS*
- VDD range: 2.5 to 5.5V
- Ind. (-40° to 85°C) Ext. (-40° to 125°C)

High Performance CPU

- Single cycle execution (most instructions)
- C compiler optimized instruction set
- 16-bit wide data path
- 76 base instructions: mostly 1 word/1 cycle
- 16 16-bit general purpose registers
- Software stack
- 16 x 16 signed fractional/integer multiplier
- 32/16 and 16/16 divide
- 40-stage barrel shifter
- DSC additions (dsPIC30F & dsPIC33F):
  - Adds 8 base DSP instructions
  - 2 40-bit accumulators with rounding and saturation options
  - Single core combines MCU & DSP features
  - Adds Modulo and Bit-reverse address modes

System Management

- Flexible clock options:
  - Primary external clock, crystal, resonator
  - Secondary lower power 32 kHz oscillator
  - Internal RC: fast or low power
  - Integrated low jitter PLL
    - PLL sourced by ext. and int. clock sources
- Programmable power-up timer
- Oscillator start-up timer/stabilizer
- Watchdog Timer with its own RC oscillator
- Clock switching/fail-safe clock monitor

Interrupt Controller

- 5 cycle fixed latency
- Up to 118 interrupt sources, up to 5 external
- 7 programmable priority levels
- 4 processor exceptions and software traps

Power Management

- Switch between clock sources in real-time
- Programmable power-on reset start up
- Programmable low-voltage detect (dsPIC30F)
- Programmable brown-out reset
- Idle and Sleep modes with fast wake up

*30 MIPS @ 4.5 to 5.5V, -40° to 85°C
**Peripheral, Mini-Host, OTG

On-chip Flash, Data EEPROM and RAM

- Flash program memory: up to 256 KB
- dsPIC30F data EEPROM: up to 4 KB
  - 1 million erase/write cycles typical
- Data RAM: up to 30 KB

Peripherals

Digital I/O

- Peripheral Pin Select (PPS)
  - Remap digital I/O
  - Support most digital peripherals
- Up to 85 programmable digital I/O pins
- Wake-up/Interrupt-on-change on up to 24 pins
- High current sink/source (PIC24F & dsPIC30F)

Communication Modules

- 3-wire SPI: up to 3 modules
  - Framing supports I/O interface to simple codecs
- I²C™: up to 3 modules
  - Full Multi-master and Slave mode support
  - 7-bit and 10-bit addressing
- UART: up to 4 modules
  - Interrupt-on-address bit detect
  - Wake-up on Start bit from Sleep mode
  - 4-character TX and RX FIFO buffers
  - LIN and IrDA® support
- USB OTG**
  - Internal Boost Regulator requires minimal external components
  - Separate 3.3V regulator
  - Transparent RAM buffer interface
- Codec interface module
  - Supports I²S and AC97 protocols

Timers/Capture/Compare/PWM

- Timer/counters: up to nine 16-bit timers
  - Can pair up to make 32-bit timers
  - 1 timer can run as real-time clock
- Input capture: up to 8 channels
  - Capture on rising, falling or both edges
  - 4-deep FIFO on each capture
- Output compare: up to 9 channels
  - Single or dual 16-bit compare mode
  - 16-bit glitchless PWM mode

Auxiliary Functions

- Parallel Master Slave Port (PMP/PSP):
  - 8-bit Parallel IO, highly configurable
  - Communicates with external data memory, communications peripherals, LCDs
  - Supports 8-bit or 16-bit data
  - Supports 16 address lines
- Hardware Real-Time Clock/Calendar (RTCC):
  - Provides clock, calendar and alarm functions
- Programmable CRC generator
- Charge/Time Measurement Unit (CTMU)
  - Capacitive Touch Sense Keypad I/F
  - Provides 1 ns resolution time measurements

Hardware DMA PIC24H & dsPIC33F

- 8 channel DMA between dual port RAM & peripherals

Analog Subsystems

- Analog comparators (up to 3):
  - Programmable reference
- Audio DAC:
  - 2 ch. 16-bit 100 ksps
  - Differential output
- 10-bit ADC:
  - PIC24F: 500 ksps, 1 module
  - dsPIC30F: 1 Msps, 1 module
- 12-bit ADC:
  - dsPIC30F: 200 ksps 1 module
- 10-/12-bit ADC (user selectable):
  - Available on PIC24H and dsPIC33F
  - 10-bit: 1.1 Msps, 4 S&H
  - 12-bit: 500 ksps, 1 S&H
  - Some devices have 2 modules
- Common ADC features:
  Buffered output or DMA
  - dsPIC30F & PIC24F: up to 16 channels auto scanning
  - PIC24H & dsPIC33F: up to 32 channels auto scanning

Motor Control Peripherals

- Motor Control PWM: up to 8 outputs
  - 4 duty cycle generators
  - Independent or complementary mode
  - Programmable dead time settings
  - Edge or center-aligned
  - Manual output override control
  - Up to 2 fault inputs
  - ADC samples triggered by PWM module
- Quadrature encoder interface module
  - Up to 2 modules
  - Phase A, Phase B and index pulse input
- High current sink/source (PIC24F & dsPIC30F)

Switch Mode Power Peripherals

- 10-bit ADC 2 Msps, Up to 4 sample and holds
- PS PWM, 1 nS duty cycle resolution
- Analog comparators
  - Programmable reference

PIC24F Family

16 MIPS, Low Cost/Low Power

The PIC24F family is ideal for cost-sensitive applications or applications migrating from 8-bit designs for a boost in performance or memory.

Product	Pins	Flash KB	RAM KB	Timer	Capture	Output Compare/ PWM	RTCC	ADC 10-bit 500 ksps	Analog Comparators	UART	SPI	I²C™	PMP	PPS	CTMU	USB OTG	JTAG	Pkg Code
PIC24FJ16GA002	28	16	4	5	5	5	Y	1 ADC, 10 ch	2	2	2	2	Y	Y	–	–	Y	ML, SO, SP, SS
PIC24FJ32GA002	28	32	8	5	5	5	Y	1 ADC, 10 ch	2	2	2	2	Y	Y	–	–	Y	ML, SO, SP, SS
PIC24FJ48GA002	28	48	8	5	5	5	Y	1 ADC, 10 ch	2	2	2	2	Y	Y	–	–	Y	ML, SO, SP, SS
PIC24FJ64GA002	28	64	8	5	5	5	Y	1 ADC, 10 ch	2	2	2	2	Y	Y	–	–	Y	ML, SO, SP, SS
PIC24FJ16GA004	44	16	4	5	5	5	Y	1 ADC, 13 ch	2	2	2	2	Y	Y	–	–	Y	ML, PT
PIC24FJ32GA004	44	32	8	5	5	5	Y	1 ADC, 13 ch	2	2	2	2	Y	Y	–	–	Y	ML, PT
PIC24FJ48GA004	44	48	8	5	5	5	Y	1 ADC, 13 ch	2	2	2	2	Y	Y	–	–	Y	ML, PT
PIC24FJ64GA004	44	64	8	5	5	5	Y	1 ADC, 13 ch	2	2	2	2	Y	Y	–	–	Y	ML, PT
PIC24FJ64GA006	64	64	8	5	5	5	Y	1 ADC, 16 ch	2	2	2	2	Y	–	–	–	Y	PT
PIC24FJ64GB106	64	64	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ96GA006	64	96	8	5	5	5	Y	1 ADC, 16 ch	2	2	2	2	Y	–	–	–	Y	PT
PIC24FJ128GA006	64	128	8	5	5	5	Y	1 ADC, 16 ch	2	2	2	2	Y	–	–	–	Y	PT
PIC24FJ128GA106	64	128	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	–	Y	PT
PIC24FJ128GB106	64	128	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ192GA106	64	192	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	–	Y	PT
PIC24FJ192GB106	64	192	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ256GA106	64	256	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	–	Y	PT
PIC24FJ256GB106	64	256	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ64GA008	80	64	8	5	5	5	Y	1 ADC, 16 ch	2	2	2	2	Y	–	–	–	Y	PT
PIC24FJ64GB108	80	64	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ96GA008	80	96	8	5	5	5	Y	1 ADC, 16 ch	2	2	2	2	Y	–	–	–	Y	PT
PIC24FJ128GA008	80	128	8	5	5	5	Y	1 ADC, 16 ch	2	2	2	2	Y	–	–	–	Y	PT
PIC24FJ128GA108	80	128	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	–	Y	PT
PIC24FJ128GB108	80	128	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ192GA108	80	192	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	–	Y	PT
PIC24FJ192GB108	80	192	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ256GA108	80	256	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	–	Y	PT
PIC24FJ256GB108	80	256	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ64GA010	100	64	8	5	5	5	Y	1 ADC, 16 ch	2	2	2	2	Y	–	–	–	Y	PF, PT
PIC24FJ64GB110	100	64	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ96GA010	100	96	8	5	5	5	Y	1 ADC, 16 ch	2	2	2	2	Y	–	–	–	Y	PF, PT
PIC24FJ128GA010	100	128	8	5	5	5	Y	1 ADC, 16 ch	2	2	2	2	Y	–	–	–	Y	PF, PT
PIC24FJ128GA110	100	128	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	–	Y	PT
PIC24FJ128GB110	100	128	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ192GA110	100	192	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	–	Y	PT
PIC24FJ192GB110	100	192	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT
PIC24FJ256GA110	100	256	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	–	Y	PT
PIC24FJ256GB110	100	256	16	5	9	9	Y	1 ADC, 16 ch	3	4	3	3	Y	Y	Y	Y	Y	PT

PIC24H General Purpose Family

40 MIPS, Highest Performance

The PIC24H family is ideal for applications with greater performance or memory requirements or require extensive data movement

Product	Pins	Flash KB	RAM KB	DMA # ch	Timer 16-bit	Input Capture	Output Compare/ PWM	ADC 10-/12-bit* 1.1/0.5 Msps	Analog Comparators	CodeGuard™ Security Segments	UART	SPI	I²C™	PMP	PPS	RTCC	CAN	JTAG	Pkg Code
PIC24HJ12GP201	18	12	1	–	3	4	2	1 ADC, 6 ch	–	2	1	1	1	–	Y	–	–	Y	P, SO
PIC24HJ12GP202	28	12	1	–	3	4	2	1 ADC, 10 ch	–	2	1	1	1	–	Y	–	–	Y	SP, SO, ML, SS
PIC24HJ32GP202	28	32	2	–	3	4	2	1 ADC, 10 ch	–	2	1	1	1	–	Y	–	–	Y	SP, SO, MM
PIC24HJ32GP302	28	32	4	8	5	4	4	1 ADC 10 ch	2	2	2	2	1	1	Y	1	–	–	SO,SP, MM
PIC24HJ64GP202	28	64	8	8	5	4	4	1 ADC 10 ch	2	3	2	2	1	1	Y	1	–	–	SO,SP, MM
PIC24HJ64GP502	28	64	8	8	5	4	4	1 ADC 10 ch	2	3	2	2	1	1	Y	1	1	–	SO,SP, MM
PIC24HJ128GP202	28	128	8	8	5	4	4	1 ADC 10 ch	2	3	2	2	1	1	Y	1	–	–	SO,SP, MM
PIC24HJ128GP502	28	128	8	8	5	4	4	1 ADC 10 ch	2	3	2	2	1	1	Y	1	1	–	SO,SP, MM
PIC24HJ16GP304	44	16	2	–	3	4	2	1 ADC 13 ch	–	2	1	1	1	–	Y	–	–	Y	PT, ML
PIC24HJ32GP204	44	32	2	–	3	4	2	1 ADC 13 ch	–	2	1	1	1	–	Y	–	–	Y	PT, ML
PIC24HJ32GP304	44	32	4	8	5	4	4	1 ADC 13 ch	2	2	2	2	1	1	Y	1	–	–	PT, ML
PIC24HJ64GP204	44	64	8	8	5	4	4	1 ADC 13 ch	2	3	2	2	1	1	Y	1	–	–	PT, ML
PIC24HJ64GP504	44	64	8	8	5	4	4	1 ADC 13 ch	2	3	2	2	1	1	Y	1	1	–	PT, ML
PIC24HJ128GP204	44	128	8	8	5	4	4	1 ADC 13 ch	2	3	2	2	1	1	Y	1	–	–	PT, ML
PIC24HJ128GP504	44	128	8	8	5	4	4	1 ADC 13 ch	2	3	2	2	1	1	Y	1	1	–	PT, ML
PIC24HJ64GP206	64	64	8	8	9	8	8	1 ADC, 18 ch	–	3	2	2	1	–	N	–	–	Y	PT
PIC24HJ64GP506	64	64	8	8	9	8	8	1 ADC, 18 ch	–	3	2	2	2	–	N	–	1	Y	PT
PIC24HJ128GP206	64	128	8	8	9	8	8	1 ADC, 18 ch	–	3	2	2	2	–	N	–	–	Y	PT
PIC24HJ128GP306	64	128	16	8	9	8	8	1 ADC, 18 ch	–	3	2	2	2	–	N	–	–	Y	PT
PIC24HJ128GP506	64	128	8	8	9	8	8	1 ADC, 18 ch	–	3	2	2	2	–	N	–	1	Y	PT
PIC24HJ256GP206	64	256	16	8	9	8	8	1 ADC, 18 ch	–	3	2	2	2	–	N	–	–	Y	PT
PIC24HJ64GP210	100	64	8	8	9	8	8	1 ADC, 32 ch	–	3	2	2	2	–	N	–	–	Y	PT, PF
PIC24HJ64GP510	100	64	8	8	9	8	8	1 ADC, 32 ch	–	3	2	2	2	–	N	–	1	Y	PT, PF
PIC24HJ128GP210	100	128	8	8	9	8	8	1 ADC, 32 ch	–	3	2	2	2	–	N	–	–	Y	PT, PF
PIC24HJ128GP310	100	128	16	8	9	8	8	1 ADC, 32 ch	–	3	2	2	2	–	N	–	–	Y	PT, PF
PIC24HJ128GP510	100	128	8	8	9	8	8	1 ADC, 32 ch	–	3	2	2	2	–	N	–	1	Y	PT, PF
PIC24HJ256GP210	100	256	16	8	9	8	8	1 ADC, 32 ch	–	3	2	2	2	–	N	–	–	Y	PT, PF
PIC24HJ256GP610	100	256	16	8	9	8	8	2 ADC, 32 ch	–	3	2	2	2	–	N	–	2	Y	PT, PF

dsPIC33F Product Family

General Purpose Family

The dsPIC33F General Purpose Family is ideal for a wide variety of 16-bit embedded control applications. In addition, the variants with codec interfaces are well suited for speech and audio applications.

Product	Pins	Flash KB	RAM KB	DMA # Ch	Timer 16-bit	Input Capture	Output Compare/ Standard PWM	Codec Interface	ADC 10-/12-bit* 1.1/0.5 Msps	16-bit Audio DAC	Analog Comparators	CodeGuard™ Security Segments	UART	SPI	I²C™	PMP	PPS	RTCC	CAN	Pkg Code
dsPIC33FJ12GP201	18	12	1	–	3	4	2	–	1 ADC, 8 ch	–	–	2	1	1	1	–	Y	–	–	P, SO
dsPIC33FJ12GP202	28	12	1	–	3	4	2	–	1 ADC, 10 ch	–	–	2	1	1	1	–	Y	–	–	SO, SP, ML, SS
dsPIC33FJ32GP202	28	32	2	–	3	4	2	–	1 ADC, 10 ch	–	–	2	1	1	1	–	Y	–	–	SO, SP, MM
dsPIC33FJ32GP302	28	32	4	8	5	4	4	1	1 ADC 10 ch	–	2	2	2	2	1	1	Y	1	–	SO,SP, MM
dsPIC33FJ64GP202	28	64	8	8	5	4	4	1	1 ADC 10 ch	–	2	3	2	2	1	1	Y	1	–	SO, SP, MM
dsPIC33FJ64GP802	28	64	16	8	5	4	4	1	1 ADC 10 ch	2 ch	2	3	2	2	1	1	Y	1	1	SO, SP, MM
dsPIC33FJ128GP202	28	128	8	8	5	4	4	1	1 ADC 10 ch		2	3	2	2	1	1	Y	1	–	SO, SP, MM
dsPIC33FJ128GP802	28	128	16	8	5	4	4	1	1 ADC 10 ch	2 ch	2	3	2	2	1	1	Y	1	1	SO, SP, MM
dsPIC33FJ16GP304	44	16	2	–	3	4	2	–	1 ADC, 13 ch	–	–	2	1	1	1	–	Y	–	–	PT, ML
dsPIC33FJ32GP204	44	32	2	–	3	4	2	–	1 ADC, 13 ch	–	–	2	1	1	1	–	Y	–	–	PT, ML
dsPIC33FJ32GP304	44	32	4	8	5	4	4	1	1 ADC 13 ch	–	2	2	2	2	1	1	Y	1	–	PT, ML
dsPI33FJ64GP204C	44	64	8	8	5	4	4	1	1 ADC 13 ch	–	2	3	2	2	1	1	Y	1	–	PT, ML
dsPIC33FJ64GP804	44	64	16	8	5	4	4	1	1 ADC 13 ch	2 ch	2	3	2	2	1	1	Y	1	1	PT, ML
dsPIC33FJ128GP204	44	128	8	8	5	4	4	1	1 ADC 13 ch		2	3	2	2	1	1	Y	1	–	PT, ML
dsPIC33FJ128GP804	44	128	16	8	5	4	4	1	1 ADC 13 ch	2 ch	2	3	2	2	1	1	Y	1	1	PT, ML
dsPIC33FJ64GP206	64	64	8	8	9	8	8	1	1 ADC, 18 ch	–	–	3	2	2	1	–	N	–	–	PT
dsPIC33FJ64GP306	64	64	16	8	9	8	8	1	1 ADC, 18 ch	–	–	3	2	2	2	–	N	–	–	PT
dsPIC33FJ64GP706	64	64	16	8	9	8	8	1	2 ADC, 18 ch	–	–	3	2	2	2	–	N	–	2	PT
dsPIC33FJ128GP206	64	128	8	8	9	8	8	1	1 ADC, 18 ch	–	–	3	2	2	1	–	N	–	–	PT
dsPIC33FJ128GP306	64	128	16	8	9	8	8	1	1 ADC, 18 ch	–	–	3	2	2	2	–	N	–	–	PT
dsPIC33FJ128GP706	64	128	16	8	9	8	8	1	2 ADC, 18 ch	–	–	3	2	2	2	–	N	–	2	PT
dsPIC33FJ256GP506	64	256	16	8	9	8	8	1	1 ADC, 18 ch	–	–	3	2	2	2	–	N	–	1	PT
dsPIC33FJ64GP708	80	64	16	8	9	8	8	1	2 ADC, 24 ch	–	–	3	2	2	2	–	N	–	2	PT
dsPIC33FJ128GP708	80	128	16	8	9	8	8	1	2 ADC, 24 ch	–	–	3	2	2	2	–	N	–	2	PT
dsPIC33FJ64GP310	100	64	16	8	9	8	8	1	1 ADC, 32 ch	–	–	3	2	2	2	–	N	–	–	PT, PF
dsPIC33FJ64GP710	100	64	16	8	9	8	8	1	2 ADC, 32 ch	–	–	3	2	2	2	–	N	–	2	PT, PF
dsPIC33FJ128GP310	100	128	16	8	9	8	8	1	1 ADC, 32 ch	–	–	3	2	2	2	–	N	–	–	PT, PF
dsPIC33FJ128GP710	100	128	16	8	9	8	8	1	2 ADC, 32 ch	–	–	3	2	2	2	–	N	–	2	PT, PF
dsPIC33FJ256GP510	100	256	16	8	9	8	8	1	1 ADC, 32 ch	–	–	3	2	2	2	–	N	–	1	PT, PF
dsPIC33FJ256GP710	100	256	30	8	9	8	8	1	2 ADC, 32 ch	–	–	3	2	2	2	–	N	–	2	PT, PF

dsPIC33F Product Family

Motor Control and Power Conversion Family

This dsPIC33F family supports motor control applications, such as brushless DC, single- and 3-phase induction and switched reluctance motors. These are also ideal for UPS, inverter and power factor correction applications.

Product	Pins	Flash KB	RAM KB	DMA # Ch	Timer 16-bit	Input Capture	Output Compare/ Standard PWM	MC PWM	QEI	ADC 10-/12-bit* 1.1/0.5 Msps	16-bit DAC	Analog Comparators	CodeGuard™ Security Segments	UART	SPI	I²C™	PMP	PPS	RTCC	CAN	Pkg Code
dsPIC33FJ12MC201	20	12	1	–	3	4	2	4+2 ch	1	1 ADC, 4 ch	–	–	2	1	1	1	–	Y	–	–	SO, P, SS
dsPIC33FJ12MC202	28	12	1	–	3	4	2	6+2 ch	1	1 ADC, 6 ch	–	–	2	1	1	1	–	Y	–	–	SO, SP, ML, SS
dsPIC33FJ32MC202	28	32	2	–	3	4	2	6+2 ch	1	1 ADC, 6 ch	–	–	2	1	1	1	–	Y	–	–	SO, SP, MM
dsPIC33FJ32MC302	28	32	4	8	5	4	4	6+2 ch	2	1 ADC 6 ch	–	2	2	2	2	1	1	Y	1	–	SO, SP, MM
dsPIC33FJ64MC202	28	64	8	8	5	4	4	6+2 ch	2	1 ADC 6 ch	–	2	3	2	2	1	1	Y	1	–	SO, SP, MM
dsPIC33FJ64MC802	28	64	16	8	5	4	4	6+2 ch	2	1 ADC 6 ch	–	2	3	2	2	1	1	Y	1	1	SO, SP, MM
dsPIC33FJ128MC202	28	128	8	8	5	4	4	6+2 ch	2	1 ADC 6 ch	–	2	3	2	2	1	1	Y	1	–	SO, SP, MM
dsPIC33FJ128MC802	28	128	16	8	5	4	4	6+2 ch	2	1 ADC 6 ch	–	2	3	2	2	1	1	Y	1	1	SO, SP, MM
dsPIC33FJ16MC304	44	16	2	–	3	4	2	6+2 ch	1	1 ADC, 9 ch	–	–	2	1	1	1	–	Y	–	–	PT,ML
dsPIC33FJ32MC204	44	32	2	–	3	4	2	6+2 ch	1	1 ADC, 9 ch	–	–	2	1	1	1	–	Y	–	–	PT,ML
dsPIC33FJ32MC304	44	32	4	8	5	4	4	6+2 ch	2	1 ADC 9 ch	–	2	2	2	2	1	1	Y	1	–	PT, ML
dsPIC33FJ64MC204	44	64	8	8	5	4	4	6+2 ch	2	1 ADC 9 ch	–	2	3	2	2	1	1	Y	1	–	PT, ML
dsPIC33FJ64MC804	44	64	16	8	5	4	4	6+2 ch	2	1 ADC 9 ch	2 ch	2	3	2	2	1	1	Y	1	1	PT, ML
dsPIC33FJ128MC204	44	128	8	8	5	4	4	6+2 ch	2	1 ADC 9 ch	–	2	3	2	2	1	1	Y	1	–	PT, ML
dsPIC33FJ128MC804	44	128	16	8	5	4	4	6+2 ch	2	1 ADC 9 ch	2 ch	2	3	2	2	1	1	Y	1	1	PT, ML
dsPIC33FJ64MC506	64	64	8	8	9	8	8	8 ch	1	1 ADC, 16 ch	–	–	3	2	2	2	–	N	–	1	PT
dsPIC33FJ64MC706	64	64	16	8	9	8	8	8 ch	1	2 ADC, 16 ch	–	–	3	2	2	2	–	N	–	1	PT
dsPIC33FJ128MC506	64	128	8	8	9	8	8	8 ch	1	1 ADC, 16 ch	–	–	3	2	2	2	–	N	–	1	PT
dsPIC33FJ128MC706	64	128	16	8	9	8	8	8 ch	1	2 ADC, 16 ch	–	–	3	2	2	2	–	N	–	1	PT
dsPIC33FJ64MC508	80	64	8	8	9	8	8	8 ch	1	1 ADC, 18 ch	–	–	3	2	2	2	–	N	–	1	PT
dsPIC33FJ128MC708	80	128	16	8	9	8	8	8 ch	1	2 ADC, 18 ch	–	–	3	2	2	2	–	N	–	2	PT
dsPIC33FJ64MC510	100	64	8	8	9	8	8	8 ch	1	1 ADC, 24 ch	–	–	3	2	2	2	–	N	–	1	PT, PF
dsPIC33FJ64MC710	100	64	16	8	9	8	8	8 ch	1	2 ADC, 24 ch	–	–	3	2	2	2	–	N	–	2	PT, PF
dsPIC33FJ128MC510	100	128	8	8	9	8	8	8 ch	1	1 ADC, 24 ch	–	–	3	2	2	2	–	N	–	1	PT, PF
dsPIC33FJ128MC710	100	128	16	8	9	8	8	8 ch	1	2 ADC, 24 ch	–	–	3	2	2	2	–	N	–	2	PT, PF
dsPIC33FJ256MC510	100	256	16	8	9	8	8	8 ch	1	1 ADC, 24 ch	–	–	3	2	2	2	–	N	–	1	PT, PF
dsPIC33FJ256MC710	100	256	30	8	9	8	8	8 ch	1	2 ADC, 24 ch	–	–	3	2	2	2	–	N	–	2	PT, PF

*dsPIC33 devices feature one or two user-selectable 1.1 Msps 10-bit ADC (4 S&H) or 500 ksps 12-bit ADC (1 S&H).

16-bit Packages

P: 40-pin PDIP
(52.27 x 15.24 x 3.81 mm)

SP: 28-pin SPDIP
(34.67 x 7.87 x 3.3 mm)

P: 20-pin PDIP
(26.24 x 7.87 x 3.3 mm)

P: 18-pin PDIP
(22.81 x 7.95 x 3.3 mm)

PF: 100-pin TQFP
(14 x 14 x 1 mm)

PF: 80-pin TQFP
(14 x 14 x 1 mm)

PF: 64-pin TQFP
(14 x 14 x 1 mm)

PT: 100-pin TQFP
(12 x 12 x 1 mm)

PT: 80-pin TQFP
(12 x 12 x 1 mm)

PT: 64-pin TQFP
(10 x 10 x 1 mm)

PT: 44-pin TQFP
(10 x 10 x 1 mm)

SO: 28-pin SOIC
(17.88 x 10.34 x 2.31 mm)

SO: 20-pin SOIC
(12.80 x 10.34 x 2.31 mm)

SO: 18-pin SOIC
(11.53 x 10.34 x 2.31 mm)

SS: 28-pin SSOP
(10.2 x 7.8 x 2 mm)

SS: 20-pin SSOP
(7.2 x 7.85 x 1.85 mm)

MM & ML: 28-pin QFN
(6 x 6 x 0.9 mm)

dsPIC30F Product Families

General Purpose Family

The dsPIC30F General Purpose Family is ideal for a wide variety of 16-bit embedded control applications. The variants with codec interfaces are well suited for speech and audio applications.

Product	Pins	Flash Memory Kbytes	RAM Bytes	EEPROM Bytes	Timer 16-bit	Input Capture	Output Compare/ Standard PWM	Codec Interface	ADC 12-bit 200 ksps	CodeGuard™ Security Segments	UART	SPI	I²C™	CAN	Package Code
dsPIC30F3014	40/44	24	2048	1024	3	2	2	–	13 ch, 1 S/H	1	2	1	1	–	P, , PT, ML
dsPIC30F4013	40/44	48	2048	1024	5	4	4	AC97, I²S	13 ch, 1 S/H	3	2	1	1	1	P, PT, ML
dsPIC30F5011	64	66	4096	1024	5	8	8	AC97, I²S	16 ch, 1 S/H	3	2	2	1	2	PT
dsPIC30F6011A	64	132	6144	2048	5	8	8	–	16 ch, 1 S/H	3	2	2	1	2	PF, PT
dsPIC30F6012A	64	144	8192	4096	5	8	8	AC97, I²S	16 ch, 1 S/H	3	2	2	1	2	PF, PT
dsPIC30F5013	80	66	4096	1024	5	8	8	AC97, I²S	16 ch, 1 S/H	3	2	2	1	2	PT
dsPIC30F6013A	80	132	6144	2048	5	8	8	–	16 ch, 1 S/H	3	2	2	1	2	PF, PT
dsPIC30F6014A	80	144	8192	4096	5	8	8	AC97, I²S	16 ch, 1 S/H	3	2	2	1	2	PF, PT

Sensor Family

The dsPIC30F Sensor family products have features designed to support high-performance, cost-sensitive and space-constrained applications. Offered in packages as small as 6x6 mm and with pin counts as low as 18 pins.

Product	Pins	Flash Memory Kbytes	RAM Bytes	EEPROM Bytes	Timer 16-bit	Input Capture	Output Compare/ Standard PWM	ADC 12-bit 200 ksps	UART	SPI	I²C™	I/O Pins (Max.)	Package Code
dsPIC30F2011	18	12	1024	–	3	2	2	8 ch, 1 S/H	1	1	1	12	P, SO, 28-pin ML
dsPIC30F3012	18/44	24	2048	1024	3	2	2	8 ch, 1 S/H	1	1	1	12	P, SO, 44-pin ML
dsPIC30F2012	28	12	1024	–	3	2	2	10 ch, 1 S/H	1	1	1	20	SP, SO, 28-pin ML
dsPIC30F3013	28/44	24	2048	1024	3	2	2	10 ch, 1 S/H	2	1	1	20	SP, SO, 44-pin ML

Motor Control and Power Conversion Family

This dsPIC30F family supports motor control applications, such as brushless DC, single- and 3-phase induction and switched reluctance motors. These are also ideal for UPS, inverter and power factor correction applications.

Product	Pins	Flash Memory Kbytes	RAM Bytes	EEPROM Bytes	Timer 16-bit	Input Capture	Output Compare/ Standard PWM	Motor Control PWM	Quadrature Encoder	ADC 10-bit 1 Msps	CodeGuard™ Security Segments	UART	SPI	I²C™	CAN	Package Code
dsPIC30F2010	28	12	512	1024	3	4	2	6 ch	Yes	6 ch, 4 S/H	1	1	1	1	–	SP, SO, MM
dsPIC30F3010	28/44	24	1024	1024	5	4	2	6 ch	Yes	6 ch, 4 S/H	1	1	1	1	–	SP, SO, 44-pin ML
dsPIC30F4012	28/44	48	2048	1024	5	4	2	6 ch	Yes	6 ch, 4 S/H	1	1	1	1	1	SP, SO, 44-pin ML
dsPIC30F3011	40/44	24	1024	1024	5	4	4	6 ch	Yes	9 ch, 4 S/H	1	2	1	1	–	P, PT, ML
dsPIC30F4011	40/44	48	2048	1024	5	4	4	6 ch	Yes	9 ch, 4 S/H	1	2	1	1	1	P, PT, ML
dsPIC30F5015	64	66	2048	1024	5	4	4	8 ch	Yes	16 ch, 4 S/H	1	1	2	1	1	PT
dsPIC30F6015	64	144	8192	4096	5	8	8	8 ch	Yes	16 ch, 4 S/H	3	2	2	1	1	PT
dsPIC30F5016	80	66	2048	1024	5	4	4	8 ch	Yes	16 ch, 4 S/H	1	1	2	1	1	PT
dsPIC30F6010A	80	144	8192	4096	5	8	8	8 ch	Yes	16 ch, 4 S/H	3	2	2	1	2	PF, PT

Digital Power Conversion Family

This dsPIC30F family supports applications such as Switch Mode Power Supplies (SMPS), induction cooking, UPS, inverter, power factor correction and digital control loops. These devices contain 1 nS resolution PWMs coupled with our fastest on-chip ADC and comparators to facilitate a variety of applications and power supply topologies.

Product	Pins	Flash Memory Kbytes	RAM (Bytes)	ADC 10-bit, 2 Msps Ch.	Analog Comparators	High-Speed PWM	Timers	Input Capture	Output Compare/ Standard PWM	UART	SPI	I²C™	Package Code
dsPIC30F1010	28	6	256	6 ch, 2 S&H	2	2 x 2	2	–	1	1	1	1	SO, SP, MM
dsPIC30F2020	28	12	512	8 ch, 4 S&H	4	4 x 2	3	1	2	1	1	1	SO, SP, MM
dsPIC30F2023	44	12	512	12 ch, 4 S&H	4	4 x 2	3	1	2	1	1	1	PT, ML

Designed for real-time control, Microchip's 16-bit controllers offer outstanding reliability, robustness and reduced system cost.

On-chip oscillator eliminates crystal, reduces cost

Many 16-bit devices permit the on-chip precision oscillator to be the clock source for your designs. The associated low-jitter PLL can boost the clock to full speed. Now you can eliminate the external crystal, save board space and reduce system cost.

Reliable watchdog timer

Microchip's watchdog timer runs from its internal oscillator independent of the system clock.

Power save modes optimize power consumption

You have many choices to optimize power consumption inspired by our nanoWatt Technology. Switch to a low frequency on-chip oscillator or divide down the system clock during periods of inactivity. Or you can "power down" core and selected peripherals. Or simply operate at slower speed to conserve power.

Microchip's 16-bit product line is designed to meet the rigorous demands of real-time systems. Not only is its real-time performance superior to other 16- and 32-bit controllers, it also offers a number of highly enabling features specifically designed to enhance system reliability and robustness, and reduce system cost by eliminating external components.

On-chip system clock monitor adds safety

The on-chip clock monitor detects a system clock failure and forces a chip-reset. Restarting the system with the on-chip oscillator provides a graceful way to handle such a catastrophic failure.

Low Jitter PLL for reliable system operation

On-chip PLL with crystal oscillator input offers low jitter, < ±0.75% over V_{DD} and temperature for reliable operation of CAN, UART or other forms of communication.

Extended temperature

Currently most 16-bit products offer 125°C options, making Microchip's 16-bit products ideal for industrial applications that run "hot" such as motor control, power conversion, lighting control and "under-the-hood" automotive systems, such as EPS, electronic gearbox, cooling fan control, etc.

Small package, big performance

Several 16-bit products are available in QFN packages as small as 6x6 mm. Now you can add 16-bit performance and save board space too.

High-current I/O drives save cost

Many 16-bit products have I/O pins that can drive LEDs directly or eliminate pre-drivers for external FET switches to save you space or cost.

Power-on reset and brown-out reset add robustness, save cost

Intelligent on-chip Power-on Reset eliminates external reset circuitry in most systems. Some devices offer Brown-out protection to reset the chip in the event of a power glitch. All this adds up to a robust system at a reduced cost.

Self-monitoring CPU protects against software glitches

Code execution flow is continually monitored to prevent catastrophic failures due to software malfunction. Accesses to non-existing memory locations are trapped, as are stack overflow, stack underflow and uninitialized pointer accesses. Now your real-time system has an added level of safety.

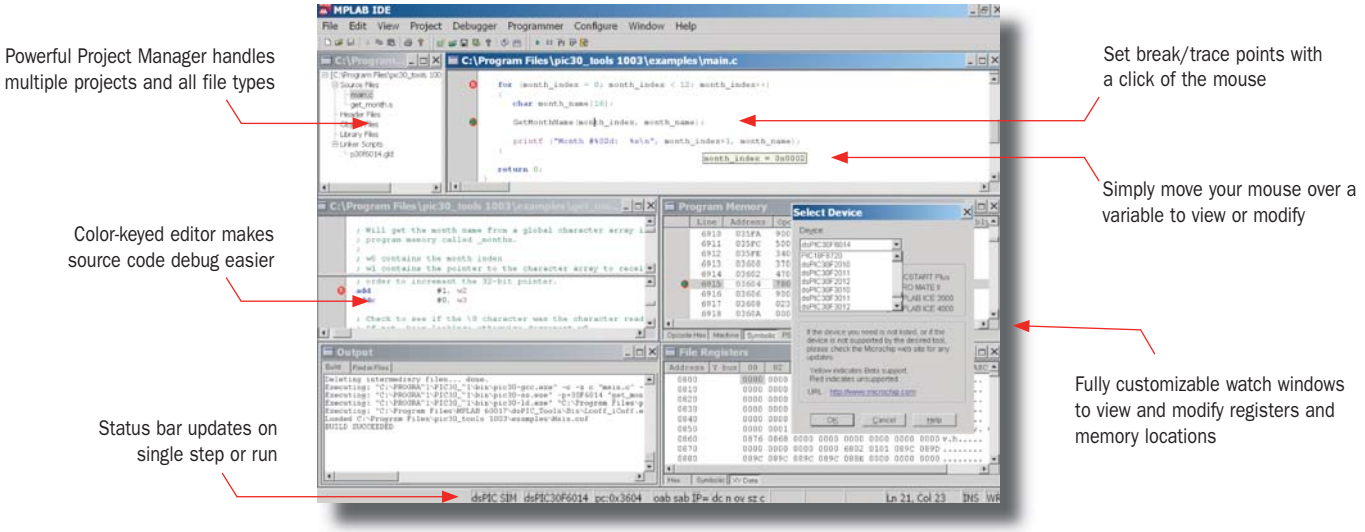
World Class Development Tools

Microchip's 16-bit controllers are supported by MPLAB® Integrated Development Environment. MPLAB IDE is a FREE development environment that is common to all Microchip 8-, 16- and 32-bit products, making it possible to use across many of your designs. When combined with Microchip's MPLAB ICD 2, customer can get started with a complete development tool chain for as little as $160.00.

MPLAB® Integrated Development Environment (IDE)

All of Microchip's MCU and DSC tools operate cohesively under the MPLAB IDE umbrella. The powerful and easy-to-use MPLAB IDE has all of the advanced edit/build/debug features you would expect from a 32-bit debug environment. MPLAB IDE integrates not only software, but all of Microchip's hardware tools and many third party tools. Key features of MPLAB IDE:

- Designed for Windows® XP, 2000 and Windows NT®
- Project build and management
- Flexible watch windows
- Mouse over variable inspection
- Full feature code editor with color context
- Source level debug in ASM and C
- Searchable trace buffers
- Version control integration



Available for MPLAB IDE

Assembler/Linker/Librarian

The MPLAB ASM30 is a full-featured macro assembler. User defined macros, conditional assembly and a variety of assembler directives make the MPLAB ASM30 a powerful code generation tool.

MPLAB SIM Software Simulator

The MPLAB SIM Software Simulator is a full-featured, cycle accurate software simulator. In addition to simulating the CPU and the instruction set, it also supports key peripherals.

MPLAB VDI (Visual Device Initializer)

Configuring a powerful 16-bit MCU or DSC can be a complex and challenging task, but not for our 16-bit products. Our MPLAB VDI allows you to configure the entire device graphically and when complete, a mouse click generates initialization code usable in assembly or C programs and required documentation.

Start Your Design with Proven and Optimized Building Block Libraries

Peripheral Driver Library

This library of over 270 C utility functions helps you set up and operate the hardware peripheral modules in various modes.

Math Library

This IEEE-754 compliant library provides single and double precision floating point ANSI C standard math functions. These routines have been optimized to provide the smallest code size. The library can be used in assembly or C.

DSP Algorithm Library

This extensive DSP building block library is fully optimized in assembly code for execution speed. The DSP functions can be used in assembly or C. Some key algorithms include cascaded IIR, FIR and LMS filters, correlation, convolution, FFT and matrix and vector operations.

Popular C Compiler

MPLAB C Compiler

The MPLAB C Compiler for PIC24 MCUs and dsPIC DSCs is a full-featured, ANSI compliant optimizing compiler. The Compiler includes a complete ANSI C standard library, including string manipulation, dynamic memory allocation, data conversion, timekeeping and math libraries.

The MPLAB C Compiler has a powerful code optimizer; other 16-bit MCUs generate as much as 165 percent larger code for the same application.

Download a full-featured, time-restricted demo version of the MPLAB C Compiler for PIC24 MCUs or dsPIC DSCs from the Microchip web site for evaluation.

Hardware Development Tools

MPLAB ICD 2
In-Circuit Debugger/Programmer (DV164005)

The MPLAB ICD 2 In-Circuit Debugger/ Programmer is a powerful, low-cost development tool. Running under MPLAB IDE, MPLAB ICD 2 can debug ASM or C source code, watch and modify variables, single step and set breakpoints.

Key features:

- Full speed operation
- USB or serial port connection to PC

MPLAB REAL ICE™
In-Circuit Emulation System (DV244005)

The MPLAB REAL ICE In-Circuit Emulator is Microchip's next-generation emulation and debugging system. Initially supporting the dsPIC33F, PIC24H, PIC24F and dsPIC30F601XA 16-bit devices, this system provides a powerful in-circuit emulation platform for easy and rapid application development and debugging. The emulation is performed using special hardware logic on the target device itself, eliminating the need for a separate emulator device.

Key features:

- Up to 6 hardware breakpoints
- Up to 1,000 software breakpoints
- User-controlled program memory trace/data memory log
- High-speed USB 2.0 PC interface
- Traditional In-Circuit Serial Programming™ (ICSP™) interface or LVDS (add-on option)
- Run, Halt and Single-step modes
- Logic probe
- Stopwatch
- Flash memory programmer
- Smart watch variable windows
- Advanced breakpoint features

MPLAB PM3 Device Programmer (DV007004)

MPLAB PM3 Device Programmer is a full-featured, production quality universal device programmer. Using interchangeable socket modules, the MPLAB PM3 supports virtually all programmable devices from Microchip. MPLAB PM3 has improved programming time for many devices and offers a built-in interface for robust ICSP.

MPLAB Starter Kits

MPLAB Starter Kits are designed to demonstrate the key features of the device family they represent. In addition to the external circuit needed to support and demonstrate the device, the starter kits include the circuitry necessary to debug and program the controller. When combined with the MPLAB® IDE, and the MPLAB C Compiler for PIC24 MCUs or dsPIC DSCs (Student Version), both included, the starter kit allows designers to gain quick knowledge and experience with 16-bit MCU and DSC products.

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

The MPLAB starter kit for dsPIC Digital Signal Controllers is an excellent low cost platform to evaluate or learn about the dsPIC architecture. It is equipped with the hardware and software necessary to code and debug simple applications and also demonstrates the audio capability of the dsPIC DSC.

Key features:

- dsPIC33FJ128GP506 DSC with 256 KB Flash
- Serial Flash Memory Chip for external data storage
- Debug and programming capability
- MPLAB C Compiler (student edition)
- 16/24/32-bit audio Codec
- Microphone input and amplified headphone output
- G.711-based audio capture and playback demo

MPLAB Starter Kit for PIC24F MCUs (DM240011)

The starter kit is based on the PIC24FJ256GB110 family and is equipped with the hardware and software necessary to demonstrate the USB OTG peripheral and the Charge/Time Measurement Unit (CTMU).

Key features:

- Built-in in-circuit emulation hardware
- USB Mass Storage Device class demonstration
- OLED Display
- Capacitive touch sense key pad

Jump-start Your Design with Our Explorer 16 Development Board and PICtail™ Plus Daughter Cards

Explorer 16 Development Board (DM240001/DM240002)

This development board offers an economical way to evaluate the PIC24F and PIC24H microcontrollers, the dsPIC33F General Purpose and Motor Control families and the PIC32 microcontroller families. This board is an ideal prototyping tool to help you quickly develop and validate key design requirements.

Key features:

- Appropriate processor PIMs (Plug-In Modules)
  - DM240001: two interchangeable PIMs, one each for the PIC24FJ128GA010 and the dsPIC33FJ256GP710 DSC
  - DM240002: features a PIM for the PIC24FJ64GA004
- Alpha-numeric 16 x 2 LCD display
- Interfaces to MPLAB® ICD 2, MPLAB REAL ICE™ and RS-232
- Includes Microchip's TC1047A high accuracy, analog output temperature sensor
- Full documentation CD includes user's guide, schematics and PWB layout
- Expansion connector to access full devices pin-out and bread board prototyping area
- PICtail™ Plus connector for expansion boards

PICtail Plus Daughter Cards

Wireless Communications PICtail™ Plus Daughter Board (AC163027-4)

The Wireless PICtail Plus Daughter Board interfaces an IEEE 802.15.4™ Transceiver to the 16-bit devices through the SPI module. This card can be used with the ZigBee™ protocol or Microchip's MiWi™ wireless networking protocol, both of which are supported by Microchip's free software stacks. This card is compatible with all 16- and 32-bit products operating at 3.3V.

SD/MMC PICtail™ Plus Daughter Board (AC164122)

The SD/MMC PICtail Plus Daughter Board is a universal board that interfaces the Secure Digital (SD) and Multi-Media Card (MMC) to the Serial Peripheral Interface (SPI) bus of the microcontroller.

Ethernet PICtail™ Plus Daughter Board (AC164123)

The Ethernet PICtail Plus Daughter Board provides a cost effective method of evaluating and developing Ethernet control applications. The development board is populated with the 28-pin ENC28J60 Ethernet controller, which interfaces to the SPI bus of the microcontroller.

IrDA® Protocol PICtail™ Plus Daughter Board (AC164124)

The IrDA® Protocol PICtail Plus Daughter Board expands the functionality of the Explorer 16 demo board to include IrDA communications. This card features a TFDU100 infrared optical sensor module from Vishay Semiconductor.

Speech Playback PICtail™ Plus Daughter Board (AC164125)

The Speech Playback PICtail Plus Daughter Board implements a fourth-order Low Pass Filter (LPF), speaker amplifier, speaker and 1 Mbit SPI serial EEPROM for playback only applications. Speech playback is accomplished by using the integrated PWM module on the 16-bit products and filtered into a voice waveform using the LPF.

Prototype PICtail™ Plus Daughter Board (AC164126)

The Prototype PICtail Plus Daughter Board is an expansion breadboard card for the Explorer 16 Development Board using a PIC24 MCU or dsPIC33 DSC. This 8x8 cm board provides access to all of the processor's pins and contains a general purpose prototyping area. This kit contains three blank Prototype PICtail Plus Daughter Boards.

Graphics PICtail™ Plus Daughter Board (AC164127)

The Graphics PICtail™ Plus Daughter Board is a demonstration board for evaluating Microchip's graphic LCD display solution, including Microchip's Graphics Library for 16-bit microcontrollers. The Graphic PICtail Plus daughter board contains a Color QVGA display with Resistive Touch Screen Capability.

Motor Control Interface PICtail™ Plus Daughter Card (AC164128)

This PICtail MC board interfaces with Explorer 16 and the HV/LV Power Module and DM300022). It has hardware support for sensor and sensorless applications such as Hall sensors, optical encoder, back EMF and current sensing. Included is a dsPIC33FJ256MC70 Motor Control Plug-in Module for use with the Explorer 16 development board.

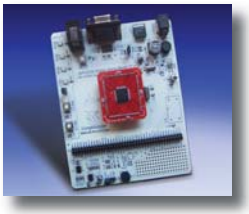
USB PICtail™ Plus Daughter Card (AC164131)

The USB PICtail Plus provide the power supply and connector circuitry for a USB supporting controller to evaluate and demonstrate USB Applications that include embedded host, peripherals and USB On-The-Go.

Hardware Development Boards

A variety of hardware development boards are available for the PIC24 MCU and dsPIC DSC, enabling you to shorten your design cycle. These boards are designed to allow easy connection to an MPLAB ICD 2, MPLAB REAL ICE or MPLAB PM3. All development boards include documentation and example source code to accelerate your design.

dsPICDEM™ 80-pin Starter Development Board (DM300019)

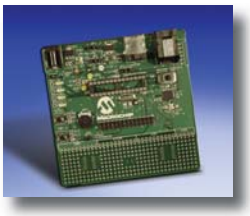


This development board offers a very economical way to evaluate the 80-pin dsPIC30F General Purpose and Motor Control families as well as the dsPIC33F devices.

Key features:

- Includes a 80-pin dsPIC30F6014A General Purpose plug-in module (MA300014)
- Accommodates 80-pin dsPIC30F6010 Motor Control plug-in module (MA300013) and the 80- to 100-pin dsPIC33F General Purpose plug-in module (MA330012)
- Power input from 9V supply
- LEDs, switches, potentiometer, UART interface
- ADC input filter circuit for speech-band signal input
- On-board DAC and filter for speech-band signal output
- Circuit prototyping area
- Assembly language demonstration program and tutorial
- Includes a selectable voltage regulator with outputs of 5 to 3.3V

16-bit 28-pin Starter Development Board (DM300027)



This development board is an economical way to get started with any of Microchip's 28-pin 16-bit MCU or DSC devices.

Key features:

- Includes a 28-pin PIC24FJ64GA002 and dsPIC33FJ12GP202
- Regulators for 3.3V or 5V operation
- Power input from 9V power supply or USB power source
- Single UART communication channel via USB bridge
- MPLAB ICD 2 and PICkit™ 2 Connections
- Header for access to all device I/O pins
- Circuit prototyping area including pads for SOIC and SOT-23 devices
- Accommodates all 28-pin, SDIP PIC24, dsPIC30F and dsPIC33F devices

Motor Control Development Systems

Two motor control development systems can be configured for maximum flexibility, prototyping or validating dsPIC30F or dsPIC33F DSC-based solutions. The systems consist of one power module, processor boards and program/debugger hardware, such as the MPLAB ICD 2 In-Circuit Debugger.

These systems in conjunction with the MPLAB ICD 2 programmer/debugger provide a quick prototyping and validation of BLDC, ACIM, PMSM, SR and Power Conversion applications. Both systems use the same power modules.

Power Modules

The dsPICDEM MC1H 3-Phase High-Voltage Power Module (DM300021) supports AC line-powered applications, while the dsPICDEM MC1L 3-Phase Low-Voltage Power Module (DM300022) supports DC-powered applications up to 48V.

Key features:

- Full automatic protection of power circuits
- Electrical isolation from power circuits
- Many options for motor feedback signals

Recommended Processor Boards

DSC Family	Processor Board
dsPIC30F	DM300020
dsPIC33F	DM240001 + AC164128

dsPIC30F Development System

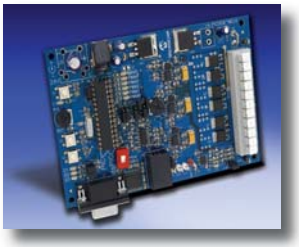
Power module shown with dsPICDEM MC1 Development Board (DM300020)

dsPIC33F Development System

Includes a DM240001 Explorer 16 board, AC164128 Motor Control PICtail Plus daughter card and a power module.

Advanced Development Boards: Complex Designs Made Simple

PICDEM™ MC LV Motor Control Development Board (DM183021)



This board provides a cost-effective method of evaluating and developing sensored or sensorless BLDC motor control applications. A 28-pin, dsPIC30F3010 device is used with this board.

Key features:

- Over-current protection and temperature sensor with I²C™ interface
- 3-phase voltage source inverter bridge
- 9 LEDs, 3 for generic status indication and 6 for PWM indication
- Test points for motor current and back EMF sensing
- Speed control potentiometer
- Supports maximum motor ratings of 48V and 2.2A
- Supports 28-pin PIC18 MCUs; specifically the PIC18F2431
- Power supply and motor are available (optional) for out-of-the-box experience

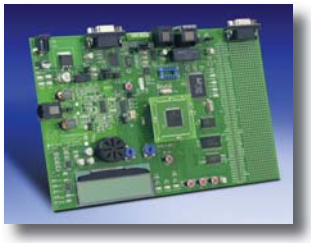
dsPICDEM™ SMPS Buck Development Board (DM300023)

This development board implements a simple DC/DC Switch Mode Power Supply (SMPS) and is a good starting point for designers new to digital loop control design.

Key features:

- Dual independent buck converters
- Buck converters can operate in Synchronous or Asynchronous modes
- Input voltage range 7V to 15V (nominal 9V)
- Output voltage programmable: 0 to input voltage minus 1.5V
- User can enable a dynamic output load to investigate transient response

dsPICDEM.net™ Connectivity Development Board (DM300004-1/2)

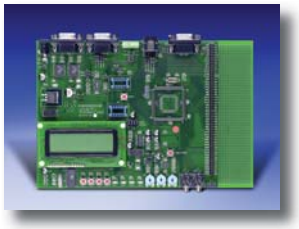


This board provides development support for soft modem and connectivity-related applications.

Key features:

- dsPICDEM.net 1 (DM300004-1) supports FCC/JATE PSTN countries
- dsPICDEM.net 2 (DM300004-2) supports CTR-21 PSTN countries
- Includes a dsPIC30F6014 plug-in module (MA300011)
- 10Base-T Ethernet MAC and PHY interface and PSTN interface with DAA/AFE chipset
- Serial communication channels (UART and CAN)
- External EEPROM and RAM memory for storing constants
- General purpose prototyping area and expansion header
- LEDs, switches, potentiometers and LCD display

dsPICDEM™ 1.1 Plus General Purpose Development Board (DM300024)

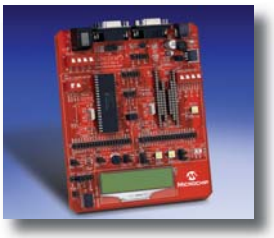


This board provides development support for speech and audio-related applications.

Key features:

- Includes a dsPIC30F6014A plug-in module (MA300014)
- Serial communication channels (two UART, SPI, CAN)
- Si3000 codec with MIC IN/Speaker OUT
- General purpose prototyping area and expansion header
- Digital potentiometer, LEDs, switches, etc.

dsPICDEM™ 2 Development Board (DM300018)



This development board provides a cost effective way to start designing solutions for all 18-, 28- and 40-pin DIP-packaged dsPIC DSC devices.

Key features:

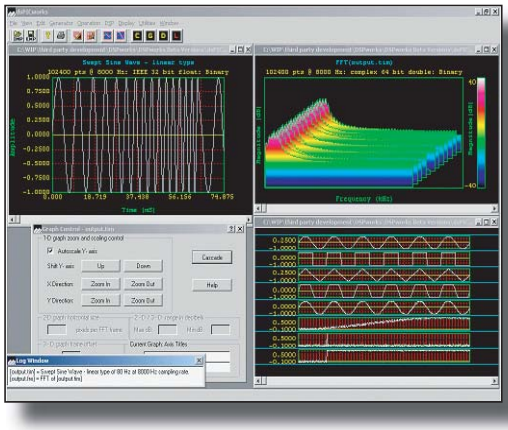
- Development platform for 11 dsPIC DSC devices in 18-, 28- and 40-pin DIP packages including Motor Control, Sensor and General-Purpose family devices
- On-board CAN and UART support
- On-board support for multiple oscillator options

Develop DSP Algorithms: The Easy Way

dsPICworks™ Data Analysis and DSP Software

The dsPICworks Data Analysis and DSP Software makes it easy to evaluate and analyze DSP algorithms. You can run a variety of DSP and arithmetic operations and analyze your data in both time and frequency domain. Key features of the dsPICworks Data Analysis and DSP Software:

- Visually analyze time and frequency domain data
- DSP operations: FFT, convolution, correlation, DCT and filtering
- Waveform synthesis
- Tool generates one-, two- and three-dimensional frequency graphs
- Data import/export options to interface with MPLAB IDE and MPLAB ASM30
- Support for fractional, integer and IEEE floating point data in decimal and hexadecimal notation



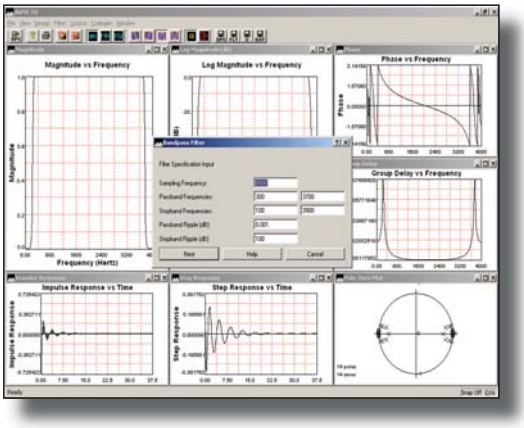
Digital Filter Design Tool

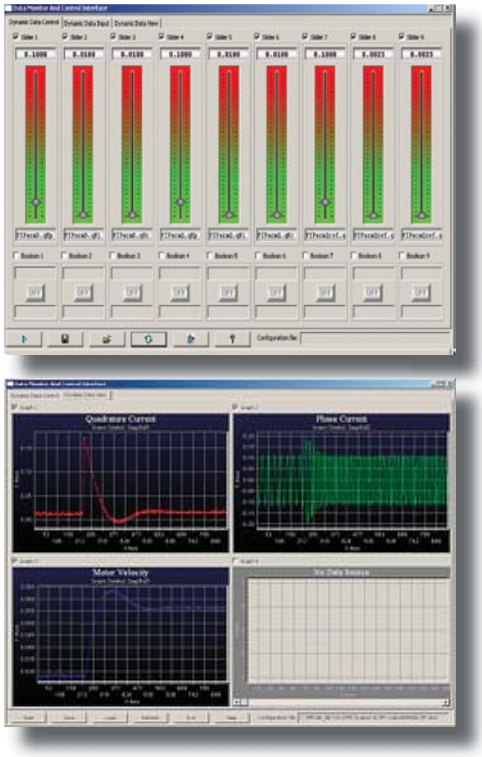
The Digital Filter Design Tool makes designing and analyzing FIR and IIR filters easy. Enter frequency specifications and filter code and coefficients are generated automatically. Graphical output windows provide the desired filter's characteristics.

Digital Filter Design Lite Tool

Not ready to purchase the whole Digital Filter package? Why not start Lite? The Digital Filter Design Lite Tool includes most of the features of the full-featured version at a fraction of the cost.

	Filter Design	Filter Design Lite
List Price	$249	$29
Low-pass	√	√
High-pass	√	√
Band-pass	√	√
Band-stop	√	√
FIR Taps	Up to 513	Up to 64
IIR Taps for LP, HP	Up to 10	Up to 4
IIR Taps for BP, BS	Up to 20	Up to 8
Generate ASM Code	√	√
Export to MPLAB® IDE	√	√
Export to MPLAB® C Compilers	√	√
MATLAB® Support	√	–





Data Monitor & Control Interface – A Free MPLAB IDE Plug-in

The Data Monitor and Control Interface (DMCI) provides dynamic access and control of software variables. It is useful for tuning application parameters and viewing run-time application data graphically. Software parameter changes are updated at run-time. No recompiling is required between debug sessions.

Feature highlights include:

- MPLAB Project Aware – The current device and software variables are recognized automatically by DMCI
- Compiler Independent – All Microchip C compiler tool suites are supported. Programs written in assembly language can be controlled as well.
- Debug Tool Independent – DMCI works with all Microchip debug tools including the MPLAB SIM simulator.
- Provides Effortless Graphical Analysis of Application Historical Data – Application data is accessed directly within MPLAB. Data can be easily plotted to any of four graphs for visual analysis.

If you selected to install the DMCI component when you installed MPLAB IDE 7.40 or later, you can find it under the Tools menu.

Libraries for Speech Applications

Speech Encoding/Decoding Libraries

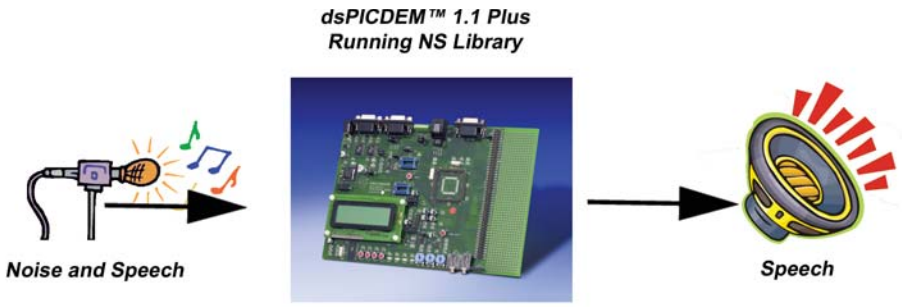
Three options exist for a variety of speech compression/encoding and decompression/decoding applications:

- G.711 is available for free. The library is an implementation of the ITU-T G.711 standard which uses A-law or μ-law companding to achieve 2: 1 compression.
- G.726A is an implementation of the ITU-T G.726 Annex A standard which uses Adaptive Differential Pulse Code Modulation (ADPCM) encoding algorithm. It can achieve up to an 8:1 compression ratio depending on output bit rate selected.
- Speex is a popular standard in the LINUX workstation community which has been adapted for the dsPIC DSC. It uses Code Excited Linear Prediction (CELP) encoding pioneered for cellular applications. It can achieve a 16:1 compression ratio.

Vocoder	Incoming Data Rate (16-bit)	Output Rate	Speech Quality (MOS)	MIPS	Flash (KB)	RAM (KB)	Target
G.711	8 kHz	64 kbps	4.3-4.5	1	3	3.6	PIC24/dsPIC DSC
G.726A	8 kHz	16 to 40 kbps	4.3-4.5	15	6	4	dsPIC DSC
Speex	8/16 kHz	8 kbps	3.7-4.2	19	33	5.4	dsPIC DSC

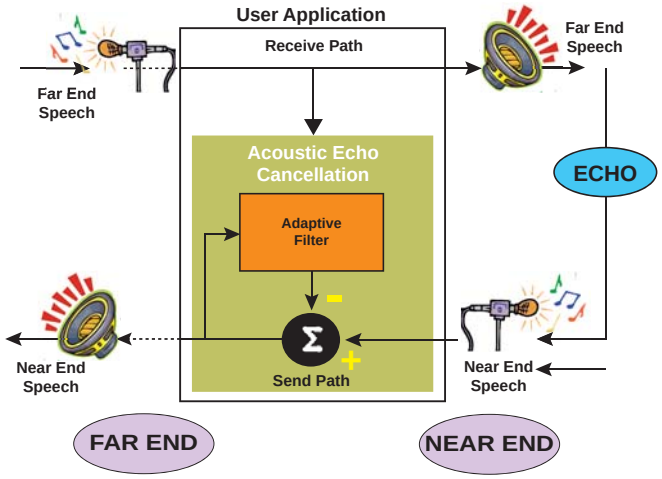
Noise Suppression Library

This application library suppresses the noise interference in a speech signal, such as ambient noise picked up by a microphone while capturing speech. This algorithm is particularly useful for systems such as hands-free phones, speakerphones, intercoms and headsets where an isolated noise reference is not available. The algorithm handles 0-4 kHz audio bandwidth and provides 10-20 dB of noise reduction. The library also includes some sample rate conversion functions to support input/output sampling rates of 9.6 kHz, 11.025 kHz and 12 kHz.



Acoustic Echo Cancellation Library

This library provides a function to eliminate the echo generated in the acoustic path between a speaker and a microphone, such as in a speakerphone or an intercom system. This library is fully compliant with the G.167 standard and provides 16, 32 or 64 ms echo delays. It handles 0-4 kHz audio bandwidth and provides echo cancellation of 40-50 dB. It also includes some sample rate conversion functions to support input/output sampling rates of 9.6 kHz, 11.025 kHz and 12 kHz.



Line Echo Cancellation Library

This library provides a function to cancel electrical line echoes caused by 2- to 4-wire conversion hybrids in telephone lines. The library can be used in long distance voice communication applications, especially in links involving satellite networks and intercontinental long haul networks, as well as digital networks, such as Voice over IP (VoIP). This library is fully compliant with the ITU-T G.168 recommendation. The library can be used for full-duplex operation. It handles 0-4 kHz audio bandwidth (8 kHz sampling of 16-bit speech data).

Line Cancellation Library Features:

- 8 kHz sampling rate
- Full duplex
- Compliant with ITU-T G.168 recommendations
- Royalty-free, one-time license

Speech Recognition

Automatic Speech Recognition (ASR) for the dsPIC DSCs supports a variety of voice-activated applications like handset and home appliance control. A Speech Word Library Builder and a Speech Recognition Software Library make up the ASR software suite.

Speech Recognition Library Features:

- Speaker independent recognition
- PC-based word library builder
- Up to 100 word vocabulary (American English)
- Supports multiple noise profiles
- Suitable for many voice control applications

Plug-and-Play with Our Connectivity Libraries

USB On-The-Go Solutions

Microchip's USB support consist of a series of application notes with software that demonstrate and support the development of embedded host, peripheral and On-The-Go functions. Specific driver classes include Human Interface Device (HID) class for user interfaces, and Mass Storage Device (MSD) class for memory devices and a Microchip custom device class driver. The USB application notes are written for use on the Explorer 16 development board which provides a common platform across the 16- and 32-bit products. All USB application notes are available free of charge at www.microchip.com/usb.

Microchip's Free TCP/IP Stack Software (ENC28J60 driver)

The Microchip TCP/IP Stack is a free suite of programs that provide services for standard TCP/IP-based applications (HTTP server, FTP server, etc.) or it can be used in a custom TCP/IP-based application. The stack is portable across all PIC18, PIC24, dsPIC30F and dsPIC33F products. It contains support for MPLAB C18, HI-TECH PIC18 and MPLAB C Compiler for PIC24 MCUs and dsPIC DSCs.

Microchip Free TCP/IP Stack

- Socket support for TCP and UDP
- RTOS independent
- Full TCP state machine
- Supports ENC28J60 Ethernet controller
- Modules provided: MAC, SLIP, ARP, IP, ICMP, TCP, SNMP, UDP, DHCP, FTP and HTTP

ZigBee™ Wireless Networking Protocol Stack

ZigBee™ is a wireless network protocol specifically designed for low data rate sensors and control Networks. There are a number of applications that can benefit from the ZigBee protocol including building automation networks, home security systems, industrial control networks, remote metering and PC peripherals. ZigBee may be the appropriate solution if your product must interact with other vendor's products on a wireless network.

MiWi™ Wireless Networking Protocol Stack

The MiWi™ Wireless Networking Protocol is a simple protocol designed for low data rate, short distance, low-cost networks. Fundamentally based on IEEE 802.15.4 for Wireless Personal Area Networks (WPANs), the MiWi protocol provides an easy-to-use alternative for wireless communication. In particular, it targets smaller applications that have relatively small network sizes, with few hops between nodes, using Microchip's MRF24J40 2.4 GHz transceiver for IEEE 802.15.4 compliant networks.

V.22bis/V.22 Soft Modem Library

This library is available free of charge from the Microchip web site. The V.22bis Soft Modem Library is a collection of algorithms for ITU-T compliant V.21/Bell 103, V.22 and V.22bis modems and V.42 recommendations. The V.22bis library comes with full source code and archives that contain object code modules required for linking with your application. The transmit and receive data pump code modules are coded in assembly language for optimal speed and smallest code size, while the AT, V.42 and Data Pump APIs are coded in C. Hardware component drivers, such as UART and Data Converter Interface (DCI) for Analog Front End (AFE) I/O, are provided. This library can be readily implemented on the dsPICDEM.net™ Connectivity Board.

V.32bis Soft Modem Library

The V.32bis Soft Modem Library is a collection of algorithms for ITU-T compliant V.21/Bell 103, V.22, V.22bis, V.32 and V.32bis modems and V.42 recommendations. The V.32bis library is provided with archives that contain object code modules required for linking with your application. The transmit and receive data pump code modules are coded in assembly language for optimal speed and smallest code size, while the AT, V.42 and Data Pump APIs are coded in C. Hardware component drivers, such as UART and DCI for AFE I/O, are provided. This library can be readily implemented on the dsPICDEM.net Connectivity Development Board.

V.32bis/V.22bis by Microchip

- Data Pump coded In assembly for optimal size and speed
- V.32bis (4800 thru 14,400 bps)
- V.22bis (1200 thru 2400 bps)
- V.42 (LAPM, error correction procedure)

IrDA® Standard Stack for Microchip 16-Bit MCUs

The IrDA Standard is a highly popular, inexpensive method for providing wireless point-to-point communication. This free stack coupled with Microchip's low-cost PIC24F microcontrollers, with their built-in IrDA standard support, provide an inexpensive solution with plenty of computing power left for other tasks.

Power Conversion and Motor Control Application Software

The Motor Control Family is suited for advanced AC Induction Motor (ACIM), Brushless DC (BLDC) and Switched Reluctance (SR) motor applications. Two advanced applications are available that run on the dsPIC30F Motor Control Development System. Full documentation and source code are available for free on the Microchip web site for all application notes. Visit the Motor Control Design Center at www.microchip.com/motor for more information about Microchip's motor control solutions.

Power Factor Correction in Power Conversion Applications Using the dsPIC® DSC

Power Factor Correction (PFC) by Average Current Mode Control is illustrated using a Digital Signal Controller (DSC). Applications such as motor control, power control, Uninterruptible Power Supplies (UPS), and Switched Mode Power Supplies (SMPS) can be combined with this PFC algorithm and implemented on a single chip. (Application Note: AN1106)

Switch Mode Power Supply (SMPS) Topologies

This application note explains the basics of different types of SMPS topologies and their applications. The pros and cons of different SMPS topologies are also explained to guide the user to select an appropriate topology for a given application, while providing useful information regarding selection of components for a given SMPS design. (Application Note: AN1114)

Sensorless BLDC Motor Control Using the dsPIC30F6010

This application note describes a fully-tested sensorless control algorithm for a 3-phase BLDC motor. Motor current, motor velocity and bus voltage are regulated in control loops. An LCD menu interface provides adjustment of all sensorless motor control parameters. This application solution utilizes a dsPIC30F6010 device and the dsPICDEM MC1 development system. (Application Note: AN901)

Vector Control of an ACIM

This application note describes a fully-tested vector, or field oriented, control algorithm for a 3-phase ACIM. The motor currents, torque and velocity are regulated in control loops. Full documentation and source code are available for free on the Microchip web site. (Application Note: AN908)

Sensored BLDC Motor Control

This application note describes a fully-tested 3-phase BLDC motor control algorithm with 3 hall-effect sensors. Code is available with and without a PI speed control loop. (Application Note: AN957)

Introduction to ACIM Control

This application note is an introductory approach to the methods described in AN908. Code is provided in an example that offers basic variable speed control of a single or three-phase ACIM. (Application Note: AN984)

Sensorless BLDC Motor Control Using the dsPIC30F2010

This application note describes how to provide sensorless BLDC motor control with the dsPIC30F2010 device. The technique used is based on another Microchip application note: Using the dsPIC30F for Sensorless BLDC Control (AN901). This application solution and AN957 present a low pin count solution with minimal I/O and use the PICDEM™ MC LV system with a dsPIC30F2010 device. (Application Note: AN992)

Sinusoidal PMSM Motor Control

This application note provides a fully working and highly flexible solution for using the dsPIC30F2010 to control a permanent magnet synchronous motor using all shunt windings to predict rotor position. (Application Note: AN1017)

Sensorless BLDC Control with Back-EMF Filtering

This application note describes how to apply a dsPIC DSC to control a sensorless BLDC motor, using the dsPIC30F6010A device on a dsPICDEM™ MC LV board platform. (Application Note: AN1083)

Sensorless Field-Oriented Control for PMSM Motors

This application note describes how to apply a dsPIC DSC to control a permanent magnet synchronous motor using the field oriented control algorithm. Shunt resistors are used to estimate rotor position. (Application Note: AN1078)

Sensorless BLDC Control with Back-EMF Filtering Using a Majority Function

This application note describes a sensorless Brushless Direct Current (BLDC) motor control algorithm, implemented using the dsPIC® Digital Signal Controller (DSC). The algorithm works by the use of a majority function for digitally filtering the Back-Electromotive Force (BEMF). Each phase of the motor is filtered to determine when to commutate the motor drive voltages. This control technique excludes the need for discrete, low-pass filtering hardware and off-chip comparators. (Application Note: AN1160)

Sensorless Field Oriented Control (FOC) of an AC Induction Motor (ACIM)

This application note presents a solution for sensorless Field Oriented Control (FOC) of induction motors using a dsPIC® Digital Signal Controller (DSC). The benefits of field oriented control can be directly realized as lower energy consumption, higher efficiency, lower operating costs and reduced cost of drive components. (Application Note: AN1162)

More Application Libraries, Methods and Modules Ready to Use

Libraries

Encryption Libraries

Implement reliable secure applications using the Symmetric and Asymmetric Key Embedded Encryption Libraries. Developed for Microchip by NTRU Cryptosystems Inc., these libraries are both proven and optimized. Library functions can be easily called by your C or assembly code.

Alternatively, the 128-bit key AES and Triple-DES Libraries developed by Microchip are available for a production license fee of $5.00 from microchipDIRECT on-line at www.microchipDIRECT.com.

Memory Disk Drive File System

The use of removable Flash-based media cards in embedded systems is becoming more prevalent. The Memory Disk Drive File System is based on ISO/IEC 9293, commonly known as FAT 16. The file system allows you to easily integrate a removable Flash-based media card (up to 2 GB) into your application. (Application Note: AN1045)

Bootloader for dsPIC30F/33F and PIC24F/24H Devices

This application note describes a UART-based bootloader for all 16-bit MCU and DSC families. (Application Note: AN1094)

A Serial Bootloader for PIC24F Devices

This application note describes a UART-based bootloader and includes Microchip's PIC24F Quick Programmer (P24QP) Windows® based graphical programming interface. (Application Note: AN1157)

Methods

Implementing Digital Lock-In Amplifiers Using the dsPIC® DSC

Lock-in amplifiers use phase-sensitive detection to measure the presence of small signals buried in large amounts of noise. Conventionally, lock-in amplifiers use complicated (and expensive) analog circuitry to perform the phase-sensitive detection and filtering. However, modern Digital Signal Controllers (DSCs), such as the dsPIC30F and dsPIC33F families, can be used to remove large amounts of the analog circuitry by performing the necessary operations in software. This capability provides increased reliability, resistance to temperature and aging effects, and the ease with which the system can be modified in the field. By using the built-in signal processing capabilities of the dsPIC33F, it is possible to perform high-speed, high-accuracy measurements on sensors such as strain gauges. The same technique can be applied to other noisy systems such as capacitive sensors or the measurement of modulated light levels. (Application Note: AN1115)

Symmetric Key Embedded Encryption Library Features:

- 128-bit AES in ECB, CTR, CBC, CBC-MAC and CCM modes
- Triple DES in ECB, CTR, CBC and CBC–MAC modes
- SHA-1, MD5, random number generator (DRBG X9.82)

Asymmetric Key Embedded Encryption Library Features:

- RSA (1024-bit and 2048-bit modulus) for encyption/decryption and signing/verification
- DSA (1024-bit modulus) for signing/verification
- Diffie-Hellman Key Agreement (1024-bit and 2048-bit modulus)
  - Private/public key generation
  - Shared-key generation
- SHA-1, MD5, random number generator (DRBG X9.82)

File System Library Features:

- Available free for use on Microchip microcontrollers
- Portable across all PIC18, PIC24 and dsPIC DSC products
- Support for MPLAB C Compilers for PIC18, PIC24 and dsPIC DSC products
- Supports SD/MMC, CompactFlash and USB thumb drives
- Supports up to 2 GB

Emulating Data EEPROM for PIC18 and PIC24 MCUs and dsPIC DSCs

For devices that do not have on-chip EEPROM, emulating EEPROM with on-chip Flash memory my be an important option. This application note presents an interface similar to an internal data EEPROM, but uses available on-chip Flash memory to improve endurance by a factor as high as 500. (Application Note: AN1095)

Achieving Higher ADC Resolution Using Oversampling

This application note describes oversampling as a method to add additional bits of accuracy to the 12-bit ADC conversion in a dsPIC DSC. (Application Note: AN1152)

Modules

Cyclic Redundancy Code (CRC) Module

CRC is one of the most versatile error checking algorithm used in various digital communication systems. This application note illustrates how to use the hardware CRC module on selected 16-bit MCUs and DSCs. Users can program any user-defined generator polynomial into this module for CRC computation. (Application Note: AN1148)

Resources for Self-paced Learning

Web Seminars

Microchip offers extensive online resources for designers ranging from downloadable documentation to web seminars (webinars) to online discussion groups. All of these helpful resources are accessible at **www.microchip.com/webseminars** and are updated frequently with the most current information on our products and services.

For more information about additional self-paced learning resources, please visit www.microchip.com/training

Application Area	Webinar Topic
Motor Control	Sensorless Field Oriented Control for ACIM PMSM
Speech & Audio	dsPIC DSC Speech and Audio Solutions DSC DAC Introduction
Graphics & Display	Graphics LCD System and PIC24 Interface Microchip Graphics QVGA Display Solution Microchip Graphics Library Architecture
Connectivity	TCP/IP Networking CAN Design Considerations Using the IrDA Standard Protocol
Power Management	Building a dsPIC® SMPS System SMPS Components and Their Affects on System Design
Chip Functionality	Introduction to the PIC24F MCU Introduction to the dsPIC DSC dsPIC DSC Peripherals PIC24F Peripherals Power Management Modes dsPIC DSC Architecture, Addressing Modes, DSP Engine Codeguard™ Security
Tools	dsPIC Development Tools Overview Introduction to the MPLAB Visual Device Initializer (VDI)
COMING SOON **USB**	USB On-The-Go Introduction

Code Examples

When time is of the essence, it is helpful to get the hints you need when you need them. Microchip has developed over 120 code examples to illustrate common design requirements. Below are some examples.

CE015 – Dynamic tuning of Internal Fast RC Oscillator
CE017 – Reading, Erasing and Writing to dsPIC30F Data EEPROM
CE018 – Using the Fast Fourier Transform (FFT) for Frequency Detection
CE021 – dsPIC SMPS Buck Converter with PID Control
CE025 – dsPIC SMPS Negative Deadtime Example
CE100 – Using A/D Converters and DSP Library for Signal Filtering
CE102 – Performing A/D Conversions in Sleep (Low-Power) Mode
CE103 – Implementing Doze Mode for Dynamic CPU Power Control
CE104 – Dynamic Clock Switching for Low Power Operation
CE108 – Oscillator Failure Traps and Failsafe Clock Monitoring
CE109 – Run-Time Self Programming of Flash Program Memory
CE112 – Fast Wake-up From Sleep Mode
CE120 – A/D Conversions with Scanning through selected Analog Inputs with DMA
CE125 – CodeGuard Security: Secure Segment Erase
CE127 – dsPIC33F Crosswire Communication between ECAN 1 and ECAN 2 Modules
CE132 – Si3000 Driver
CE139 – 10-bit ADC Sampling at 2.2 MSPS
CE141 – SPI with Framed mode
CE201 – Configuring 10-bit A/D Converters for 1 MSPS Conversion Rate
CE227 – PIC24H Crosswire Communication between ECAN 1 and ECAN 2 Modules

For a full list of code examples, visit www.microchip.com/codeexamples

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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 multitude of courses on a regular basis to fit your demanding schedule. You can benefit by learning in small hands-on classroom settings that focus on your specific needs.

Visit the Microchip web site at www.microchip.com/RTC for classes and schedules.

Software Development Tools and Operating Systems

Development Tool	Product Name	Description	Part Number	List Price(1)	Devices Supported			
					PIC24F	PIC24H	dsPIC30F	dsPIC33F
Integrated Development Environment	MPLAB® IDE*	Integrated Development Environment	SW007002	Free	√	√	√	√
	Green Hills Multi	Integrated Development Environment	–	Contact GHS	√	√	√	√
C Compilers	MPLAB® C Compiler for PIC24 MCUs and dsPIC DSCs	ANSI C compiler, assembler, linker and librarian	SW006012	$895	√	√	√	√
	MPLAB® C Compiler for PIC24 MCUs	ANSI C compiler, assembler, linker and librarian	SW006013	$495	√	√	–	–
	MPLAB® C Compiler for dsPIC DSCs	ANSI C compiler, assembler, linker and librarian	SW006014	$495	–	–	√	√
	Embedded Workbench for dsPIC30F	ISO/ANSI C and Embedded C++ compiler in a professional, extensible IDE, (Windows® NT/2000/ Windows XP®) special DSP support included	EWdsPIC 1	Contact IAR	√	√	√	√
	HI-TECH Compiler for dsPIC/PIC24	ANSI C Compiler for dsPIC® DSCs and PIC24 MCUs, integrates with MPLAB® IDE	SW500009	$1195	√	√	√	√
	CCS PCD C-Compiler for PIC24/dsPIC	Command-line C Compiler for Microchip PIC24 MCU and dsPIC DSC families, integrates with MPLAB® IDE	SW500021	$250	√	√	√	√
Operating Systems	AVIX-RT AVIX	AVIX is an RTOS specifically developed for Microchip's PIC24 MCUs and dsPIC DSCs	–	Contact AVIX	√	√	√	√
	CMX-Tiny+™ for dsPIC® DSC	Preemptive Real-time Operating System (RTOS) for dsPIC30F	SW300032	$3000	√	√	√	√
	CMX-RTX™ for dsPIC® DSC	Fully preemptive Real-time Operating System (RTOS) for dsPIC30F	SW300031	$4000	√	√	√	√
	CMX Scheduler™	Multi-tasking, preemptive scheduler for dsPIC30F	SW300030	Free	√	√	√	√
	Express Logic Thread X MCU	ThreadX MCU Edition RTOS is a fully preemptive, deterministic, real-time operating system designed for Microchip's PIC24 MCUs.	SW500130	$5990	√	√	–	–
		ThreadX MCU Edition RTOS is a fully preemptive, deterministic, real-time operating system designed for Microchip's dsPIC DSCs	SW500131	$5990	–	–	√	√
	FreeRTOS.org™	Portable, open source, mini real time kernel	–	Contact freeRTOS.org™	√	√	√	√
	Lassar Systems AVA	A unique and powerful RTOS designed exclusively for Microchip's PIC24 MCUs and dsPIC DSCs	–	Contact Lassar Systems	√	√	√	√
	Micriμm μC/OS-II	Portable, scalable, preemptive real-time, multitasking kernel	–	Contact Micrium	√	√	√	√
	osCAN for dsPIC® DSC	OSEK/VDX v2.2	–	Contact Vector	–	√	√	√
	Pumpkin's Salvo RTOS	Salvo RTOS is a full-featured multitasking priority-based event-driven RTOS for all Microchip microcontrollers	–	Contact Pumpkin	√	√	√	√
	RoweBots DSPnano	DSPnano POSIX RTOS is a tiny, fully preemptive, deterministic, real-time operating system designed for Microchip's PIC24 MCUs and dsPIC30/33 processors	–	Contact RoweBots	√	√	√	√
	SEGGER embOS	Real-time operating system for embedded applications	–	Contact SEGGER	√	√	√	√
DSP	dsPICworks™	Data analysis and DSP software	SW300023	Free	√	√	√	√
	Digital Filter Design	Full featured graphical IIR and FIR filter design package for dsPIC30F	SW300001	$249	–	–	√	√
	Digital Filter Design Lite	Graphical IIR and FIR filter design package for dsPIC30F	SW300001-LT	$29	–	–	√	√

(1) List price may change without notice.

*Includes MPLAB ASM30, MPLAB SIM, MPLAB VDI.

Development Boards and Reference Designs

Development Tool	Description	Part Number	List Price(1)	Devices Supported			
				PIC24F	PIC24H	dsPIC30F	dsPIC33F
Development Tool Starter Kits (Includes Debug Capability)	Explorer 16 Starter Kit	DV164033	$299.99	√	√	–	√
	MPLAB Starter Kit for dsPIc DSCs	DM330001	$59.98	–	–	–	√
	MPLAB Starter Kit for PIC24F MCUs	DM240011	$59.98	√	–	–	–
Starter Development Boards	Explorer 16 Development Board	DM240001	$129.99	√	√	–	√
	dsPICDEM™ 80-pin Starter Development Board	DM300019	$79.99	–	–	√	–
	16-bit 28-pin Starter Development Board	DM300027	$79.99	√	√	√	√
	dsPICDEM™ 2 Development Board	DM300018	$99.99			√	
General Purpose Development Board	dsPICDEM™ 1.1 Plus General Purpose Development Board	DM300024	$299.99	–	–	√	√
Motor Control Development Boards	PICDEM™ MC LV Development Board	DM183021	$129.99	–	–	√	–
	dsPICDEM™ MC1 Motor Control Development Board	DM300020	$300	–	–	√	–
	dsPICDEM™ MC1H 3-Phase High Voltage Power Module	DM300021	$800	–	–	√	√
	3-Phase ACIM High Voltage Motor (208/460V)	AC300021	$120	–	–	√	√
	dsPICDEM™ MC1L 3-Phase Low Voltage Power Module	DM300022	$700	–	–	√	√
	3-Phase BLDC Low Voltage Motor (24V)	AC300020	$120	–	–	√	√
Connectivity Development Boards	dsPICDEM.net™ 1 with FCC/JATE-compliant and Ethernet NIC support	DM300004-1	$389.99	–	–	√	–
	dsPICDEM.net™ 2 with CTR-21-compliant and Ethernet NIC support	DM300004-2	$389.99	–	–	√	–
SMPS Development Board	dsPICDEM™ SMPS Buck Development Board	DM300023	$99.99	–	–	√	–

(1) List price may change without notice.

Hardware Development Tools

Development Tool	Description	Part Number	List Price(1)	Devices Supported			
				PIC24F	PIC24H	dsPIC30F	dsPIC33F
MPLAB® ICD 2	In-Circuit Debugger/Programmer	DV164005	$159.99	√	√	√	√
	In-Circuit Debugger/Programmer with dsPICDEM™ 1.1 Plus General Purpose Board	DV164032	$399.99	–	–	√	–
	Explorer 16 Development Board + MPLAB® ICD 2 In-Circuit Debugger/Programmer	DV164033	$299.99	√	√	–	√
MPLAB® REAL ICE™	In-Circuit Emulator System	DV244005	$499.98	√	√	√	√
	Performance Pak	AC244002	$159.98	√	√	√	√
MPLAB® PM3	Full Featured Device Programmer, Base Unit	DV007004	$895	√	√	√	√
	Socket Module for 18L/28L/40L DIP Devices	AC164301	$189	√	√	√	√
	Socket Module for 16L (.150)/28L (.300) SOIC Devices	AC164302	$189	√	√	√	√
	Socket Module for 28L ML Devices	AC164322	$189	√	√	√	√
	Socket Module for 44L ML Devices	AC164322	$189	√	√	√	√
	Socket Module for 44L TQFP Devices	AC164305	$189	√	√	√	√
	Socket Module for 64L TQFP Devices (PF Package)	AC164313	$189	–	–	√	–
	Socket Module for 64L TQFP Devices (PT Package)	AC164319	$189	√	√	√	√
	Socket Module for 80L TQFP Devices (PF Package)	AC164314	$189	–	–	√	–
	Socket Module for 80L TQFP Devices (PT Package)	AC164320	$189	√	–	√	√
3rd Party Programmers	BPM Microsystems	–	–	√	√	√	√
	Data I/O	–	–	√	√	√	√

(1) List price may change without notice.

PICtail™ Plus Daughter Boards, Plug-in Modules and Adapters for Development Boards

A Plug-in Module (PIM) is a daughter board with a PIC® MCU or dsPIC® DSC soldered on top and header socket strips on the bottom. This method allows for easy swapping of devices onto the various development boards, without having to unsolder and resolder parts.

Development Tool	Description	Part Number	List Price(1)	Devices Supported			
				PIC24F	PIC24H	dsPIC30F	dsPIC33F
PICtail™ Plus Daughter Boards (for use with Explorer 16 Development Board DM240001)	PICtail™ Plus Daughter Board for Secure Digital (SD)/Multimedia Card (MMC) to SPI interface	AC164122	$37.99	√	√	–	√
	Ethernet PICtail™ Plus Daughter Board	AC164123	$39.99	√	√	–	√
	Speech Playback PICtail™ Plus Daughter Board	AC164125	$45	√	√	–	√
	Prototype PICtail™ Plus Daughter Board	AC164126	$20	√	√	–	√
	Wireless PICtail™ Plus Daughter Board	AC163027	$39.99	√	√	–	√
	IrDA® PICtail™ Plus Daughter Board	AC164124	$25	√	√	–	√
	Graphic PICtail™ Plus Daughter Board	AC164127	$125	√	√	–	√
	Motor Interface PICtail™ Plus Daughter Board	AC164128	$125	√	√	–	√
	USB PICtail™ Plus Daughter Board	AC164131	$60	√	–	–	–
Plug-in Modules Supporting Explorer 16 Development Board	PC Board with 100-pin PIC24FJ128GA010 MCU sample; use with DM240001 Development Board	MA240011	$25	√	–	–	–
	PC Board with 100-pin PIC24HJ256GP610 MCU sample; use with DM240001 Development Board	MA240012	$25	–	√	–	–
	PC Board with 44-pin PIC24FJ64GA004 MCU sample; use with DM240001 Development Board	MA240013	$25	√	–	–	–
	PC Board with 44-pin PIC24FJ256GA110 MCU sample; use with DM240001 Development Board	MA240014	$25	√	–	–	–
	PC Board with 44-pin PIC24FJ256GB110 MCU sample; use with DM240001 Development Board	MA240015	$25	√	–	–	–
	PC Board with 100-pin dsPIC33FJ256GP710 DSC sample; use with DM240001 Development Board	MA330011	$25	–	–	–	√
	PC board with 100-pin PIC32MX360F512L MCU sample; use with DM240001 Development Board	MA320001	$25	–	–	–	–
	PC board with 100-pin dsPIC33FJ256MC710 motor control DSC sample; use with DM240001 Development Board	MA330013	$25	–	–	–	√
	PC board with 100-pin dsPIC33FJ12MC202 DSC sample; use with DM240001 Development Board	MA330014	$25	–	–	–	√
	PC board with 100-pin dsPIC33FJ12GP202 DSC sample; use with DM240001 Development Board	MA330015	$25	–	–	–	√
	PC board with 44-pin dsPIC33FJ32MC204 DSC sample; use with DM240001 Development Board	MA330017	$25	–	–	–	√
	PC board with 100-pin dsPIC33FJ32MC204 DSC sample; use with DM240001 Development Board	MA330016	$25	–	–	–	√
Plug-in Modules Supporting Other dsPICDEM Development Board	PC Board with 44-pin SMPS dsPIC30F2023 sample; use with DM300019 Development Board	MA300016	$25	–	–	√	–
	PC Board with 100-pin dsPIC33FJ256GP710 DSC sample; use with DM300019 Development Board	MA330012	$25	–	–	–	√
	PC Board with 80-pin dsPIC30F6010A motor control DSC sample; use with DM300019 and DM300020 Development Boards	MA300015	$25	–	–	√	–
	PC Board with 80-pin dsPIC30F6014A general purpose DSC sample; use with DM300019 and DM300024 Development Boards	MA300014	$25	–	–	√	–

(1) List price may change without notice.

Software Libraries and Application Development Tools

Development Tool	Description	Part Number	List Price(1)	Devices Supported			
				PIC24F	PIC24H	dsPIC30F	dsPIC33F
dsPIC30F Math Library	Standard math and floating point library (ASM, C Wrapper)	SW300020	Free	√	√	√	√
dsPIC30F Peripheral Library	Peripheral initialization, control and utility routines (C)	SW300021	Free	√	√	√	√
dsPIC30F DSP Library	Essential DSP algorithm suite (Filters, FFT)	SW300022	Free	–	–	√	√
Symmetric Key Embedded Encryption Library	Security encryption software support for AES, triple-DES, SHA-1, RNG and MD5	SW300050-5K*	$2500	–	–	√	√
	Evaluation copy of security encryption software support for AES, triple-DES, SHA-1, RNG and MD5	SW300050-EVAL	$5				
Triple DES/AES Encryption Libraries	Production license for security encryption software support for AES and Triple-DES	SW300052	$5	√	√	√	√
Asymmetric Key Embedded Encryption Library	Security encryption software support for RSA, DSA, Diffie-Hellman, SHA-1, RNG and MD5	SW300055-5K*	$2500	–	–	√	√
	Evaluation copy of security encryption software support for RSA, DSA, Diffie-Hellman, SHA-1, RNG and MD5	SW300055-EVAL	$5	–	–	√	√
Noise Suppression Library	Function to suppress noise interference in speech signals	SW300040-5K*	$2500	–	–	√	√
	Evaluation copy of function to suppress noise interference in speech signals	SW300040-EVAL	Free	–	–	√	√
Acoustic Echo Cancellation Library	Function to eliminate echo generated from a speaker to a microphone	SW300060-5K*	$2500	–	–	√	√
	Evaluation copy of function to eliminate echo generated from a speaker to a microphone	SW300060-EVAL	Free	–	–	√	√
Line Echo Cancellation Library	Function to cancel electrical line echoes caused by 2- or 4-wire conversion hybrids	SW300080-5K	$2500	–	–	√	√
	Function to cancel electrical line echoes caused by 2- or 4-wire conversion hybrids	SW300080-EVAL	Free	–	–	√	√
TCP/IP Library	TCP/IP connectivity and protocol support	CMX for dsPIC30F	Contact CMX	–	–	√	√
	TCP/IP connectivity and protocol support	SW300024	Free	√	√	√	√
Soft Modem Library	V.22bis/V.22 Soft Modem Library	SW300002	Free	–	–	√	√
	V.32bis Soft Modem Library	SW300003*	$2500	–	–	√	√
	Evaluation copy of V.32bis Soft Modem Library	SW300003-EVAL	Free	–	–	√	√
	V.32 (non-trellis) Soft Modem Library	–	Contact Vocal	–	–	√	√
Speech Recognition System	Automatic speech recognition system including a PC-based speech training sub-system and a speech recognizer software library (16:1 compression)	SW300010-5K*	$2500	–	–	√	√
	Evaluation copy of automatic speech recognition system including a PC-based speech training sub-system and a speech recognizer software library (16:1 compression)	SW300010-EVAL	Free	–	–	√	√
SPEEX Speech Encoding/ Decoding Library	Speech library to perform speech compression and decompression	SW300070-5K*	$2500	–	–	√	√
	Evaluation copy of speech library to perform speech compression and decompression	SW300070-EVAL	Free	–	–	√	√
G.711 Speech Encoding/ Decoding Library	APCM speech compression and decompression (2:1 compression)	SW300026	Free	√	√	√	√
G.726A Speech Encoding/ Decoding Library	Speech compression and decompression (8:1 compression)	SW300090-5K*	$2500	–	–	√	√
	Evaluation copy of speech compression and decompression (8:1 compression)	SW300090-EVAL	Free	–	–	√	√
Memory Disk Drive File System	Implements all the standard FAT16 functions: fopen, fread, fwrite, fseek, etc.	AN1045	Free	√	√	√	√
CANbedded for dsPIC® DSC	CAN driver library for dsPIC30F	–	Contact Vector	–	√	√	√

(1) List price may change without notice.
*To license for production quantities greater than 5,000 pieces for a project's lifetime – contact Microchip.

Third Party Contact Information

Company	Phone	E-mail	Web Site
CMX Systems, Inc.	+1 904 880 1840	cmx@cmx.com	www.cmx.com
FreeRTOS.org™	–	–	www.freertos.org
HI-TECH Software	+61 7 3552 777	hitech@htsoft.com	www.htsoft.com
IAR	+46 18 16 78 00	info@iar.se	www.iar.se
Micrium	+1 954 217 2036	info@micruim.com	www.micruim.com
SEGGER	+49 2103 2878 0	info@segger.com	www.segger.com
Vector Informatik GmbH	+49 711 80670 0	info@vector-informatik.com	www.vector-informatik.com
VOCAL Technologies, LTD	+1 716 688 4675	sales@vocal.com	www.vocal.com

Documentation

Note that all the latest revisions of these documents are available on the Microchip web site.

Document Type	Document Title	Document Number
Overview Documents	PIC24H High Performance 16-bit Microcontroller Family Overview	DS70166
	dsPIC30F High Performance 16-bit Digital Signal Controller Family Overview	DS70043
	dsPIC33F High Performance 16-bit Digital Signal Controller Family Overview	DS70155
Programming Specifications	dsPIC30F Flash Programming Specification	DS70102
	dsPIC33F/PIC24H Flash Programming Specification	DS70152
	PIC24F128GA Programming Specification	DS39768
Reference Manuals	PIC24F Family Reference Manual	DS39710
	dsPIC30F Language Tools Quick Reference Guide	DS51322
	dsPIC30F, dsPIC33F Programmer's Reference Manual	DS70157
	dsPIC30F Family Reference Manual	DS70046
Application Notes	AN833 – Microchip TCP/IP Stack Application Note	DS00833
	AN901 – Using the dsPIC30F for Sensorless BLDC Control	DS00901
	AN908 – Using the dsPIC30F for Vector Control of an AC Induction Motor	DS00908
	AN957 – Sensored BLDC Motor Control Using dsPIC30F2010	DS00957
	AN962 – Implementing Auto Baud on dsPIC30F Devices	DS00962
	AN984 – An Introduction to AC Induction Motor Control Using the dsPIC30F	DS00984
	AN992 – Sensorless BLDC Motor Control Using the dsPIC30F2010	DS00992
	AN1017 – Sinusoidal Control of a PMSM Motor with the dsPIC30F DSC	DS01017
	AN1025 – Converting A 5.0V Supply Rail to a Regulated 3.0V	DS01025
	AN1044 – Data Encryption Routines for PIC24 and dsPIC DSC Devices	DS01044
	AN1045 – Implementing File I/O Functions on Flash Cards Formatted with a FAT16 File System	DS01045
	AN1078 – Sensorless Field Oriented Control for PMSM Motors	DS01078
	AN1083 – Sensorless BLDC Control with Back-EMF Filtering	DS01083
	AN1095 – Emulating Data EEPROM for PIC18 and 16-bit MCUs and DSCs	DS01095
	AN1106 – Power Factor Corrector in Power Conversion Applications	DS01106
	AN1160 – Sensorless BLDC Control with Back-EMF Filtering Using a Majority Function	DS01160
	AN1162 – Sensorless Field Oriented Control (FOC) of an AC Induction Motor	DS01162
	AN1071 – IrDA® Standard Stack for Microchip 16-Bit Microcontrollers	DS01071
	AN1140 – USB Embedded Host Stack	DS01140
	AN1141 – USB Embedded Host Stack Programmer's Guide	DS01141
	AN1142 – USB Mass Storage Class on an Embedded Host	DS01142
	AN1145 – Using a USB Flash Drive on an Embedded Host	DS01145
	AN1163 – USB Mass Storage Class on an Embedded Device	DS01163
	AN1164 – USB CDC Class on an Embedded Device	DS01164
	AN1166 – USB Generic Function on an Embedded Device	DS01166
	AN1169 – USB HID Class on an Embedded Device	DS01169
Migration Document	PIC18F to PIC24F Migration: An Overview	DS39764

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 knowlege base and peer help: **http://forum.microchip.com**

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