MICROCHIP

dsPIC® Digital Signal Controllers
The Best of Both Worlds
October 2005

What is a Digital Signal Controller?

A Digital Signal Controller (DSC) is a single-chip, embedded controller that seamlessly integrates the control attributes of a Microcontroller (MCU) with the computation and throughput capabilities of a Digital Signal Processor (DSP) in a single core.

Microchip's dsPIC® DSC offers everything you would expect from a powerful 16-bit MCU: fast, sophisticated and flexible interrupt handling; a wide array of digital and analog peripheral functions; power management; flexible clocking options; power-on-reset; brown-out protection; watchdog timer; code security; full-speed real-time emulation; and full-speed in-circuit debug solutions.

By skillfully adding DSP capability to a high-performance 16-bit MCU, Microchip's dsPIC30F and dsPIC33F families of DSCs achieve the best of both worlds and mark the beginning of a new era in embedded control.
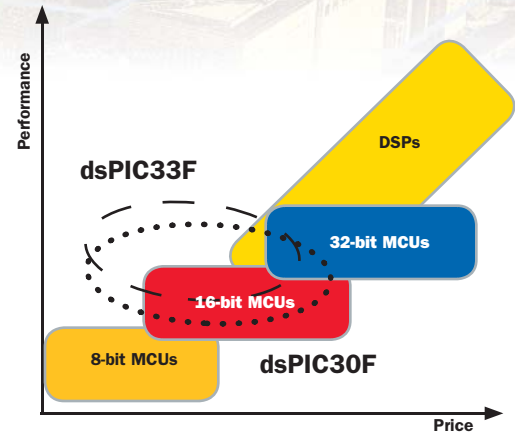
The Capability You Need

Powerful 16-bit MCU:

The dsPIC30F and dsPIC33F families of digital signal controllers execute most instructions in 1 cycle. Combine high instruction throughput with true DSP capabilities, such as single cycle 16-bit multiply and zero overhead looping, and you have the most powerful 16-bit MCU for your embedded control designs.

Flexible Flash:

The dsPIC30F and dsPIC33F both employ flexible and secure Flash memory. You can use the dsPIC DSC Flash to store programs or data tables. Additionally, all dsPIC DSCs can securely self-program their own flash in a finished product. If you need extraordinary retention or endurance, we have that too.

Optimized C Compiler:

The architecture of these digital signal controllers was co-developed by our MPLAB® C30 C Compiler team. The result is a high C code efficiency when compared to any 16-bit MCU or DSP. C code benchmarks show that competitive 16-bit MCUs require up to double the amount of program code space for the same application program written in C.

Looking to Add DSP?

If you are one of the many MCU users looking to add DSP features to your system, chances are you don't like your choices. Adding a DSP chip to your existing MCU-based system can be costly and complicated. The dsPIC30F and the dsPIC33F are designed to look and feel like MCUs. Adding DSP functionality in the familiar controller-like environment can be accomplished with ease.

DSP for the DSP Expert!

A seasoned DSP developer will be amazed at the capabilities this family of digital signal controllers offers — everything you expect from a DSP of its class: dual 40-bit accumulators, single-cycle 16 x 16 MAC, 40-bit barrel shifter, dual operand fetches, saturation and rounding modes and DO and REPEAT loops. Then we added a few items usually missing from DSPs: flexible interrupts, large register sets, a watchdog timer, clock fail detect and real-time emulation to name a few.

Considering a 32-bit MCU?

Considering a 32-bit controller because your current MCU has run out of steam? Microchip's digital signal controllers integrate the power of digital signal processors and can outperform a 32-bit controller in many applications. Our outstanding C code efficiency for a 32-bit data type reduces memory requirements and cost.

Best of Both Worlds

MCU Attributes
- State-centric
- Interrupt intensive
- Cost driven
- Flash capability
- Robust peripherals
- HLL frequently used

dsPIC®

Single core architecture
Familiar MCU look and feel
DSP performance
Rich peripheral options
Advanced interrupt capability
Flexible Flash memory
Self-programming capability
Low pin count options
Optimized for C

DSP Attributes
- Flow-centric
- Interrupt averse
- Performance driven
- Emerging Flash
- Limited peripherals
- HLL infrequently used

Bridging the Performance Gap

Microchip's digital signal controllers place unprecedented performance in the hands of 16-bit MCU designers. The dsPIC DSC has the "heart" of a 16-bit MCU with robust peripherals and fast interrupt handling capability and the "brain" of a DSP that manages high computation activities, creating the optimum single-chip solution for embedded system designs. This enables you to add powerful new features to your product and integrate functions to save board space.

Outstanding MCU Performance

The first 16-bit MCUs were developed to overcome the native 64 KB boundary imposed by 8-bit MCUs. The need for advanced performance was not contemplated in these early architectures. When the need for improved performance became obvious, next-generation devices were developed, but were constrained by backward compatibility requirements and legacy issues.

Developed from the ground up, the dsPIC DSC addresses traditional 16-bit requirements without sacrificing performance. It combines state-of-the-art 16-bit MCU performance in its general-purpose, register-based core with all the features you need for DSP operations.

True DSP Performance

The dsPIC DSC balances its outstanding MCU qualities with real DSP performance. All the features you require from a high performance, robust DSP are effortlessly integrated in a single core.

DSP Performance

Function	Cycle Count Equation	Conditions*	Number of Cycles	Execution Time @40 MIPS
Complex FFT**	—	N=64	3739	93.5 μs
Complex FFT**	—	N=128	8485	212.1 μs
Complex FFT**	—	N=256	19055	476.4 μs
Single Tap FIR	—	—	1	25 ns
Block FIR	53+N(4+M)	N=32, M=32	1205	30.2 μs
Block FIR Lattice	41+N(4+7M)	N=32, M=32	7337	183.5 μs
Block IIR Canonic	36+N(8+7S)	N=32, S=4	1188	29.7 μs
Block IIR Lattice	46+N(16+7M)	N=32, M=8	2350	58.7 μs
Matrix Add	20+3(C*R)	C=8, R=8	212	5.3 μs
Matrix Transpose	16+C(6+3(R-1))	C=8, R=8	232	5.8 μs
Vector Dot Product	17+3N	N=32	113	2.9 μs
Vector Max	19+7(N-2)	N=32	229	5.7 μs
Vector Multiply	17+4N	N=32	145	3.6 μs
Vector Power	16+2N	N=32	80	2.0 μs
PID Loop Core	—	—	7	175 ns

*C= # columns, N= # samples, M= # taps, S= # sections, R= # rows
**Complex FFT routine inherently prevents overflow

1 cycle = 25 nanoseconds @ 40 MIPS

Microchip's 16-bit Embedded Controller Families

Microchip offers a broad selection of embedded control solutions. In addition to traditional 16-bit microcontrollers, the 16-bit digital signal controllers offer an innovative solution for today's compute-intensive real-time control applications.

Built around an identical base architecture and instruction set, three compatible 16-bit controller families offer unprecedented flexibility, choice and performance: the dsPIC30F and the dsPIC33F DSCs and the PIC24 MCU.

While the PIC24 offers a base instruction set, the dsPIC30F and the dsPIC33F integrate full DSP capability.
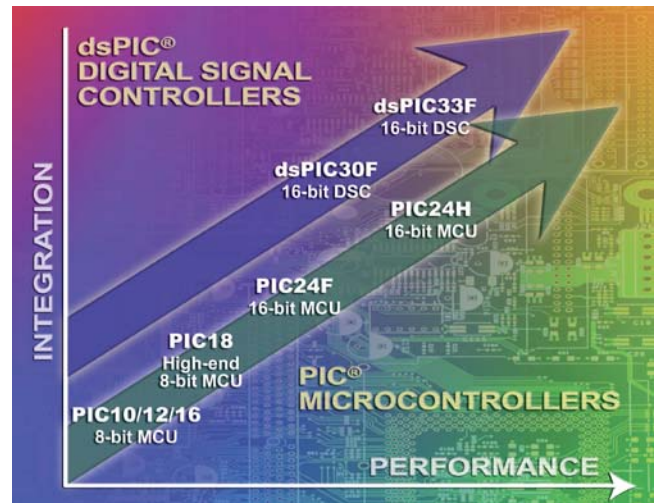
One Architecture:
Three Compatible Families:

16-bit data, 24-bit wide instructions
Same instruction set (DSP features not in PIC24)
Same C compiler and software tools
Same Hardware tools
Compatible peripherals
Compatible pinouts

dsPIC30F

30 MIPS @5V
2.5 to 5.5V operation
-40° to 85°C and -40° to 125°C
Up to 144 KB Program Flash
Integrated Data EEPROM
Up to 8 KB RAM
18 to 80 pin packages

dsPIC33F

40 MIPS @3.3V
3.0 to 3.6V operation
-40° to 85°C (extended temp. planned)
Up to 256 KB Program Flash
Data EEPROM emulation in Program Flash
Up to 30 KB RAM
64 to 100 pin packages
8 channel DMA

PIC24

16 and 40 MIPS version @3.3V
3.0 to 3.6V operation
-40° to 85°C (-40° to 125°C planned)
Up to 256 KB Program Flash
Data EEPROM emulation in Program Flash
Up to 16 KB RAM
28 to 100 pin packages

dsPIC30F/dsPIC33F Family Block Diagram
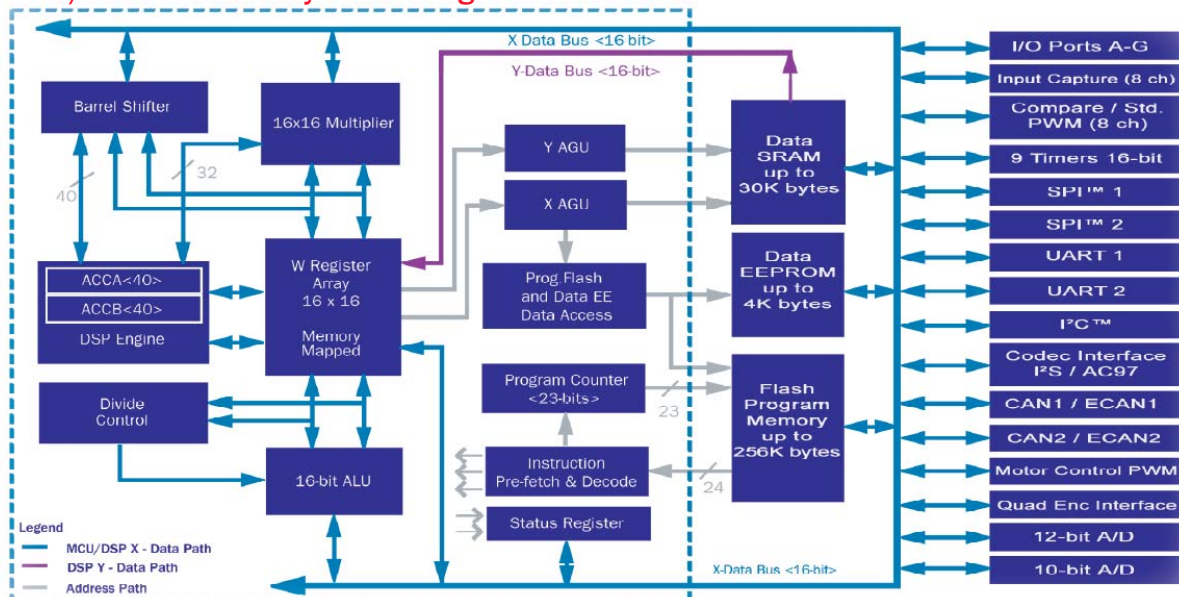
dsPIC30F/dsPIC33F Features Overview

Operating Range dsPIC30F

DC to 30 MIPS*

V_{DD} range: 2.5 to 5.5V

Ind. (-40° to 85° C) and ext. (-40° to 125°C)

*30 MIPS @ 4.5 to 5.5V, -40° to 85° C

Operating Range dsPIC33F

DC to 40 MIPS

V_{DD} range: 3.0 to 3.6V

Ind.(-40° to 85° C) Extended temp. planned

High Performance DSC CPU

Single core combines MCU and DSP features

C compiler optimized instruction set

16-bit wide data path

24-bit wide instructions

84 base instructions: mostly 1 word/1 cycle

16 16-bit general purpose registers

2 40-bit accumulators
· With rounding and saturation options

Flexible and powerful addressing modes
· Indirect, modulo and bit-reversed

Software stack

16 x 16 fractional/integer multiplier

32/16 and 16/16 divide

Single cycle multiply-and-accumulate

40-stage barrel shifter

Hardware DMA (dsPIC33F)

8 channel DMA

2 KB dual port RAM

Power Management

Switch between clock sources in real-time

Programmable power-on reset start up

Programmable low-voltage detect

Programmable brown-out reset

Idle and Sleep modes with fast wake-up

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. & 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

Digital I/O

Up to 85 programmable digital I/O pins

Wake-up/Interrupt-on-change on up to 24 pins

25 mA sink and source on all dsPIC30F I/O pins

On-chip Flash, Data EE 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

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 8 channels
· Single or dual 16-bit compare mode
· 16-bit glitchless PWM mode

Communication Modules

3-wire SPI™: up to 2 modules
· Framing supports I/O interface to simple codecs

I²C™: up to 2 modules
· Full Multi-master and Slave mode support
· 7-bit and 10-bit addressing

UART: up to 2 modules
· Interrupt-on-address bit detect
· Wake-up on Start bit from Sleep mode
· 4-character TX and RX FIFO buffers

Codec interface module
· Supports I²S and AC97 protocols

CAN/ECAN 2.0B active: up to 2 modules
· 3 transmit, 2 receive buffers (dsPIC30F)
· 8 transmit, 32 receive buffers (dsPIC33F)
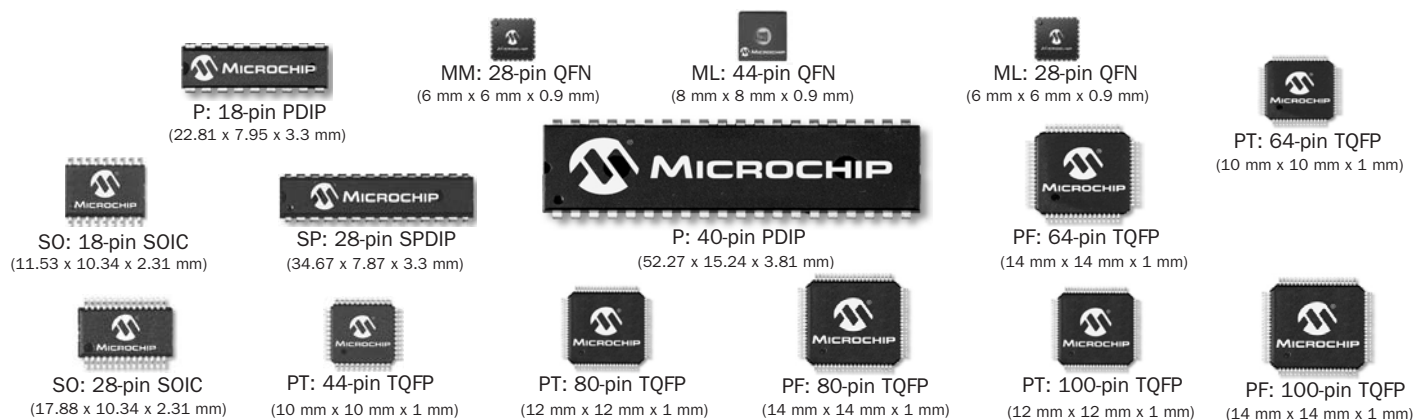· Wake-up on CAN message

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
· A/D samples triggered by PWM module

Quadrature encoder interface module
· Phase A, Phase B and index pulse input

Analog-to-Digital Converters

10-bit A/D converter:
· dsPIC30F: 1Msps, 1 module
· dsPIC33F: 1.1 Msps, 1 or 2 modules
· Up to 8 simultaneous sample/hold

12-bit A/D converter:
· dsPIC30F: 200 ksps, 1 module
· dsPIC33F: 500 ksps, 1 or 2 modules

Common features:
· ±1 LSb accuracy
· 16-deep result buffer
· dsPIC30F: up to 16 channels, auto scanning
· dsPIC33F: up to 32 channels, auto scanning

dsPIC DSC Packages

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

ML: 44-pin QFN
(8 mm x 8 mm x 0.9 mm)

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

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

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

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

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

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

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

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

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

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

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

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

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

dsPIC30F Product Families

General Purpose Family

The dsPIC30F 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-Memory Kbytes	RAM Bytes	EEPROM Bytes	Timer 16-bit	Input Capture	Output Compare/Standard PWM	Codec Interface	A/D 12-bit 200 ksps	UART	SPI™	I²C™	CAN	I/O Pins (max.)†	Package Code
dsPIC30F3014	40/44	24	2048	1024	3	2	2	—	13 ch, 1 S/H	2	1	1	—	30	P, PT, ML
dsPIC30F4013	40/44	48	2048	1024	5	4	4	AC97, I²S	13 ch, 1 S/H	2	1	1	1	30	P, PT, ML
dsPIC30F5011	64	66	4096	1024	5	8	8	AC97, I²S	16 ch, 1 S/H	2	2	1	2	52	PT
dsPIC30F6011[1] dsPIC30F6011	64	132	6144	2048	5	8	8	—	16 ch, 1 S/H	2	2	1	2	52	PF PT
dsPIC30F6012[1] dsPIC30F6012A	64	144	8192	4096	5	8	8	AC97, I²S	16 ch, 1 S/H	2	2	1	2	52	PF PT
dsPIC30F5013	80	66	4096	1024	5	8	8	AC97, I²S	16 ch, 1 S/H	2	2	1	2	68	PT
dsPIC30F6013[1] dsPIC30F6013A	80	132	6144	2048	5	8	8	—	16 ch, 1 S/H	2	2	1	2	68	PF PT
dsPIC30F6014[1] dsPIC30F6014A	80	144	8192	4096	5	8	8	AC97, I²S	16 ch, 1 S/H	2	2	1	2	68	PF PT

Motor Control and Power Conversion Family

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

Product	Pins	Flash-Memory Kbytes	RAM Bytes	EEPROM Bytes	Timer 16-bit	Input Capture	Output Compare/Standard PWM	Motor Control PWM	Quadrature Encoder	A/D 10-bit 1 Msps	UART	SPI™	I²C™	CAN	I/O Pins (Max.)†	Package Code
dsPIC30F2010	28	12	512	1024	3	4	2	6 ch	Yes	6 ch, 4 S/H	1	1	1	—	20	SP, SO, MM
dsPIC30F3010	28/44	24	1024	1024	5	4	2	6 ch	Yes	6 ch, 4 S/H	1	1	1	—	20	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	20	SP, SO, 44-pin ML
dsPIC30F3011	40/44	24	1024	1024	5	4	4	6 ch	Yes	9 ch, 4 S/H	2	1	1	—	30	P, PT, ML
dsPIC30F4011	40/44	48	2048	1024	5	4	4	6 ch	Yes	9 ch, 4 S/H	2	1	1	1	30	P, PT, ML
dsPIC30F5015	64	66	2048	1024	5	4	4	8 ch	Yes	16 ch, 4 S/H	1	2	1	1	52	PT
dsPIC30F6015	64	144	8192	4096	5	8	8	8 ch	Yes	16 ch, 4 S/H	2	2	1	2	52	PF
dsPIC30F5016	80	66	2048	1024	5	4	4	8 ch	Yes	16 ch, 4 S/H	1	2	1	1	68	PT
dsPIC30F6010 dsPIC30F6010A*	80	144	8192	4096	5	8	8	8 ch	Yes	16 ch, 4 S/H	2	2	1	2	68	PF PT

Sensor Family

The dsPIC30F Sensor Family products have features designed to support high-performance, cost sensitive and space constrained applications. Offered as small as 6x6 mm and with pin counts as low as 18 pins, this family provides industry leading performance in a small form factor.

Product	Pins	Flash-Memory Kbytes	RAM Bytes	EEPROM Bytes	Timer 16-bit	Input Capture	Output Compare/Standard PWM	A/D 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

*   Devices with an "A" designation are scheduled to be released in the fourth quarter of 2005
†   I/O pin count includes pins shared by the peripheral functions
1   Suggest "A" version for new designs

dsPIC33F Product Families

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 Memory Kbytes	RAM Kbytes	DMA # Ch	Timer 16-bit	Input Capture	Output Compare/ Standard PWM	Codec Interface	A/D* 12-bit 500 ksps	UART	SPI™	I²C™	CAN	I/O Pins (max)†	Package Code
dsPIC33FJ64GP206	64	64	8	8	9	8	8	1	1 ADC, 18 Ch, 1 S/H	2	2	1	—	53	PT
dsPIC33FJ64GP306	64	64	16	8	9	8	8	1	1 ADC, 18 Ch, 1 S/H	2	2	2	—	53	PT
dsPIC33FJ64GP706	64	64	16	8	9	8	8	1	2 ADC, 18 Ch, 2 S/H	2	2	2	2	53	PT
dsPIC33FJ128GP206	64	128	8	8	9	8	8	1	1 ADC, 18 Ch, 1 S/H	2	2	1	—	53	PT
dsPIC33FJ128GP306	64	128	16	8	9	8	8	1	1 ADC, 18 Ch, 1 S/H	2	2	2	—	53	PT
dsPIC33FJ128GP706	64	128	16	8	9	8	8	1	2 ADC, 18 Ch, 2 S/H	2	2	2	2	53	PT
dsPIC33FJ256GP506	64	256	16	8	9	8	8	1	1 ADC, 18 ch, 1 S/H	2	2	2	1	53	PT
dsPIC33FJ64GP708	80	64	16	8	9	8	8	1	2 ADC, 24 ch, 2 S/H	2	2	2	2	69	PT
dsPIC33FJ128GP708	80	128	16	8	9	8	8	1	2 ADC, 24 ch, 2 S/H	2	2	2	2	69	PT
dsPIC33FJ64GP310	100	64	16	8	9	8	8	1	1 ADC, 32 Ch, 1 S/H	2	2	2	—	85	PT, PF
dsPIC33FJ64GP710	100	64	16	8	9	8	8	1	2 ADC, 32 ch, 2 S/H	2	2	2	2	85	PT, PF
dsPIC33FJ128GP310	100	128	16	8	9	8	8	1	1 ADC, 32 Ch, 1 S/H	2	2	2	—	85	PT, PF
dsPIC33FJ128GP710	100	128	16	8	9	8	8	1	2 ADC, 32 ch, 2 S/H	2	2	2	2	85	PT, PF
dsPIC33FJ256GP510	100	256	16	8	9	8	8	1	1 ADC, 32 ch, 1 S/H	2	2	2	1	85	PT, PF
dsPIC33FJ256GP710	100	256	30	8	9	8	8	1	2 ADC, 32 ch, 2 S/H	2	2	2	2	85	PT, PF

Motor Control and Power Conversion Family

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

Product	Pins	Flash Memory Kbytes	RAM Kbytes	DMA # Ch	Timer 16-bit	Input Capture	Output Compare/ Standard PWM	Motor Control PWM	Quadrature Encoder Interface	A/D* 10-bit 1.1 Msps	UART	SPI™	I²C™	CAN	I/O Pins (max)†	Package Code
dsPIC33FJ64MC506	64	64	8	8	9	8	8	8 ch	Yes	1 A/D, 16 Ch, 4 S/H	2	2	2	1	53	PT
dsPIC33FJ64MC706	64	64	16	8	9	8	8	8 ch	Yes	2 A/D, 16 ch, 8 S/H	2	2	2	1	53	PT
dsPIC33FJ128MC506	64	128	8	8	9	8	8	8 ch	Yes	1 A/D, 16 Ch, 4 S/H	2	2	2	1	53	PT
dsPIC33FJ128MC706	64	128	16	8	9	8	8	8 ch	Yes	2 A/D, 16 ch, 8 S/H	2	2	2	1	53	PT
dsPIC33FJ64MC508	80	64	8	8	9	8	8	8 ch	Yes	1 A/D, 18 Ch, 4 S/H	2	2	2	1	69	PT
dsPIC33FJ128MC708	80	128	16	8	9	8	8	8 ch	Yes	2 A/D, 18 ch, 8 S/H	2	2	2	1	69	PT
dsPIC33FJ64MC510	100	64	8	8	9	8	8	8 ch	Yes	1 A/D, 24 Ch, 4 S/H	2	2	2	1	85	PT, PF
dsPIC33FJ64MC710	100	64	16	8	9	8	8	8 ch	Yes	2 A/D, 24 ch, 8 S/H	2	2	2	2	85	PT, PF
dsPIC33FJ128MC510	100	128	8	8	9	8	8	8 ch	Yes	1 A/D, 24 Ch, 4 S/H	2	2	2	1	85	PT, PF
dsPIC33FJ128MC710	100	128	16	8	9	8	8	8 ch	Yes	2 A/D, 24 ch, 8 S/H	2	2	2	2	85	PT, PF
dsPIC33FJ256MC510	100	256	16	8	9	8	8	8 ch	Yes	1 A/D, 16 ch, 4 S/H	2	2	2	1	85	PT, PF
dsPIC33FJ256MC710	100	256	30	8	9	8	8	8 ch	Yes	2 A/D, 24 ch, 8 S/H	2	2	2	2	85	PT, PF

† I/O pin count includes pins shared by the peripheral functions
* The A/D is 10 or 12-bit (user configurable)

Designed for real-time control, the dsPIC DSC offers outstanding reliability, robustness and reduced system cost

On-chip oscillator eliminates crystal, reduces cost
The dsPIC DSC's on-chip precision oscillator can be the clock source for many systems. The PLL in the dsPIC DSC can boost the clock speed and still meet ±2% accuracy over V_{DD} and temperature . Now you can eliminate the external crystal, save board space and reduce system cost.

Reliable watchdog timer
Flash configuration bits are used to enable the watchdog timer and select its period. Software cannot disable it; it runs from its own internal oscillator, independent of the system clock. Now *that* is a reliable watchdog.

Power save modes optimizes power consumption
The dsPIC DSC offers many ways to optimize power consumption. Switch to a low frequency on-chip oscillator or divide down the system clock during periods of inactivity. Go into "power-down" mode to shut down all clocks to reduce current draw to microamperes yet allow a quick wake-up on interrupt.

On-chip system clock monitor adds safety
The dsPIC DSC's on-chip clock monitor detects a system clock failure and forces a chip-reset. Restarting the system with the on-chip oscillator (FRC) provides a graceful way to handle such a catastrophic failure.

The dsPIC DSC 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.

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.

125°C ambient operation
The dsPIC30F devices operate up to 125°C ambient temperature, making these ideal for industrial applications that run "hot" such as motor control, power conversion, lighting control as well as "under the hood" automotive systems such as EHPS, electronic gearbox, cooling fan control, etc.

Small package, big performance
Several dsPIC DSCs come in QFN packages as small as 6 x 6 mm and only 0.9 mm high. Now you can add 16-bit performance and save board space too.

25 mA I/O drive saves cost
Each dsPIC30F I/O pin sources or sinks 25 mA, making it possible to drive LEDs directly or eliminate pre-drivers for external FET switches to save you space and cost.

Power-on Reset and Brown-out Reset add robustness, saves cost
Intelligent on-chip Power-on Reset eliminates external reset circuit in most systems. Vary the reset period to allow for different crystal start-up delays. Brown-out protection, if enabled, resets 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 un-initialized pointer accesses. Now your real-time system has an added level of safety.

One Architecture, Many Solutions

The versatile dsPIC DSC family provides solutions for embedded control applications and offers a wide variety of digital and analog peripheral modules. Choose a high pin count, high-density memory device as a main controller in a large, complex embedded system. Or select a small pin count, small package device to tackle a single motor or a sensor. No other 16-bit MCU or DSP family gives you so much flexibility. Invest in the dsPIC DSC architecture once and reap the benefits of having a single platform over many applications.

Motor Control

The dsPIC30F and dsPIC33F devices are ideal for motors requiring more than a basic microcontroller. Whether you need a little more computation power or full DSP capability, these devices deliver. Apply the digital signal control to sensorless control applications, precision speed/position/servo control, torque management, variable speed motors, high RPM motors, variable load applications, noise reduction or energy efficiency improvement. Brushless DC, AC induction or switched reluctance motors are ideal candidates for the these family of controllers. For additional information about Microchip's motor control capabilities, please visit the Motor Control Design Center at *www.microchip.com/motor*.

Applications:

- Heating, ventilation and air conditioning
- Absolute encoders and resolvers
- Blowers and lawn equipment
- Electronic Power Steering
- Industrial gate openers
- Seat belt tensioners
- Exercise equipment
- Washing machines
- Sewing machines
- Industrial pumps
- Stability control
- Power tools
- Refrigeration
- Printing machines

Enabling Features of the dsPIC DSC:

- 1 or 2 fault pins
- 28-, 40-, 64-, 80- and 100-pin variants
- 6 or 8 motor PWM output
- Complementary or independent PWM
- Center-aligned or edge-aligned PWM
- A/D sampling synchronized to PWM cycle
- 10-bit, 1 to 2.2 Msps A/D converter
- 2, 4 or 8 simultaneous A/D samples
- 5V native operation for noisy environments (dsPIC30F)
- On-chip Quadrature Encoder Interface (QEI)
- Motor control algorithm reference designs
- Up to 2 programmable dead time settings
- Visual design guide motor control GUI (MPLAB plug-in)

Internet Connectivity

If your embedded control system needs to be connected to the Internet or to a dial-up phone line, the dsPIC DSC provides you with a single chip solution. The ready-to-use TCP/IP Ethernet driver and soft modem application libraries help you to add connectivity to your design. For additional information about Microchip's connectivity capabilities, please visit the Connectivity Design Center at *www.microchip.com/connectivity*.

Applications:

- Remote diagnostics of industrial equipment
- Remote medical equipment
- Water, gas and electric meters
- Industrial gate openers
- Remote monitoring
- Vending machines
- Power line modems
- Security systems
- Set top boxes
- Internet speakers

Enabling Features of the dsPIC DSC:

- UART interface
- TCP/IP Software Library
- Soft Modem Library (V.32bis/V.22bis)
- Encryption libraries
- Ethernet driver software
- RTOS for multitasking
- Reduced board space
- Reduced total system cost

Speech

Often speech and low fidelity audio applications use a DSP for algorithm processing and an MCU for control. The dsPIC DSC can replace both in many applications and reduce total system cost. The dsPIC DSC provides enough MIPS for many speech and audio applications, such as noise and echo cancellation, speech recognition and quality speech compression and playback. The dsPIC DSC is also an ideal companion to a main DSP in high-end audio applications; offloading functions such as a digital tuner, satellite radio, equalizer, etc.

Applications:

- Intercom systems
- High quality speech playback
- Distributed speaker network
- Musical instrument effects
- Voice activated and wireless microphones
- Teleconferencing equipment
- Noise cancelling headsets
- Cabin noise cancellation
- Speech recognition
- Speakerphones
- Hands-free kit
- Answering machines
- Digital two-way radios
- Voice recorders

Enabling Features of the dsPIC DSC:

- Codec interface: AC97 and I²S
- 12-bit, up to 1 Msps A/D converter
- Small footprint package options
- Reduced total system cost
- Reduced board space
- Digital Filter Design tool
- Ready to use DSP Library
- Noise Suppression Library
- Line Echo Cancellation Library
- Acoustic Echo Cancellation Library
- Speech Encoding/Decoding Library
- Speech Recognition Application Library

Power Conversion and Monitoring

dsPIC DSCs are ideal for a variety of power conversion and monitoring applications. UPSs, inverters, as well as power management units within complex equipment, such as copiers, telecom switches and routers, require advanced power management. The dsPIC30F and dsPIC33F have Pulse Width Modulation (PWM) outputs, fast analog-to-digital conversion and plenty of computation power to satisfy the needs of these applications.

Applications:

- Power and environment monitor in servers
- Power management for equipment
- Circuit breakers
- Arc fault detection
- Auxiliary power unit
- Electric vehicles
- AC to DC converters
- DC to DC converters
- Power factor correction
- Inverters
- Online UPS
- Welding machines

Enabling Features of the dsPIC DSC:

- 10-bit, 1 to 2.2 Msps A/D converter
- Up to 8 sample/hold
- A/D sampling synchronized to PWM cycle
- 6 or 8 PWM output
- Complementary or independent PWM
- Center-aligned or edge-aligned PWM
- 1 or 2 fault pins
- 58.6 kHz PWM frequency at 10-bit resolution (at 30 MIPS)
- Up to 2 programmable dead time settings
- 28-, 40-, 64-, 80- and 100-pin variants
- 5V native operation for noisy environments (dsPIC30F)

Sensor Control

The 18- and 28-pin small footprint dsPIC30F devices are ideal for advanced sensor control. The combination of a 12-bit A/D converter, communication peripherals, approximately 1 μA power-down current, power management features and DSP capability makes it possible to create intelligent sensor interface modules. These devices can also assist an overloaded central controller.

Applications:

- Advanced 2-D PIR detection
- Chemical and gas sensors
- Glass break detectors
- Gyroscopic modules
- Knock detection
- Vibration sensors
- Pressure sensors
- Torque sensors
- Coin acceptors
- Magnetic sensors
- Ultrasonic sensors

Enabling Features of the dsPIC DSC:

- Data EEPROM
- DSP capability
- High speed input capture
- Small footprint 18- or 28-pin packages
- 12-bit, 200 Ksps A/D converter
- SPI™, I²C™ and UART communication ports
- Visual digital filter design tool
- Configurable Flash memory can update algorithms

Automotive

Microchip is an ISO/TS 16949:2002 qualified supplier to major automotive manufacturers. Most of our products are available for automotive-grade temperature requirements and support a long product life cycle. Available in 18- to 100-pin packages, the dsPIC30F and dsPIC33F devices are ideal for a variety of automotive applications from a large central controller to a small sensor interface or a peripheral processor. For additional information about Microchip's automotive capabilities, please visit the Automotive Design Center at *www.microchip.com/auto*.

Applications:

- Electrically assisted hydraulic steering
- Electronic clutch and gearboxes
- Roll and stability controllers
- Seat belt pretensioners
- Electronic power steering
- Cabin noise cancellation
- Advanced battery monitors
- Airbag main controllers
- Ignition controllers
- Side impact airbags
- Occupant sensors
- Fuel pressure controls

Enabling Features of the dsPIC DSC:

- DSP capability
- Powerful MCU core
- CAN and OSEK Library
- 18- to 100-pin products
- One or two CAN/ECAN 2.0B modules
- Long product life cycle supported
- Broad product selection for many applications
- Extended temperature operation
- LIN support through UART and software
- Safe mode operation: LVD, BOR, WDT, software traps
- For extraordinary Flash endurance (1 million erase/write cycles and data retention of >40 years) choose the dsPIC30F family
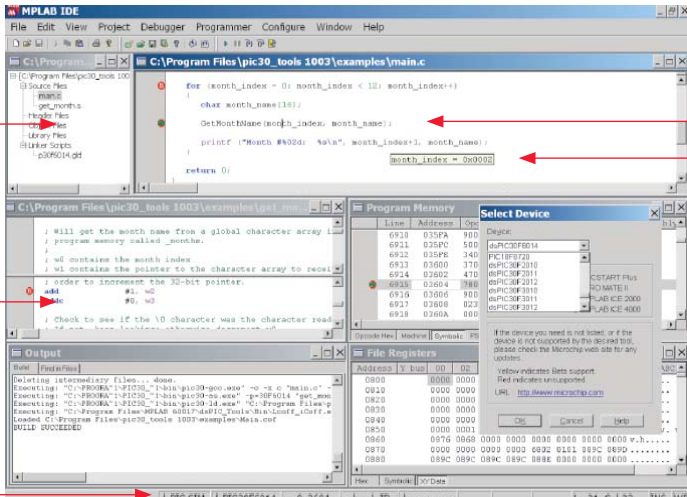
Powerful Tools and Libraries to Ease Your Development

Microchip's digital signal controllers come with an extensive array of development tools, application libraries (many of which are free of charge), development boards and reference designs that allow high-performance embedded solutions to be designed effortlessly and rapidly.

FREE MPLAB® Integrated Development Environment (IDE)

All dsPIC DSC tools operate effortlessly under the MPLAB IDE umbrella. The powerful and yet 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

Powerful Project Manager handles multiple projects and all file types

Color-keyed editor makes source code debug easier

Status bar updates on single step or run

Set break/trace points with a click of the mouse

Simply move your mouse over a variable to view or modify

Fully customizable watch windows to view and modify registers and memory locations

The Essential Software and Hardware Development Tools

Microchip is committed to making your development as easy and efficient as possible. This commitment is the reason why Microchip develops its own software and hardware tools. You have our full technical support whether the issue is silicon or tools-related.

Our development tools suite provides value with many free and low-cost tools. You can get started with the MPLAB ICD 2 In-Circuit Debugger and the MPLAB IDE for approximately US $160.

If you already own a PRO MATE® II, the dsPIC30F family is supported on it. If you are considering a new full-featured programmer, the MPLAB PM3 is recommended.

|	
MPLAB® IDE	Integrated Development Environment
MPLAB® ASM30	Assembler*
MPLAB® SIM	Software Simulator*
MPLAB® C30	ANSI C Compiler
MPLAB® ICD 2	In-Circuit Debugger/Development Programmer
MPLAB® ICE 4000	In-Circuit Emulator for dsPIC30F**
MPLAB® PRO MATE® II	Full Featured Device Programmer
MPLAB® PM3	Full Featured Device Programmer
MPLAB® VDI	Visual Device Initializer*

* Comes with no-cost MPLAB® IDE
** A low cost in-circuit emulator family is planned for the dsPIC33F

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
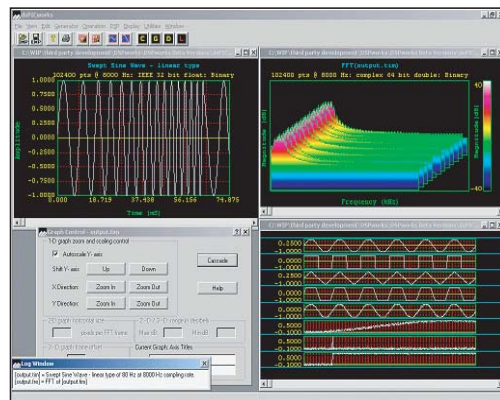
Digital Filter Design Tool

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® C30 C Compiler	√	√
MATLAB® Support	√	—
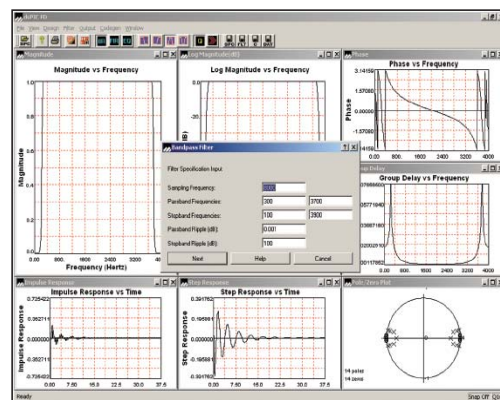
Jump-start Your Design with Proven and Optimized Building Block Libraries

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. Key functions in the Math Library:

· sin, cos, tan
· asin, acos, atan
· ln, log10, sqrt, power
· ceil, floor, mod, frexp

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 addressed in the DSP Algorithm Library:

· Cascaded IIR filters
· FIR filters and LMS filters
· Correlation, convolution
· FFT and window functions
· Matrix and vector operations

Peripheral Driver Library

This library of over 270 C utility functions helps you set up and operate the hardware peripheral modules in various modes. Functions covered in the Peripheral Driver Library:

· 10-bit and 12-bit A/D converters
· UART, SPI™, I²C™ and codec interface
· Motor Control PWM and QEI
· General purpose timers
· Input capture and output compare

World Class Software Development Tools

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.

The MPLAB LINK30 and MPLAB LIB30 are Linker and Librarian modules that allow efficient linking, library creation and maintenance.

Industry Leading C Code Efficiency

The dsPIC DSC was designed with a robust, full-featured instruction set optimized for C compiler efficiency from the start. Coupled with Microchip's highly optimized MPLAB C30 C Compiler, this combination produces results that fit into a smaller sized on-chip Flash memory.

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, such as timers, I/O, interrupts, UART and A/D modules. MPLAB SIM has powerful stimulus capabilities and file I/O. It is ideal for algorithm development.

MPLAB C30 C Compiler

The MPLAB C30 C Compiler is a full-featured, ANSI compliant optimizing compiler. The MPLAB C30 C Compiler includes a complete ANSI C standard library, including string manipulation, dynamic memory allocation, data conversion, timekeeping and math libraries.

The MPLAB C30 C Compiler has a powerful code optimizer; other 16-bit MCUs generate as much as 165 percent larger code for the same application.

Relative Code Size (in Bytes)

16-bit Applications (~ 40 KB code)

100%	113%	114%	152%	153%	153%	157%

Microchip MPLAB® C30 V 1.30 | A | B | C | D | E | F
(Leading Competitors)

32-bit Applications (~ 50 KB code)

100%	114%	129%	136%	156%	180%	188%

Microchip MPLAB® C30 V 1.30 | A | E | B | C | D | F
(Leading Competitors)

Download a full-featured, time-restricted demonstration version of the MPLAB C30 C Compiler from the Microchip web site for your evaluation.
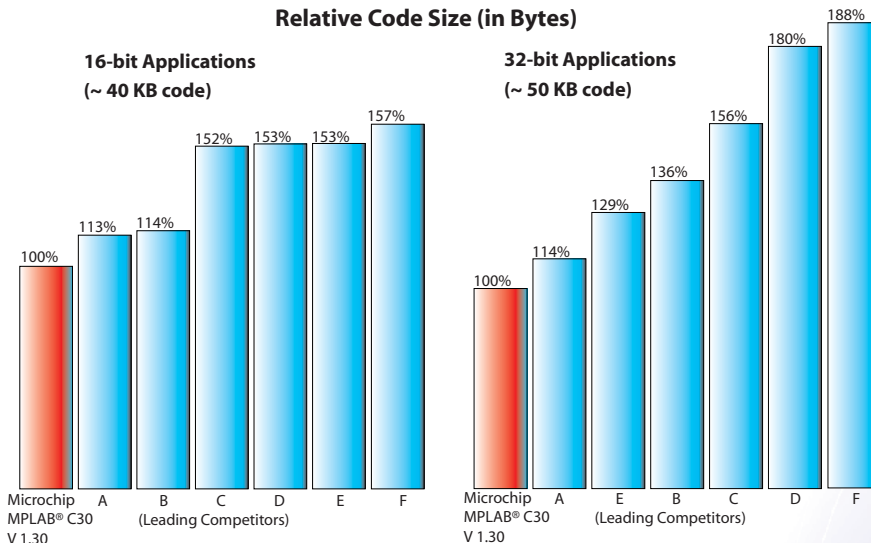
MPLAB VDI (Visual Device Initializer)

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

The MPLAB VDI does extensive error checking on assignments and conflicts on pins, memories and interrupts, as well as a selection of operating conditions. The generated code files are effortlessly integrated with the rest of your application code through the MPLAB project manager.

The detailed reports on resource assignment and configuration simplify project documentation. Key features of the MPLAB VDI:

· Drag-and-drop feature selection
· One click configuration
· Extensive error checking
· Generates initialization code
· Integrates effortlessly in MPLAB project manager
· Printed reports ease project documentation requirements

# Libraries for Speech Applications

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.

dsPICDEM™ 1.1
Running NS Library

Noise and Speech

Speech
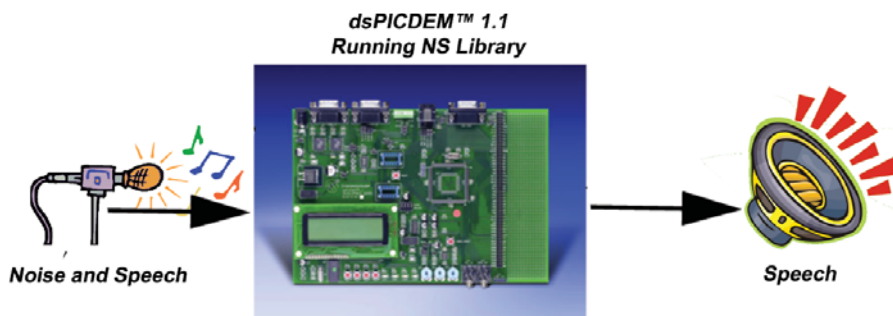
Acoustic Echo Cancellation Library

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.
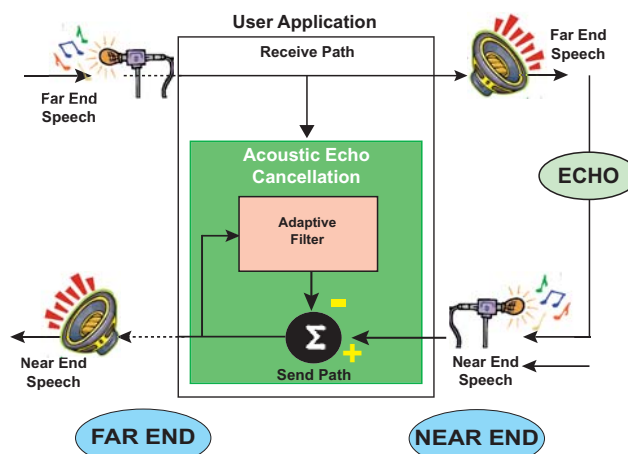
Line Echo Cancellation Library

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 Encoding/Decoding Library

This application library performs speech compression and decompression and is based on a modified open-source Speex technology. The library features a 16:1 compression ratio and an 8 kbps data rate, making the library a good choice for digital voice communication, store-and-playback and playback-only applications. For playback-only applications, a PC software utility is included, allowing the designer to create encoded speech files for playback.

Speech Encoding/Decoding Library features:
- 8 kHz input sample rate; 8 kbps output data rate
- Sorting encoded speech requires 4 Kbytes
- Optional voice activity detection
- External Flash support for playing back large speech files
- Royalty-free, one time license fee

Speech Recognition

Automatic Speech Recognition (ASR) for our digital signal controllers 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

TCP/IP Protocol Stack

MicroNet™ TCP/IP Stack by CMX

MicroNet TCP/IP Stack by CMX is specifically designed for optimized use of Flash and RAM resources on the dsPIC DSC. The software runs directly on the processor with no gateways or PCs required. The stack can be run in stand alone mode or work in conjunction with an RTOS. Using only industry standard protocols, CMX-MicroNet offers true TCP/IP networking via direct, dial-up or Ethernet connectivity and wireless Ethernet (802.11b) as well. This library can be readily implemented on the dsPICDEM.net™ Connectivity Board. This stack supports Point-to-Point Protocol, E-mail support and modem control, which are not currently supported on the free Microchip stack

Microchip Free TCP/IP Stack

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 optimized for size and is designed to run on the dsPIC DSC. While this particular implementation is specifically targeted to run on the dsPICDEM.net Connectivity Development Board, it can be retargeted to any hardware equipped with a dsPIC DSC. HTML web pages generated by the digital signal controller can be viewed with a standard web browser such as Microsoft® Internet Explorer.

Microchip Free ZigBee™ Stack

The ZigBee software stack is available for PIC18, PIC24 and dsPIC30F, dsPIC33F devices. This stack supports Reduced Function Device (RFD), Full Function Device (FFD) and Coordinator functionality. The stack is available form Microchip under a no cost license agreement and may be downloaded from Microchip's web site at www.microchip.com/ZigBee.

Soft Modem Libraries

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.32/V.22/V22bis Soft Modem Library by VOCAL Technologies, LTD

The Soft Modem Library is a collection of data modulations and protocols (V.32, V.22, V.22bis, V.23, V.21, Bell 103, Bell 212A and Bell 202). This library is provided with archives that contain object code modules, which link to your application. The data modulation is coded in C with inline assembly language optimization for speed and code size. 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 Board.

MicroNet™ TCP/IP Stack by CMX
- RFC compliant protocol stack
- Supports CMX RTOS
- Ethernet NIC driver
- Small Flash/RAM footprint
- Source code provided

Microchip Free TCP/IP Stack
- Out-of-box support for MPLAB C30 compilers
- Implements complete TCP state machine
- Modules provided: MAC, SLIP, ARP, IP, ICMP, TCP, SNMP, UDP, DHCP, FTP, IP Gleaning, HTTP, MPFS (Microchip File System)
- RTOS independent

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)

V.32/V.22/V.22bis by VOCAL Technologies, LTD
- VOCAL's proven solution on a dsPIC30F
- V.32 (9600 and 4800 bps, non-trellis encoding)
- V.22/V.22bis (2400, 1200 and 600 bps)
- V.42 (LAPM, error correction procedure)

More Application Libraries Ready to Use

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. These library functions can be easily called by your C or assembly code.

The algorithms included in these libraries have emerged as de facto standards for many large scale secure applications such as web access (SSL/TLS), E-mail (S-MIME), secure XML transactions and virtual private networks (IPsec). These algorithms are also recommended by Federal Information Processing Standards (FIPS) and the Internet Engineering Task Force (IETF).

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)

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 appilcation notes.

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).

Introduction to ACIM Control

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

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).

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).

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).

$5 Evaluation License for Evaluation and Development

A common issue with software libraries is that in order to evaluate the complete library, you must enter into a complex and expensive license arrangement. Any Microchip dsPIC DSC library can be licensed for $5.00 for evaluation and development purposes. These libraries are complete and unchanged from the production libraries, not reduced function evaluation versions. Evaluation licenses are available from the Microchip web site (http://buy.microchip.com). Licenses for production are based on a simple low cost one-time license fee. Production licenses are available from Microchip or from our authorized distributors.

Operating Systems and Communication Drivers

RTOS

If you need a Real-Time Operating System (RTOS) to handle multitasking, we have a three-tier solution for you.

- CMX-RTX™: full-featured fully preemptive multi-tasking OS
- CMX-Tiny+™: fully preemptive scaled-down version of the RTX OS
- CMX-Scheduler™: fully preemptive multi-tasking mini OS (FREE)

All three operating systems are fully preemptive and written in assembly language optimized for maximum performance. These RTOS products are developed by CMX and available from Microchip and CMX.

RTOS features:
- Small program memory footprints
- The fastest context switch times
- The lowest interrupt latency times
- True Preemption

OSEK and CAN Drivers

Vector Informatik GmbH provides automotive operating systems, sometimes labeled as an OSEK operating system. The Vector Informatik osCAN operating system, which is based on the OSEK/VDX® standard, provides a multitasking operating system with optimal features for use on MCUs. This product represents a small, sturdy operating system kernel.

The companion support for managing the CAN interface drivers on the dsPIC30F family of products is the CANbedded CAN driver suite from Vector Informatik. This product consists of a number of adaptive source code modules that cover the basic communication requirements in automotive applications.

Some of the CAN functions supported:
- Initialize CAN Module
- Set CAN Operational Mode
- Set CAN Baud Rate
- Set CAN Mask
- Set CAN Filter
- Send CAN Message
- Receive CAN Message
- Abort CAN Sequence
- Random Number Generator
- Provide Error Notification

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 on *www.microchip.com/ webseminars* and are updated frequently with the most current information on our products and services.

Workshop in a Box

Periodically Microchip or our sales channel partners offer a fee-based, instructor-led Workshop in a Box, a full day, hands-on training session. The registration fee includes a "box" containing a dsPIC DSC development board and related training material, that is yours to keep to help you further your development skills.

If you have interest in a dsPIC DSC Introductory Workshop in a Box or a dsPIC DSC Motor Control Workshop in a Box, please contact your sales representative. In-house workshops can be arranged to accommodate larger design teams.

Webinar Topic	Duration
Introduction to the dsPIC® Digital Signal Controller	20 min
Introduction to Microchip's Development Tools	25 min
Introduction to dsPIC30F Architecture - Part 1	20 min
Introduction to dsPIC30F Architecture - Part 2	20 min
Introduction to MPLAB® IDE Integrated Development Environment	25 min
Basic dsPIC30F Development Tools	25 min
dsPIC30F Addressing Modes - Part 1	20 min
dsPIC30F Addressing Modes - Part 2	20 min
Introduction to dsPIC30F DSP Engine and ALU	30 min
Introduction to dsPIC30F Interrupts	25 min
dsPIC30F 12-bit ADC Module - Part 1	20 min
dsPIC30F 12-bit ADC Module - Part 2	20 min
dsPIC30F 10-bit ADC Module - Part 1	20 min
dsPIC30F 10-bit ADC Module - Part 2	20 min
Introduction to the MPLAB® VDI Visual Device Initializer	30 min
Serial Communications using the dsPIC30F - Part 1 (UART)	20 min
Serial Communications using the dsPIC30F - Part 2 (SPI™)	20 min
Serial Communications using the dsPIC30F - Part 3 (I²C™)	30 min
Serial Communications using the dsPIC30F - Part 4 (CAN)	30 min
General Purpose Timers	20 min
dsPIC30F Motor Control Peripherals - Part 1 (MCPWM)	20 min
dsPIC30F Motor Control Peripherals - Part 2 (QEI)	20 min

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

Hardware Development Tools

MPLAB ICD 2
In-Circuit Debugger

The MPLAB ICD 2 In-Circuit Debugger 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 of the MPLAB ICD 2:

· Full speed dsPIC DSC operation
· USB or serial port connection to PC
· Supports full dsPIC DSC supply voltage range
· Can be used as an inexpensive programmer
· Smart watch variable windows
· Advanced breakpoint features

MPLAB PM3
Device Programmer

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 In-Circuit Serial Programming™ (ICSP™).

The dsPIC DSC family is supported on the PM3 and PRO MATE II Device Programmer with appropriate socket modules.

MPLAB ICE 4000
In-Circuit Emulator for the dsPIC30F*

The powerful, full-featured real-time MPLAB ICE 4000 In-Circuit Emulator for the dsPIC30F is capable of debugging the most demanding real-time systems. Key features of the MPLAB ICE 4000 In-Circuit Emulator:

· Full-speed, real-time emulation
· Supports full dsPIC30F supply voltage range
· 64K deep by 216-bit wide trace memory
· Unlimited breakpoints
· Complex break, trace and trigger logic
· Multi-level trigger up to four levels
· 48-bit time stamp
· USB connection to PC
· Stopwatch

* A low cost in-circuit emulator family is planned for the dsPIC33F
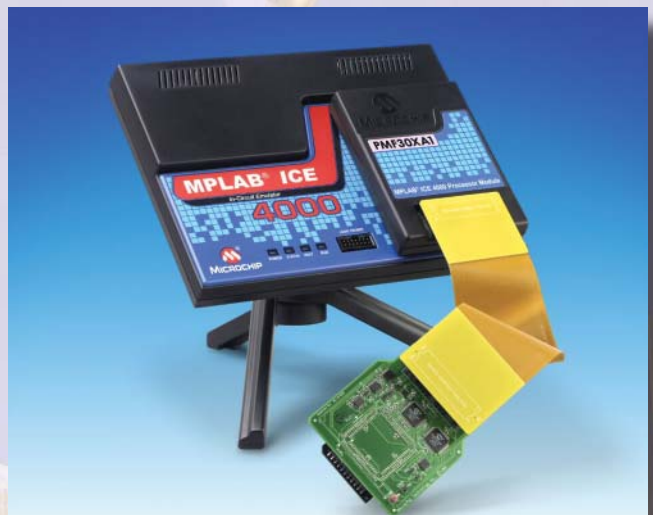
# Hardware Development Boards: Jump-start Your Design

A variety of hardware development boards are available for the dsPIC DSC, enabling you to shorten your design cycle. These boards are designed to allow easy connection to an MPLAB ICD 2, MPLAB ICE 4000 or MPLAB PM3. All development boards include documentation and example source code to accelerate your design.

dsPICDEM™ 80-Pin Starter Development Board

This development board offers a very economical way to evaluate the 80-pin dsPIC30F General Purpose and Motor Control Famiies 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)
· Accommodates the 100- to 80-pin dsPIC33F General Purpose plug-in module (MA330012)
· Power input from 9V supply
· LEDs, switches, potentiometer, UART interface
· A/D 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


DM300019
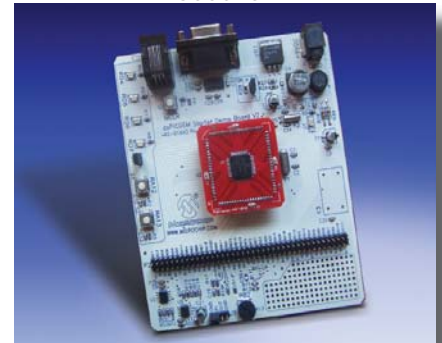
dsPICDEM 28-Pin Starter Development Board

This development board provides an economical solution to get started with the 28-pin dsPIC30F devices, including Motor Control, Sensor and Power Conversion families. Key features:

· Includes a 28-pin dsPIC30F2010 device
· Power input from 9V power supply
· UART interface
· Header for access to all device I/O pins
· Circuit prototyping area
· Assembly language demonstration program and tutorial
· Accommodates all dsPIC30F 28-pin DIP or SOIC devices

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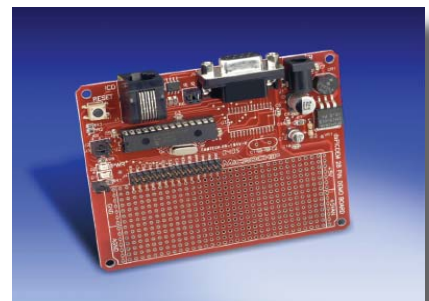
dsPICDEM 2 Development Board

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
· Example source code and a User Guide is provided to jump-start application development for all 11 devices


DM300018

Explorer 16 Development Board

This development board offers a very economical way to evaluate both the dsPIC33F General Purpose and Motor Control Family devices as well as the PIC24 microcontrollers. This board is an ideal prototyping tool to help you quickly develop and validate key design requirements. Key features:

· Supports the dsPIC33FJ256GP710 and the PIC24FJ128GA010
· Modular design for plug-in demonstration boards, expansion header
· Terminal interface program and menu programs
· Includes 100-pin dsPIC33F General Purpose (MA330011) and 100-pin PIC24 (MA240011) plug-in modules

DM240001

20
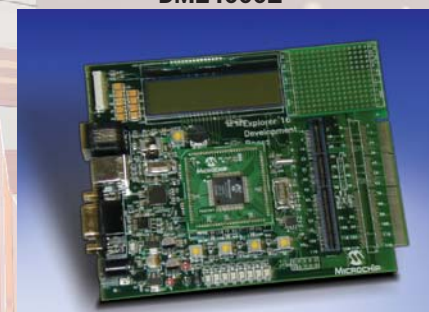
Advanced Development Boards: Complex Designs Made Simple

A variety of hardware development boards are available for the dsPIC DSC, enabling you to shorten your design cycle. These boards are designed to allow easy connection to an MPLAB ICD 2, MPLAB ICE 4000 or MPLAB PM3. All development boards include documentation and example source code to accelerate your design.

dsPICDEM 1.1 General Purpose Development Board

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.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)
- 10-Base T Ethernet MAC and PHY interface
- 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

Motor Control Development System

The Motor Control Development System provides quick prototyping and validation of BLDC, ACIM, PMSM, SR and UPS applications. The system consists of the dsPICDEM MC1 Motor Control Development Board and one of two optional 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:

DM300021/22

DM300020

- Heat sink for ambient cooling of power sections
- Full automatic protection of power circuits
- Electrical isolation from power circuits
- Many options for motor feedback signals

Note: Power module shown with dsPICDEM MC1 Development Board DM300020

Includes a dsPIC30F6010 plug-in module (MA300013)

PICDEM™ MC LV Motor Control Development Board

DM183021

This development board provides a cost-effective method of evaluating and developing sensored or sensorless Brushless DC (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
- Also supports 28-pin PIC18 MCUs; specifically the PIC18F2431
- Power supply and motor are available (optional) for out-of-the-box experience

Software Development Tools

Development Tool	Product Name	Description	Part#	Available From	List Price [1]
Software	MPLAB® IDE	Integrated Development Environment	SW007002	Microchip	Free
	MPLAB® ASM30	Assembler (included in MPLAB® IDE)	SW007002	Microchip	Free
	MPLAB® SIM	Software Simulator (included in MPLAB® IDE)	SW007002	Microchip	Free
	MPLAB® VDI	Visual Device Initializer (included in MPLAB® IDE)	SW007002	Microchip	Free
C Compilers	MPLAB® C30	ANSI C Compiler, Assembler, Linker and Librarian	SW006012	Microchip	$895
	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	IAR	Contact Vendor
	dsPICC	ANSI C compiler	dsPICC	HI-TECH	$950

Hardware Development Tools

Development Tool	Description	Part#	Available From	List Price [1]
MPLAB® ICD 2	In-Circuit Debugger and Device Programmer	DV164005	Microchip	$159.99
	In-Circuit Debugger and Device Programmer with dsPICDEM™ 1.1 General Purpose Board	DV164032	Microchip	$399.99
MPLAB® ICE 4000	In-Circuit Emulator Pod for dsPIC30F	ICE4000	Microchip	$2560
	Processor Module for dsPIC30F	PMF30XA1	Microchip	$595
	Device Adapter for 80L/64L TQFP Devices	DAF30-2	Microchip	$295
	Device Adapter for 44L TQFP Devices	DAF30-3	Microchip	$225
	Device Adapter for 44L/40L/28L/18L DIP and SOIC Devices (ML and MM)	DAF30-4	Microchip	$225
	Transition Socket for 18L SOIC	XLT18SO	Microchip	$75
	Transition Socket for 18L DIP	ACICE0202	Microchip	$20
	Transition Socket for 28L SOIC	XLT28SO	Microchip	$75
	Transition Socket for 28L DIP	ACICE0204	Microchip	$30
	Transition Socket for 28L ML/MM	XLT28QFN3 or XLT28QFN4	Microchip	$175
	Transition Socket for 40L DIP	ACICE0206	Microchip	$40
	Transition Socket for 44L ML	XLT44QFN2	Microchip	$175
	Transition Socket for 44L TQFP	XLT44PT or XLT44PT3	Microchip	$125
	Transition Socket for 64L TQFP (PF Package)	XLT64PT3 or XLT64PT4	Microchip	$125
	Transition Socket for 64L TQFP (PT Package)	XLT64PT2 or XLT64PT5	Microchip	$125
	Transition Socket for 80L TQFP (PF Package)	XLT80PT2	Microchip	$125
	Transition Socket for 80L TQFP (PT Package)	XLT80PT or XLT80PT3	Microchip	$125
MPLAB® PRO MATE® II	Socket Module for 18L DIP/SOIC Devices	AC30F005	Microchip	$189
	Socket Module for 28L DIP/SOIC Devices	AC30F004	Microchip	$189
	Socket Module for 40L DIP Devices	AC30F003	Microchip	$159
	Socket Module for 44L TQFP Devices	AC30F006	Microchip	$159
	Socket Module for 64L TQFP Devices (PF Package)	AC30F002	Microchip	$159
	Socket Module for 64L TQFP Devices (PT Package)	AC30F008	Microchip	$159
	Socket Module for 80L TQFP Devices (PF Package)	AC30F001	Microchip	$159
	Socket Module for 80L TQFP Devices (PT Package)	AC30F007	Microchip	$159
MPLAB® PM3	Full Featured Device Programmer, Base Unit	DV007004	Microchip	$895
	Socket Module for 18L/28L/40L DIP Devices	AC164301	Microchip	$189
	Socket Module for 16L (.150)/28L (.300) SOIC Devices	AC164302	Microchip	$189
	Socket Module for 28L ML Devices	AC164322	Microchip	$189
	Socket Module for 44L ML Devices	AC164322	Microchip	$189
	Socket Module for 44L TQFP Devices	AC164305	Microchip	$189
	Socket Module for 64L TQFP Devices (PF Package)	AC164313	Microchip	$189
	Socket Module for 64L TQFP Devices (PT Package)	AC164319	Microchip	$189
	Socket Module for 80L TQFP Devices (PF Package)	AC164314	Microchip	$189
	Socket Module for 80L TQFP Devices (PT Package)	AC164320	Microchip	$189

Development Boards and Reference Designs

Development Tool	Description	Part#	Available From	List Price [1]
General Purpose Development Board	dsPICDEM™ 1.1 Development Board for 80L TQFP devices	DM300014	Microchip	$299.99
Starter Development Boards	dsPICDEM™ 80-pin Starter Development Board	DM300019	Microchip	$79.99
	dsPICDEM™ 28-pin Starter Development Board	DM300017	Microchip	$79.99
	dsPICDEM™ 2 Development Board	DM300018	Microchip	$99.99
	Explorer 16 Development Board	DM240001	Microchip	$129.99
Motor Control Development Boards	PICDEM™ MC LV Development Board	DM183021	Microchip	$129.99
	dsPICDEM™ MC1 Motor Control Development Board	DM300020	Microchip	$300
	dsPICDEM™ MC1H 3-Phase High Voltage Power Module	DM300021	Microchip	$800
	3-Phase ACIM High Voltage Motor (208/460V)	AC300021	Microchip	$120
	dsPICDEM™ MC1L 3-Phase Low Voltage Power Module	DM300022	Microchip	$700
	3-Phase BLDC Low Voltage Motor (24V)	AC300020	Microchip	$120
Connectivity Development Boards	dsPICDEM.net™ 1 with FCC/JATE-compliant and Ethernet NIC support	DM300004-1	Microchip	$389.99
	dsPICDEM.net™ 2 with CTR-21-compliant and Ethernet NIC support	DM300004-2	Microchip	$389.99

Plug-in Modules for Development Boards

A Plug-in Module (PIM) is a daughter board with a dsPIC DSC soldered on top and header socket strips on the bottom. The PIMs use the device header pins, on the dsPIC DSC development boards, which also support the MPLAB ICE 4000 emulator device adapters. This method allows for easy swapping of devices onto the various development boards, without having to unsolder and resolder parts.

Development Tool	Description	Part#	Available From	List Price [1]
Plug-in Modules	PC board with 80-pin dsPIC30F6014 general purpose DSC sample; use with DM300004-1, DM300004-2 Development Boards	MA300011	Microchip	$25
	PC board with 80-pin dsPIC30F6010 motor control DSC sample; use with DM300019 and DM300020 Development Boards	MA300013	Microchip	$25
	PC board with 80-pin dsPIC30F6014A general purpose DSC sample; use with DM300014 and DM300019 Development Boards	MA300014	Microchip	$25
	PC Board with 100-pin dsPIC33FJ256GP710 DSC sample; use with DM240001 Development Board	MA330011	Microchip	$25
	PC Board with 100-pin dsPIC33FJ256GP710 DSC sample; use with DM300019 Development Board	MA330012	Microchip	$25

(1) List price may change without notice.

Software Libraries and Application Development Tools

Development Tool	Description	Part#	Available From	List Price[1]
dsPIC30F Math Library	Standard math and floating point library (ASM, C Wrapper)	SW300020	Microchip	Free
dsPIC30F Peripheral Library	Peripheral initialization, control and utility routines (C)	SW300021	Microchip	Free
dsPIC30F DSP Library	Essential DSP algorithm suite (Filters, FFT)	SW300022	Microchip	Free
dsPICworks™	Data analysis and DSP software	SW300023	Microchip	Free
Digital Filter Design	Full featured graphical IIR and FIR filter design package for dsPIC30F	SW300001	Microchip	$249
Digital Filter Design Lite	Graphical IIR and FIR filter design package for dsPIC30F	SW300001-LT	Microchip	$29
CMX-Tiny+™ for dsPIC® DSC	Preemptive Real-time Operating System (RTOS) for dsPIC30F (from CMX)	CMX-Tiny+ for dsPIC30F	CMX	$3000
	Preemptive Real-time Operating System (RTOS) for dsPIC30F	SW300032	Microchip	$3000
CMX-RTX™ for dsPIC® DSC	Fully preemptive Real-time Operating System (RTOS) for dsPIC30F (from CMX)	CMX-RTX for dsPIC30F	CMX	$4000
	Fully preemptive Real-time Operating System (RTOS) for dsPIC30F	SW300031	Microchip	$4000
CMX Scheduler™	Multi-tasking, preemptive scheduler for dsPIC30F	SW300030	CMX	Free
Symmetric Key Embedded Encryption Library	Security encryption software support for AES, triple-DES, SHA-1, RNG and MD5	SW300050 - 5K*	Microchip	$2500
	Evaluation copy of security encryption software support for AES, triple-DES, SHA-1, RNG and MD5	SW300050-EVAL	Microchip	$5
Asymmetric Key Embedded Encryption Library	Security encryption software support for RSA, DSA, Diffie-Hellman, SHA-1, RNG and MD5	SW300055 - 5K*	Microchip	$2500
	Evaluation copy of security encryption software support for RSA, DSA, Diffie-Hellman, SHA-1, RNG and MD5	SW300055-EVAL	Microchip	$5
Noise Suppression Library	Function to suppress noise interference in speech signals	SW300040 - 5K*	Microchip	$2500
	Evaluation copy of function to suppress noise interference in speech signals	SW300040-EVAL	Microchip	$5
Acoustic Echo Cancellation Library	Function to eliminate echo generated from a speaker to a microphone	SW300060 - 5K*	Microchip	$2500
	Evaluation copy of function to eliminate echo generated from a speaker to a microphone	SW300060-EVAL	Microchip	$5
Acoustic Accessory Kit	Accessory Kit (includes: audio cable, headset, oscillators, microphone, speaker, DB9 M/F RS-232 cable, DB9M-DB9M Null Modem Adapter)	AC300030	Microchip	$87.50
Line Echo Cancellation Library	Function to cancel electrical line echoes caused by 2- or 4-wire conversion hybrids	SW300080-5K	Microchip	$2500
	Function to cancel electrical line echoes caused by 2- or 4-wire conversion hybrids	SW300080-EVAL	Microchip	$5
ZigBee™ Software Stack	Supports RFD, FFD and coordinator functionality	SW300025	Microchip	Contct Microchip
TCP/IP Library	TCP/IP connectivity and protocol support	CMX-MicroNet for dsPIC30F	CMX	Contact Vendor
	TCP/IP connectivity and protocol support	SW300024	Microchip	Free
Soft Modem Library	V.22bis/V.22 Soft Modem Library	SW300002	Microchip	Free
	V.32bis Soft Modem Library	SW300003*	Microchip	$2500
	Evaluation copy of V.32bis Soft Modem Library	SW300003-EVAL	Microchip	$5
	V.32 (non-trellis) Soft Modem Library		VOCAL Technologies, LTD	Contact Vendor
Speech Recognition System	Automatic speech recognition system including a PC-based speech training sub-system and a speech recognizer software library	SW300010 - 5K*	Microchip	$2500
	Evaluation copy of automatic speech recognition system including a PC-based speech training sub-system and a speech recognizer software library	SW300010-EVAL	Microchip	$5
Speech Encoding/Decoding Library	Speech library to preform speech compression and decompression	SW300070 - 5K*	Microchip	$2500
	Evaluation copy of speech library to preform speech compression and decompression	SW300070-EVAL	Microchip	$5
CANbedded for dsPIC® DSC	CAN driver library for dsPIC30F		Vector Informatik	Contact Vendor
osCAN for dsPIC® DSC	OSEK/VDX v2.2		Vector Informatik	Contact Vendor

(1) List price may change without notice; * To license for production quantities greater than 5000 pieces for a project's lifetime—contact Microchip.

Documentation[2]

Document Type	Document Title	Document Number
Overview Documents	dsPIC30F High Performance 16-bit Digital Signal Controller Family Overview	DS70043
	dsPIC33F High Performance 16-bit Digital Signal Controller Family Overview	DS70155
Data Sheets	dsPIC30F2010 Data Sheet	DS70118
	dsPIC30F2011, dsPIC30F2012, dsPIC30F3012, dsPIC30F3013 Data Sheet	DS70139
	dsPIC30F3010, dsPIC30F3011 Data Sheet	DS70141
	dsPIC30F3014, dsPIC30F4013 Data Sheet	DS70138
	dsPIC30F4011, dsPIC30F4012 Data Sheet	DS70135
	dsPIC30F5011, dsPIC30F5013 Data Sheet	DS70116
	dsPIC30F5015, dsPIC30F5016 Data Sheet	DS70149
	dsPIC30F6010 Data Sheet	DS70119
	dsPIC30F6011, dsPIC30F6012, dsPIC30F6013, dsPIC30F6014 Data Sheet	DS70117
	dsPIC30F6011A, dsPIC30F6012A, dsPIC30F6013A, dsPIC30F6014A Data Sheet	DS70143
	dsPIC30F6010A, dsPIC30F6015 Data Sheet	DS70150
Reference Manuals	dsPIC30F Programmer's Reference Manual	DS70030
	dsPIC30F/33F Programmer's Reference Manual	DS70157
	dsPIC30F Family Reference Manual	DS70046
Application Notes	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 dsPIC30F2010	DS00992

(2) Note that all the latest revisions of these documents are always available from the Microchip web site.

Third Party Contact Information

Company	Phone	E-mail	Web Site
CMX Systems, Inc.	+1 904 880 1840	cmx@cmx.com	www.cmx.com
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
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Italy	39-0331-742611
Netherlands	31-416-690399
United Kingdom	44-118-921-5869

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China - Chengdu	86-28-8676-6200
China - Fuzhou	86-591-8750-3506
China - Hong Kong	852-2401-1200
China - Shanghai	86-21-5407-5533
China - Shenyang	86-24-2334-2829
China - Shenzhen	86-755-8203-2660
China - Shunde	86-757-2839-5507
China - Qingdao	86-532-502-7355
China - Xian	86-29-8833-7250
China - Wuhan	86-27-5980-5300
India - Bangalore	91-80-2229-0061
India - New Delhi	91-11-5160-8631
India - Pune	91-20-2566-1512
Japan - Yokohama	81-45-471- 6166
Korea - Seoul	82-2-554-7200
Malaysia - Penang	604-646-8870
Philippines - Manila	011-632-634-9065
Singapore	65-6334-8870
Taiwan - Kaohsiung	886-7-536-4818
Taiwan - Taipei	886-2-2500-6610
Taiwan - Hsinchu	886-3-572-9526
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