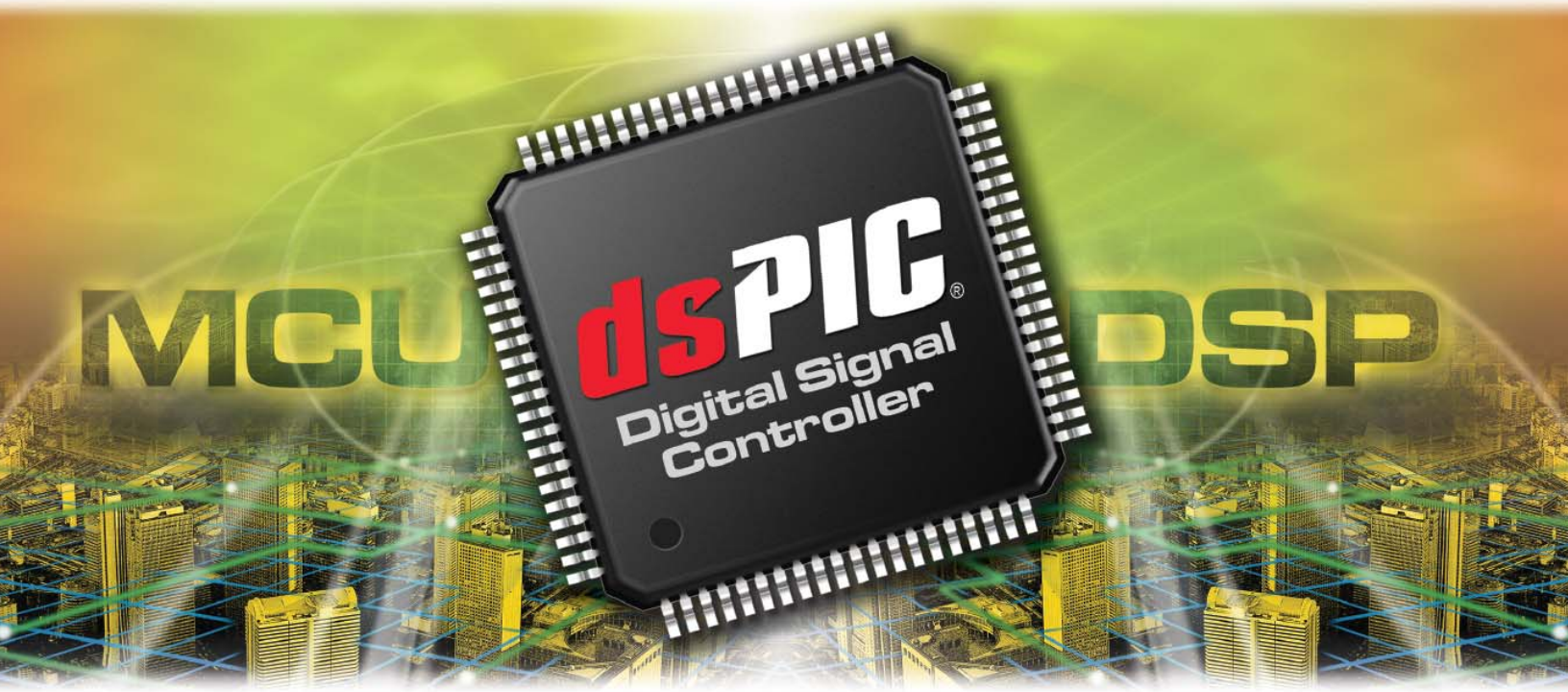
MICROCHIP

Tools and Solutions for the dsPIC30F Designer

A comprehensive overview of libraries, boards and software development tools for the dsPIC30F product family



Microchip's Whole Product Solution

It has always been Microchip's goal to provide great silicon solutions to our customers. However, silicon is only part of the story. Support tools, such as programmers, compilers, reference designs, libraries, application notes, evaluation boards and the like are required to make your evaluation and product development process as efficient as possible. Microchip considers a product released when the silicon plus its appropriate support tools are ready for production. This document describes Microchip's rapidly evolving solutions to support the ongoing enhancements to the dsPIC® Digital Signal Controller (DSC), including:

Development Tools:

- MPLAB® IDE Integrated Development Environment
- MPLAB Assembler, Linker, Librarian, Simulator
- MPLAB C30 C Compiler
- MPLAB Visual Device Initializer
- MPLAB ICD 2 In-Circuit Debugger and MPLAB ICE 4000 In-Ciruit Emulator tools
- Software libraries and more

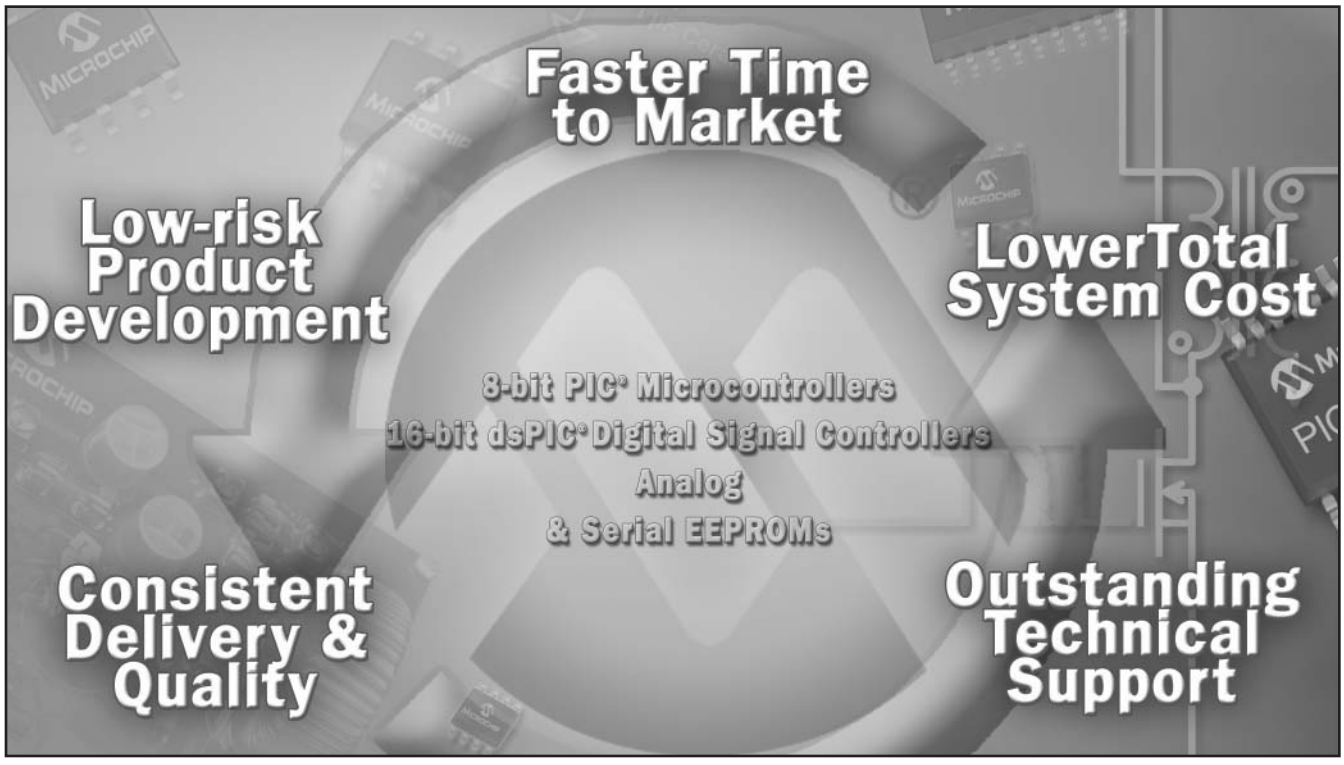
Reference Designs and Development Boards:

- Development boards
- Reference designs supported by application notes and web based materials
- Application development designs

Design Materials and Training:

- Data sheets and reference manuals are available in print, online or on CD
- Training support including regional seminars, MASTERs, web seminars, Getting Started Guides and more

For more information on the whole product solution available today for the dsPIC DSCs and the most current documentation, please refer to the Microchip web site at **www.microchip.com** under the product category dsPIC DSC.



Tools and Solutions for the dsPIC® Digital Signal Controller (DSC) Designer

Topic			Page
Microchip's Whole Product Solution			2
	Product Overview	*Microchip Part Number*	
Development Boards	dsPICDEM™ 80-Pin Starter Development Board	DM300019	4
	dsPICDEM 28-Pin Starter Development Board	DM300017	5
	dsPICDEM 1.1 General Purpose Development Board	DM300014	6
	dsPICDEM 2 Development Board	DM300018	7
	dsPICDEM.net™ 1 and dsPICDEM.net 2 Development Boards	DM300004-1/2	8
	dsPICDEM MC1 Motor Control Development System	DM300020/21/22	9
	PICDEM™ MC LV Development Board	DM183021	10
Software Libraries	dsPIC30F Soft Modem Library	SW300002/3/3-EVAL	11
	dsPIC30F Speech Recognition Library	SW300010/EVAL	12
	dsPIC30F Noise Suppression Library	SW300040/EVAL	13
	dsPIC30F Acoustic Echo Cancellation Library	SW300060/EVAL	14
	dsPIC30F Symmetric Key Embedded Encryption Library	SW300050/EVAL	15
	dsPIC30F Asymmetric Key Embedded Encryption Library	SW300055/EVAL	16
	dsPIC30F Speech Encoding/Decoding Library	SW300070/EVAL	17
	dsPIC30F Math Library	SW300020	18
	dsPIC30F DSP Library	SW300022	19
	dsPIC30F Peripheral Library	SW300021	20
Application Development Tools	dsPICworks™ Data Analysis and DSP Software	SW300023	21
	Digital Filter Design/Digital Filter Design Lite	SW300001/LT	22
	RTOS/CMX RTX for dsPIC30F	SW300031	23
	RTOS/CMX Tiny+ for dsPIC30F	SW300032	24
	RTOS/CMX Scheduler for dsPIC30F	SW300030	25
	TCP/IP-CMX MicroNet for dsPIC30F	Contact CMX	26
Application Solutions	Sensorless BLDC Motor Control Using dsPIC30F	AN901	27
	Using the dsPIC30F for Vector Control of an AC Induction Motor	AN908	28
	Sensored BLDC Motor Control Using dsPIC30F2010	AN957	29
	An Introduction to AC Induction Motor Control Using the dsPIC30F	AN984	30
	Using the dsPIC30F for Sensorless BLDC Motor Control	AN992	31
Software Development Tools	MPLAB® Visual Device Initializer (Included in MPLAB® IDE)	SW007002	32
	MPLAB C30 C Compiler	SW006012	33
Solutions and Tools Selectors Guide with pricing information			34-35

dsPICDEM™
80-Pin Starter Development Board

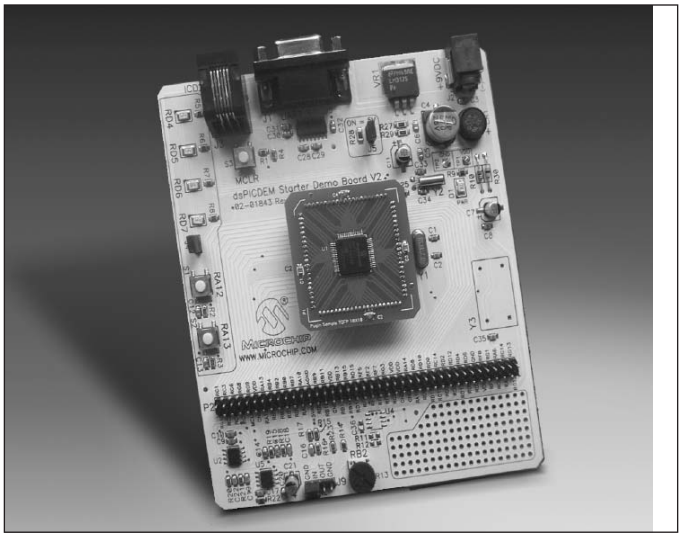
Summary

This development board offers a very economical way to evaluate both the dsPIC30F and dsPIC33F General Purpose and Motor Control Family devices. This board is an ideal prototyping tool to help you quickly develop and validate key design requirements.

Features

Key features of the dsPICDEM 80-Pin Starter Development Board include:

- Includes an 80-pin dsPIC30F6014 plug-in module (MA300011)
- Power input from 9V supply
- Selectable voltage regulator outputs of 5V and 3.3V
- 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
- Can accommodate 80-pin dsPIC30F6010 plug-in module (MA300013) — sold separately
- Can accommodate 100 to 80-pin adapter dsPIC33F plug-in module (MA330011) — sold separately (uses 3.3V V_{DD} solution)



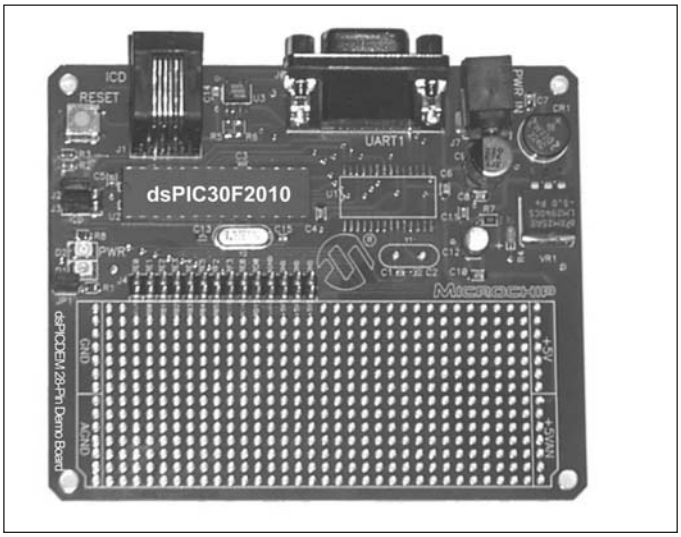
Package Contents

- dsPICDEM 80-Pin Starter Development Board
- Documentation on CD

dsPICDEM™
28-Pin Starter Development Board

Summary

The low-cost dsPICDEM 28-Pin Starter Devemolpment Board allows the user to easily validate a development tool setup using a 28-pin SDIP or SOIC dsPIC30F device. The development board has a socketed dsPIC30F2010 digital signal controller, power supply regulator, crystal oscillator, ICD header, serial port, power on indicator, Reset push-button, 28L SOIC layout pad and a prototyping area.



Features

Key features of the dsPICDEM 28-Pin Starter Development Board include:

- dsPIC30F2010 28-pin SDIP sample device and socket
- Power input from 9V supply
- Connector for MPLAB® ICD 2 In-Circuit Debugger
- RS-232 interface
- Header for access to all device I/O pins
- Layout pad for 28-pin SOIC device
- Prototyping area
- Power-on demo program demonstrating interrupts, device I/O and UART communication
- A tutorial program in assembly code showing the user how to set up a project in MPLAB IDE

Package Contents

- dsPICDEM 28-Pin Starter Development Board
- Documentation on CD

dsPICDEM™ 1.1
General Purpose Development Board

Summary

The dsPICDEM™ 1.1 General Purpose Development Board provides the application designer with a low cost development tool to become familiar with the dsPIC® Digital Signal Controller (DSC) 16-bit architecture, high performance peripherals and powerful instruction set.

The board features an active development program loaded on the installed dsPIC30F6014 device. Several program functions are selectable via a menu system displayed on the LCD. These include: temperature and voltage measurements, frequency domain characteristics of a sinewave signal generated on-board from a digital potentiometer, FIR and IIR digital filter selections and DTMF tone generation using the codec interface peripheral (external speaker required).

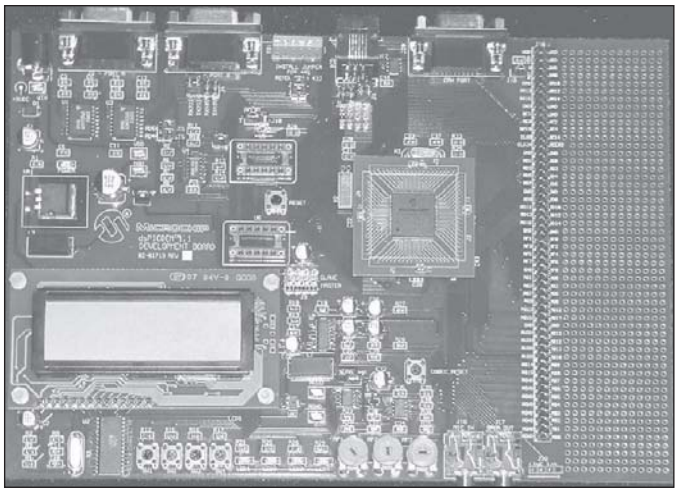
Also included is a simple tutorial written in assembly language. Users can create a project, assemble and link the code, program and/or debug the code using Microchip's MPLAB® IDE Integrated Development Environment - included free, and an MPLAB ICD 2 In-Circuit Debugger - available separately.

The development board serves as an ideal prototyping tool to quickly develop and validate design requirements.

Features

Key features of the dsPICDEM 1.1 General Purpose Development Board include:

- dsPIC30F6014 plug-in sample
- Serial communication channels interface (two UARTs, SPI™, CAN, RS-485)
- Si3000 voiceband codec with MIC In/speaker jacks
- General purpose prototyping area with expansion header
- 122 x 32 dot addressable LCD
- MPLAB® ICD 2 and MPLAB ICE 4000 emulator support
- LED's, switches and potentiometers
- Temperature sensor
- Separate digital and analog voltage regulators
- Digital potentiometer for DAC capability



Package Contents

- dsPICDEM 1.1 General Purporse Development Board with pre-programmed dsPIC30F6014 device
- RS-232 cable
- Power supply
- Example software and documentation on CD

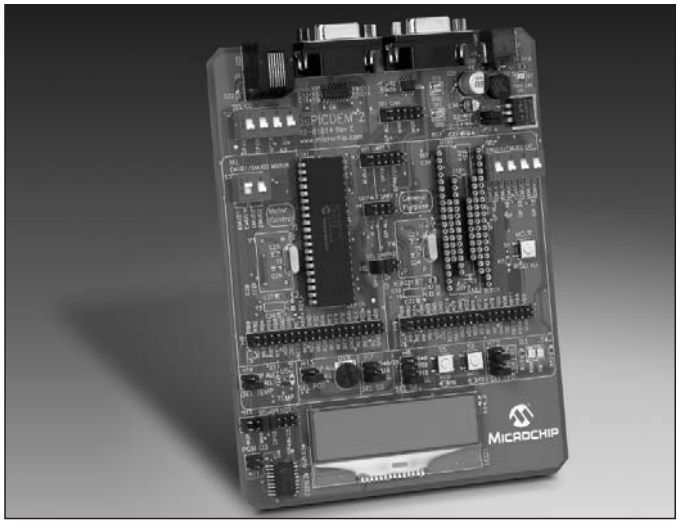
dsPICDEM™ 2 Development Board

Summary

The dsPICDEM 2 Development Board is a development and evaluation tool that helps create embedded applications using dsPIC® Digital Signal Controllers (DSCs). Sockets are provided for 28- and 40-pin devices in the dsPIC30F motor control family and 18-, 28- and 40-pin devices in the dsPIC30F general purpose and sensor family. The supported devices are shown in the table below.

The board includes a sample dsPIC30F4011 in the 40-pin motor control socket, a power supply regulator, crystal oscillators for each set of sockets, an ICD connector for the MPLAB® ICD 2 In-Circuit Debugger and both RS-232 and CAN ports for external communication. In addition, the board is populated with prototyping hardware, including LED indicators, push button switches, a potentiometer, a temperature sensor and a 2x16 LCD screen. All pins on all the device sockets are accessible through headers.

dsPIC30F Device	Supported Packages
Motor Control Family	
dsPIC30F2010	28-pin SPDIP
dsPIC30F3010	28-pin SPDIP
dsPIC30F4012	28-pin PDIP
dsPIC30F3011	40-pin PDIP
dsPIC30F4011	40-pin PDIP
Sensor Family	
dsPIC30F2011	18-pin PDIP
dsPIC30F3012	18-pin PDIP
dsPIC30F2011	28-pin SPDIP
dsPIC30F3013	28-pin SPDIP
General Purpose Family	
dsPIC30F3014	40-pin PDIP
dsPIC30F4013	40-pin PDIP



Features

Key features of the dsPICDEM 2 Development Kit include:

- Multiple sockets for 18-, 28- and 40-pin PDIP and SPDIP devices
- Sample application programs complete with MPLAB IDE workspace and project files provided for supported dsPIC30F devices
- A dsPIC30F4011 40-pin PDIP sample device installed on board
- 5V regulator provides VDD and AVDD from a 9V DC power supply
- MPLAB ICD 2 In-Circuit Debugger ready
  - Options for selecting alternate debugging channels
- MPLAB ICE 4000-ready
- RS-232 interface
- Controller Area Network (CAN) interface
- Temperature sensor and analog potentiometer to simulate A/D inputs
- 2 push button switches and 2 LED indicators to simulate digital input and output
- 2x16 ASCII Character LCD with SPI™ interface
- Access to all pins on the dsPIC30F device sockets via 2x40-pin headers
- CD with documentation and ample application programs
- A sample pack containing dsPIC30F3012 and dsPIC30F4013 devices

dsPICDEM.net™ 1 and dsPICDEM.net 2 Connectivity Development Boards

Summary

The dsPICDEM.net 1 and dsPICDEM.net 2 Connectivity Development Boards provide the application developer a basic platform for developing and evaluating both connectivity and non-connectivity based requirements.

The dsPICDEM.net board provides the hardware circuitry for supporting both the Public Switched Telephone Network (PSTN) and 10-Base T MAC/PHY interfaces.

- The PSTN interface hardware on the dsPICDEM.net 1 board is suited for FCC/JATE compliancy
- The PSTN interface hardware on the dsPICDEM.net 2 board is suited for CTR-21 compliancy

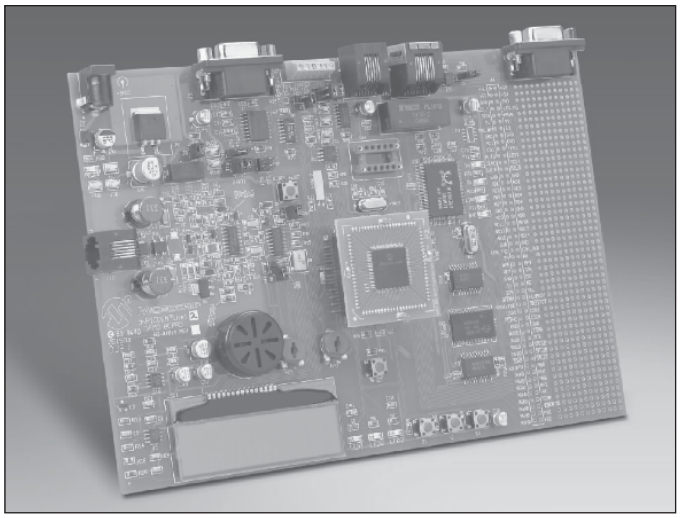
The board comes with an ITU-T compliant V.22bis/V.22 modem development module pre-programmed on the installed dsPIC30F6014 device. This demo provides full source code to connect and transfer data between the dsPIC® Digital Signal Controller (DSC) Soft Modem (dsPIC SM) and an ITU-T compliant reference modem. The modem can be configured for either the originate or answer mode of operation. Configuration and control of the dsPIC30F Soft Modem demo is supported with an optimized AT command set which is entered into a suitable communication program running on the PC, such as HyperTerminal, and communicated to the dsPIC DSC over a RS-232 serial channel.

Also included are the CMX-MicroNet web and FTP Server programs which demonstrate two TCP/IP protocol based applications over the 10-Base T Ethernet datalink layer.

Features

Key features of the dsPICDEM.net 1 and dsPICDEM.net 2 Connectivity Development Boards include:

- dsPIC30F6014 plug-in sample
- 10-Base T Ethernet MAC and PHY interface
- PSTN interface with DAA/AFE chipset
- Serial communication channels interface (UART and CAN)
- External I²C™ EEPROM memory for storing constants
- External 64K x 16 RAM memory
- General purpose prototyping Area with expansion header



Features (Continued)

- Dual channel digital potentiometer
- 2 x 16 LCD display
- MPLAB® ICD 2 and MPLAB ICE 4000 emulator Support
- LED's, switches and potentiometers
- Temperature sensor
- Full suite of development code
  - Getting Started tutorial
  - Full featured dsPICDEM.net board configuration and control demo
  - V.22bis Soft-Modem (full source code provided)
  - CMX-MicroNet Web Server
  - CMX-MicroNet FTP Server
- Comprehensive User's Guide describing development code

Package Contents

- dsPICDEM.net Connectivity Board with pre-programmed dsPIC30F6014
- RS-232 cable
- CAT 5 crossover cable
- Power supply
- Example software and documentation on CD

dsPICDEM™ MC1
Motor Control Development System

Summary

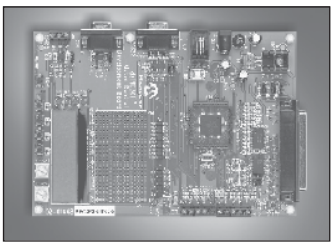
The dsPICDEM MC1 Motor Control Development System provides the application developer with three main components for quick prototyping and validation of BLDC, PMAC and ACIM applications. The three main components include: the dsPICDEM MC1 Motor Control Development Board, the dsPICDEM MC1L, 3-phase low voltage power module and the dsPICDEM MC1H, 3-phase high voltage power module.

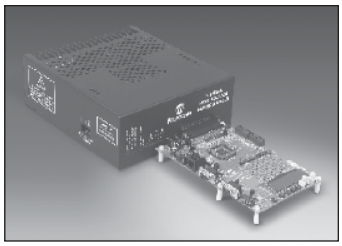
The dsPICDEM MC1 Motor Control Development System contains the dsPIC30F6010 but supports all dsPIC® Digital Signal Controller (DSC) motor control variances, various peripheral interfaces and a custom interface header system, which allows different motor power modules to be connected to the PCB. The control board also has connectors for mechanical position sensors, such as incremental rotary encoders and hall effect sensors, and a breadboard area for custom circuits. The main control board receives its power from a standard plug-in transformer.

The dsPICDEM MC1L 3-phase low voltage power module is optimized for 3-phase motor applications that require a DC bus voltage less than 50 volts and can deliver up to 400W power output. The 3-phase low voltage power module is intended to power BLDC and PMAC motors.

The dsPICDEM MC1H 3-phase high voltage power module is optimized for 3-phase motor applications that require DC bus voltages up to 400 volts and can deliver up to 1 kW power output. The high voltage module has an active power factor correction circuit that is controlled by the dsPIC DSC. This power module is intended for AC induction motor and power inverter applications that operate directly from the AC line voltage.

Two compatible motors are available for the dsPICDEM MC1 Motor Control Development System.





Features

The dsPICDEM MC1 Motor Control Development System features:

- A dsPIC30F6010 Motor Control MCU Based Board

The optional power modules provide:

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

Package Contents

Motor Control Development Board

- dsPICDEM MC1 Motor Control Development Board with pre-programmed dsPIC DSC
- RS-232 cable
- Power supply
- Example software and documentation on CD

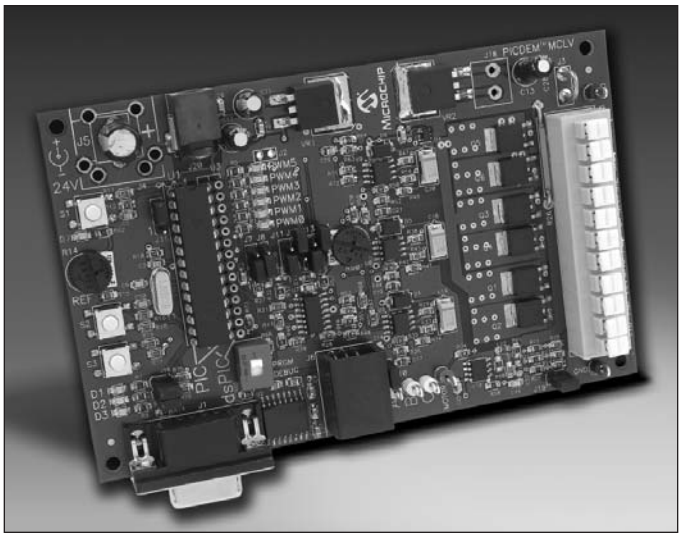
Power Modules

- High voltage or low voltage power module
- Example software and documentation on CD

PICDEM™
MC LV Development Board

The PICDEM™ MC LV Development Board is a ready-to-use and easy-to-use BLDC motor control hardware platform built around the dsPIC30F2010, dsPIC30F3010 and dsPIC30F4012 (along with the PIC18F2431/2331). The PICDEM MC LV board has a control section around the onboard dsPIC® digital signal controller or the PIC® microcontroller, 3-phase voltage source inverter, fault-monitoring circuit, temperature sensor, monitoring LEDs, serial interface for PC connection, and In-Circuit Serial Program™ (ICSP™) connector for programming and debugging. In addition, the board has hardware interfaces that make it easy to implement sensor and sensorless control of a BLDC motor using the dsPIC30F2010, the dsPIC30F3010 or the dsPIC30F4012.

The PICDEM™ MC LV Development Board has all of the necessary hardware to support a direct drive to a 10 to 48 VDC BLDC (up to 2.2A max.) motor using a sensored or sensorless algorithm.



Features

The PICDEM™ MC LV Development Board features:

- A 3-phase voltage source inverter bridge
- Motion sensor inputs
- Over current protection, level programmable using potentiometer
- Temperature sensor with I^2C™ interface
- Test points for motor current and back EMF sensing
- Speed control potentiometer
- Example software and documentation available on CD
- 24V external power supply (optional)
- A 3-phase, 24V BLDC low voltage motor (optional)

Package Contents

- PICDEM™ MC LV Development Board pre-programmed with a PIC18F2431 and a dsPIC30F3010 (shipped separately)
- Free Motor Control Graphical User Interface (MC-GUI)

MICROCHIP

www.microchip.com

dsPIC30F
Soft Modem Library

Summary

The dsPIC30F Soft Modem Library is composed of ITU-T compliant algorithms for V.21, V.22, V.22bis, V.23, V.32 and V.32bis modem recommendations. Bell standard 103 is also included in this library.

V.21, V.23 and Bell 103 are Frequency Shift Keying (FSK) modems. V.32, V.32bis and V.22bis are Quadrature Amplitude Modulated (QAM) modems. V.22 is a Quadrature Phase Shift Keyed (QPSK) modem. V.21, V.22, V.22bis, V.32 and V.32bis are all 2-wire, full-duplex modems. V.23 is full-duplex when it operates with a 75 bps backwards channel.

V.22bis includes fallback to V.22, V.23 and V.21 standards. V.32bis optionally falls back to V.22bis, V.22, V.23 and V.21 standards.

Typical Applications

The dsPIC30F Soft Modem Library is well suited for small transaction orientated based applications such as, but not limited to:

- POS terminals
- Set top boxes
- Drop boxes
- Fire panels
- Internet-enabled home security systems
- Internet-connected power, gas and water meters
- Internet-connected vending machines
- Smart appliances
- Industrial monitoring

Contents

The dsPIC30F Soft Modem Libraryis provided in two basic software packages:

- V.22bis/V.22 offered free with full source code, includes:
  - V.22bis/V.22, V.23, V.21/Bell 103, V.42, DP and V.42 API, AT command set
- V.32bis/V.32 offered in object code, includes:
  - V.32bis/V.32, V.22bis/V.22, V.23, V.21/Bell 103, V.42, DP and V.42 API, AT command set

The library currently supports single channel data-pump implementations.

Both libraries are supported with fallback data pump modulations down to V.21. Each data modem library is provided with a respective library archive containing all the data pump object code modules required to link to an application. UART and Data Converter Interface (DCI) for DAA/AFE I/O hardware component drivers are provided in assembly source code for linking with an application.

ITU-T Recommendation V.42 is provided with each library. V.42 contains a High Level Data Link Control (HDLC) protocol referred to as Link Access Procedure for Modems (LAPM) and defines error-correcting protocols for modems.

All data pump modulations are developed in ASM30 assembly code yielding optimal code size and execution time. The AT, V.42 and data pump APIs are based on MPLAB® C30 C Compiler language.

Electronic documentation accompanies this library to help implement its functions. A comprehensive *Soft Modem User's Guide* describes the required APIs for the AT, V.42 and data pump layers.

Features and Performance of Data Modems

Algorithm[1]	Performance: Data Rate (Kbps)	Half/Full Duplex	Data Mod.	Program Memory[2, 3] (Kbytes)	Data Memory[2, 3] (Kbytes)	MIPS
V.21/Bell 103[4]	0.3	Full	FSK	13	1.0	4.5
V.22/V.22bis	1.2	Full	PSK/QAM	22	1.7	7
	2.4					
V.23[4]	1.2	Half	FSK	15	1.0	4.5
	0.6					
V.32	9.6	Full	QAM/TCM	31	3.2	12
	4.8					
V.32bis	14.4	Full	QAM/TCM	36	3.6	15
	12					
	9.6					
	7.2					
	4.8					
V.42		n/a		14	2.0	1.5
DP + V.42 API		n/a		7	1.2	-
AT Command Set		n/a		8	0.15	-

Notes:

1. Data pump modules, V.21, V.22, V.22bis, V.23, V.32, V.32bis and Bell 103 are implemented in Assembly language; V.42, data pump; AT command APIs are implemented in C language
2. The program/data memory usage for the V-series data pumps is NOT cumulative, due to the sharing of components internally
3. Memory size does not account for applications combining data pump, V.42 and AT commands (if required)
4. V.21/Bell 103 and V.23 data pumps do not require V.42

Technical Notes

V.21 operates at 300 symbols per second, at mean frequencies of 1080 ±100 Hz and 1750 ±100 Hz. V.23 operates at mean frequencies of 1500 ±200 Hz for the 600 bps forward channel and 1700 ±400 Hz for the 1200 bps forward channel. The V.23 75 bps backwards channel has a mean frequency of 420 ±30 Hz.

V.32 and V.32bis data modems operate at 2400 symbols per second on a carrier frequency of 1800 Hz, in both directions. Both V.32 and V.32bis implement Trellis Coding Modulation (TCM) for all data rates, except 4800 bps. V.32 includes uncoded 9600 bps.

dsPIC30F
Speech Recognition Library

Summary

The dsPIC30F Speech Recognition Library provides voice control of embedded application with isolated, speaker-independent word recognition of US English. It allows control of an application through a set of fixed voice commands. The library has already been pre-trained by a demographic cross-section of male and female US English speakers. Conveniently, no training is required for end-users of the product.

This library is an ideal front end for hands-free products such as modern appliances, security panels and cell phones. The Speech Recognition Library has very modest memory and processing requirements and is targeted for the dsPIC30F5011, dsPIC30F5013, dsPIC30F6012 and dsPIC30F6014 processors.

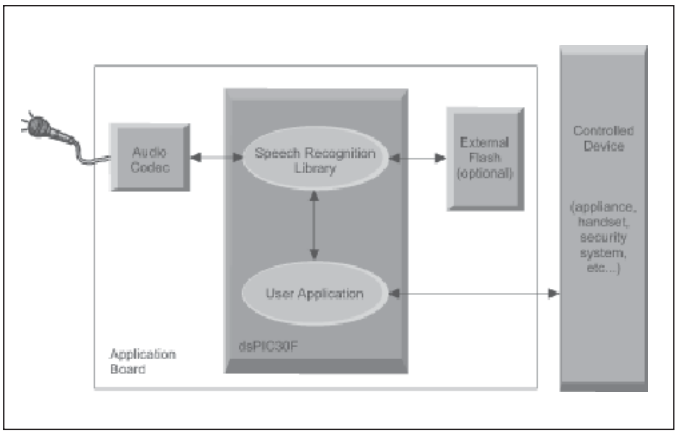
The library samples speech data from a voice codec connected to the dsPIC30F's data converter interface. The data is processed a frame at a time, and when a word ending is detected, the received word is identified using Hidden Markov Model processing. After the library identifies the word, the application can respond accordingly.

The speech recognition algorithm is written in assembly language to optimize performance and minimize RAM usage. A well defined API makes it easy to integrate the Speech Recognition Library with your application. Library functions allow the application to easily disable and enable speech recognition. The library lets other system processing operations take place without disrupting speech recognition.

A PC-based word library builder program creates a custom library from a master library of 100 common words to allow users to control their application vocally. .A noise profile is selected to suit the operating environment. The noise profile consists of a noise type and a signal-to-noise ratio (SNR). The noise type can be any combination of 3 different noise sources (automobile, office and white noise), and the SNR may be as low as 15 dB. The word library builder program generates source files that can be used to build an application. These files contain data tables that the library uses to perform speech recognition.

Devices Supported

- dsPIC30F5011
- dsPIC30F5013
- dsPIC30F6012
- dsPIC30F6014



Features

Key features of the dsPIC30F Speech Recognition Library include:

- US English language support
- Speaker-independent recognition of isolated words
- No speaker training is required
- Hidden-Markov Model based recognition system
- Recognition time < 500 msec
- Master Library of 100 common words (available in *dsPIC30F Speech Recognition Library User's Guide*)
- Windows® based utility creates a custom library from the master library
- Additional words can be added to the master library (fee based)
- Data tables can be stored in external memory
- Optional keyword activation and silence detection
- Optional system self-test using a predefined keyword
- Flexible API
- Full compliance with MPLAB® C30 Language Tools
- *dsPIC30F Speech Recognition Library User's Guide* is provided with the library
- Designed to run on dsPICDEM™ 1.1 General Purpose Development Board (DM300014)

Resource Requirements

- Sampling interface: SI-3000 audio codec operating at 12.0 kHz
- System operating frequency: 12.288, 18.432 or 24.576 MHz
- Computational power: 8 MIPs
- Program Flash memory: 18 KB + 1.5 KB for each library word
- RAM: <3.0 KB

MICROCHIP
www.microchip.com

dsPIC30F
Noise Suppression Library

Summary

The dsPIC30F Noise Suppression (NS) Library provides a function to suppress the effect of noise interfering with a speech signal. This function is useful for microphone-based applications, which have a potential for incoming speech getting corrupted by ambient noise captured by the microphone. It is especially suitable for systems in which an acoustically isolated noise reference is not available, such as:

- Hands-free cell phone kits
- Speakerphones
- Intercoms
- Teleconferencing systems
- Headsets
- As a front-end to a speech recognition system
- Any microphone-based application that needs to eliminate undesired noise

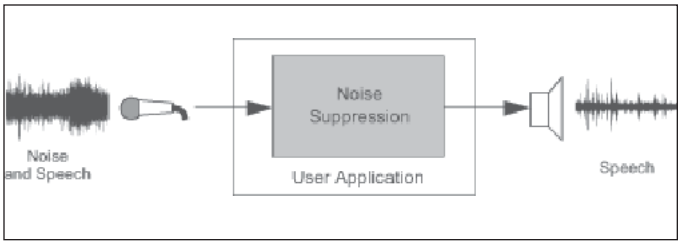
The Noise Suppression Library is written entirely in assembly language and is highly optimized to make extensive use of the dsPIC30F DSP instruction set and advanced addressing modes. The algorithm avoids data overflow. The Noise Suppression Library provides a “NoiseSuppressionInit” function for initializing the various data structures required by the algorithm and a “NoiseSuppression” function to remove noise from a 10 ms block of sampled 16-bit speech data. Both functions are executed through a well-documented Application Programmer’s Interface (API).

The “NoiseSuppression” function is primarily a frequency ddomain algorithm. A Fast Fourier Transform (FFT) is performed on each 10 ms block of data to analyze the frequency components of the signal. Thereafter, a Voice Activity Detection (VAD) algorithm is used to determine if the signal segment is speech or noise. The NS algorithm maintains a profile of the noise and updates it every time a noise segment is detected by the VAD. Every frequency band of the input signal is then scaled according to the proportion of noise contained in that frequency band, thereby causing a significant degree of noise suppression in the resultant signal. The algorithm, thus, adapts to changes in the nature and level of noise, and does not require a separate noise reference input.

The dsPIC30F Noise Suppression Library uses an 8 kHz sampling rate. However, the library includes a sample rate conversion function that ensures interoperability with libraries designed for higher sampling rates (9.6 kHz, 11.025 kHz or 12 kHz). The conversion function allows incoming signals at higher sampling rates to be converted to a representative 8 kHz sample. Similarly, the conversion function allows the output signal to be converted upward from 8 kHz to match the user application.

Devices Supported

dsPIC30F6014
dsPIC30F6012
dsPIC30F5013
dsPIC30F5011
dsPIC30F4013



Features

Key feature of the Noise Suppression Library include:

- All functions can be called from either a C or assembly application program
- Five user functions:
  - NoiseSuppressionInit
  - NoiseSuppression
  - InitRateConverter
  - SRC_upConvert
  - SRC_downConvert
- Full compliance with the Microchip MPLAB® C30 C Compiler, assembler and linker
- Simple user interface – one library file and one header file
- Highly optimized assembly code, utilizing DSP instructions and advanced addressing modes
- Audio bandwidth: 0-4 kHz at 8 kHz sampling rate
- 10-20 dB noise reduction, depending on type of noise
  - Several speech recordings corrupted by babble, car cabin, white and narrowband noise included for library evaluation
- *dsPIC30F Noise Suppression Library User’s Guide* is provided
- Demo application source code is provided
- Accessory kit available for purchase includes: an audio cable, headset, oscillators, microphone, speaker, DB9 M/F RS-232 cable, DB9M-DB9M null modem adapter and can be used for library evaluation

Resource Requirements

Noise Suppression

Computational requirements: 3.3 MIPS
Program Flash memory: 7 KB
RAM: 1 KB

Sample Rate Conversion

Computational requirements: 1 MIPS
Program Flash memory: 2.6 KB
RAM: 0.5 KB

Note: The user application might require an additional 1 KB-1.5 KB of RAM for data buffering (application-dependent).

dsPIC30F
Acoustic Echo Cancellation Library

Summary

The dsPIC30F Acoustic Echo Cancellation (AEC) Library provides a function to eliminate echo generated in the acoustic path between a speaker and a microphone. This function is useful for speech and telephony applications in which a speaker and a microphone are located in close proximity to each other and are susceptible to signals propagating from the speaker to the microphone resulting in a perceptible and distracting echo effect at the far-end. It is especially suitable for these applications:

- Hands-free cell phone kits
- Speakerphones
- Intercoms
- Teleconferencing systems

For hands-free phones intended to be used in compact environments, such as a car cabin, this library is fully compliant with the G.167 standard for acoustic echo cancellation.

The Acoustic Echo Cancellation Library is written entirely in assembly language and is highly optimized to make extensive use of the dsPIC30F DSP instruction set and advanced addressing modes. The algorithm avoids data overflow. The AEC Library provides an "`AcousticEchoCancellerInit`" function for initializing the various data structures required by the algorithm and an "`AcousticEchoCanceller`" function to remove the echo component from a 10 ms block of sampled 16-bit speech data. The user can easily call both functions through a well-documented Application Programmer's Interface (API).

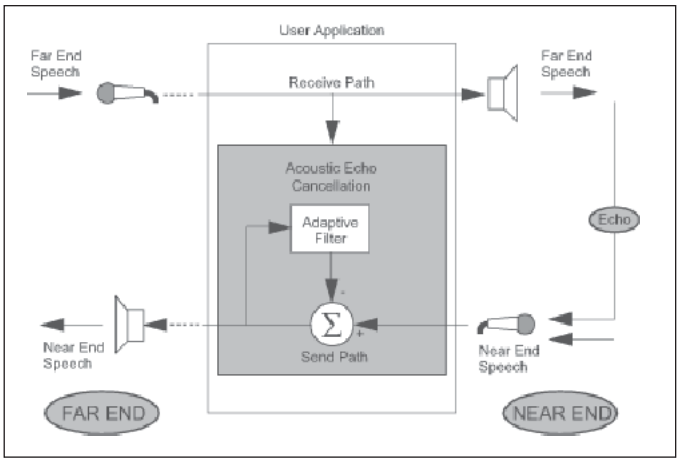
The "`AcousticEchoCanceller`" function is primarily a Time Domain algorithm. The received far-end speech samples (typically received across a communication channel such as a telephone line) are filtered using an adaptive Finite Impulse Response (FIR) filter. The coefficients of this filter are adapted using the Normalized Least Mean Square (NLMS) algorithm, such that the filter closely models the acoustic path between the near-end speaker and the near-end microphone (i.e., the path traversed by the echo). Voice Activity Detection (VAD) and Double Talk Detection (DTD) algorithms are used to avoid updating the filter coefficients when there is no far-end speech and also when there is simultaneous speech from both ends of the communication link (double talk). As a consequence, the algorithm functions correctly even in the presence of full-duplex communication. A Non-Linear Processor (NLP) algorithm is used to eliminate residual echo.

The dsPIC30F Acoustic Echo Cancellation Library uses an 8 kHz sampling rate. However, the library includes a sample rate conversion function that ensures interoperability with libraries designed for higher sampling rates (9.6 kHz, 11.025 kHz or 12 kHz). The conversion function allows incoming signals at higher sampling rates to be converted to a representative 8 kHz sample. Similarly, the conversion function allows the output signal to be converted upward from 8 kHz to match the user application.

Echo Tail Length (ms)	MIPS	Program Flash Memory (KB)	RAM (KB)
64	16.5	6	5.7
32	10.5	6	3.4
16	7.5	6	2.6

Sample Rate Conversion
Computational requirements: 1 MIPS
Program Flash memory: 2.6 KB
RAM: 0.5 KB

Note: The user application might require an additional 2 to 2.5 KB of RAM for data buffering (application-dependent)



Features

Key features of the Acoustic Echo Cancellation Librar include:

- All functions can be called from either a C or assembly application program
- Five user functions:
  - `AcousticEchoCancellerInit`
  - `AcousticEchoCanceller`
  - `InitRateConverter`
  - `SRC_upConvert`
  - `SRC_downConvert`
- Full compliance with the Microchip MPLAB® C30 C Compiler, assembler and linker
- Simple user interface – one library file and one header file
- Highly optimized assembly code, utilizing DSP instructions and advanced addressing modes
- Echo cancellation for 16, 32 or 64 ms echo delays or 'tail lengths' (configurable)
- Fully tested for compliance with G.167 specifications for in-car applications
- Audio bandwidth: 0-4 kHz at 8 kHz sampling rate
- Convergence rate: Up to 43 dB/sec., typically > 30 dB/sec.
- Echo cancellation: Up to 50 dB, typically > 40 dB
- Can be used together with the Noise Suppression (NS) Library, since the same processing block size (10 ms) is used
- *dsPIC30F Acoustic Echo Cancellation Library User's Guide* is included
- Demo application source code is provided with the library
- Accessory Kit available for purchase includes an audio cable, headset, oscillators, microphone, speaker, DB9 M/F RS-232 cable, DB9M-DB9M null modem adapter and can be used for library evaluation

Devices Supported

dsPIC30F6014

dsPIC30F6012

dsPIC30F5013 (for a max. of 32 ms echo delay)

dsPIC30F5011 (for a max. of 32 ms echo delay)

MICROCHIP
www.microchip.com

dsPIC30F Symmetric Key Embedded Encryption Library

Summary

Microchip offers a reliable security solution for embedded applications built on the dsPIC30F platform. This solution is provided by means of two libraries – Symmetric Key and Asymmetric Key Embedded Encryption Libraries. The Symmetric Key Library features:

- Hash functions
  - SHA-1 secure hash standard
  - MD5 message digest
- Symmetric-key encryption/decryption functions
  - Advanced Encryption Standard (AES)
  - Triple Data Encryption Algorithm (Triple-DES)
- Random number generator functions
  - Deterministic Random Bit Generator ANSI X9.82

Typical Applications

The algorithms supported by this library have emerged as the de facto standard for many large-scale, secured applications like web access, E-mail, secure XML transactions and virtual private networks (VPN). These algorithms are also recommended by most Internet Engineering Task Force (IETF), Federal Information Processing Standards (FIPS) and IPSec standards. Some typical applications for this library include:

- Mobile and wireless devices, PDAs
- Secure banking
- Secure web transactions
  - Secure Socket Layer (SSL)
  - Transport Layer Security (TLS)
  - Secure Multi-purpose Internet Mail Extensions (S/MIME)
- ZigBee™ technology and other monitoring and control applications
- Smart card readers/trusted card readers
- Friend/foe identification

Typical Applications (Continued)

- Secure devices and peripherals interoperating with TCG and NGSCB PC's

The Trusted Computing Group (TCG) and related Microsoft Next- generation Secure Computing Base (NGSCB) both specify RSA and Triple-DES. RSA and other asymmetric solutions are featured in the dsPIC30F Asymmetric Key Embedded Encryption Library (SW300055).

Features

- C-callable library functions developed in MPLAB® ASM30 Assembly language
- Optimized for speed, code size and RAM usage:
  - RAM usage below 60 bytes
- Library functions extensively tested for adherence to applicable standards
- Symmetric key encryption/decryption functions support multiple modes of operation:
  - Electronic Code Book (ECB) mode
  - Cipher Block Chaining with Message Authentication (CBC-MAC) mode
  - Counter (CTR) mode
  - Combined CBC-MAC and Counter (CCM) mode
- A comprehensive *dsPIC30F Embedded Encryption Libraries User's Guide* describes the required APIs for library functions
- Several examples of use are provided for each library function

Getting Started

- Review the dsPIC30F Symmetric Key Embedded Encryption Library web page at www.microchip.com
- Download the dsPIC30F Embedded Encryption Libraries User's Guide from the Microchip web site
- Purchase part number SW300050
- If Asymmetric Key Embedded Encryption Library support is required (part number SW300055), visit www.microchip.com and review the applicable information

Cryptographic Functions

Cryptographic Algorithm	Applicable Specification	Cryptographic Function[2]	Code Size (in bytes)	Data Rate[4] (Kbytes/sec)
RNG	ANSI X9.82, FIPS 180-2	Deterministic Random Bit Generator	1353	–
SHA-1	FIPS 180-2	Secure Hash Algorithm – 160 bit	909	423
MD5	RFC 1321	Message Digest – 128 bit	1428	656
T-DES	FIPS 46-3	Basic Encryption and Decryption	8892	49(3)
	FIPS 46-3	ECBWrapper(1)	123	
	NISTSP 800-38A	CBCWrapper(1)	903	
	NISTSP 800-38A	CTRWrapper(1)	348	
AES (128-bit)	FIPS 197	Basic Encryption	2505	232(3)
	FIPS 197	Basic Decryption	2895	
	FIPS 197	ECBWrapper(1)	234	
	FIPS 113	CBC-MAC Encryption Wrapper(1)	663	
	NISTSP 800-38A	CBCDecryption Wrapper(1)	357	
	NISTSP 800-38A	CTRWrapper(1)	348	
	IEEE 802.11i	CCMWrapper(1)	930	

Notes:

1. Wrapper functions are used in combination with the underlying basic encryption and/or decryption functions for the respective algorithm (AES,T-DES)
2. All library functions use the stack and require input and output message buffers to be set up by the calling application; stack usage is below 60 bytes of RAM
3. AES and T-DES data rate represents the average of the data rates for performing basic encryption and decryption functions for a single block of data
4. All data rate statistics shown here assume device peration of 30 MIPS

dsPIC30F Asymmetric Key Embedded Encryption Library

Summary

Microchip offers a reliable security solution for embedded applications built on the dsPIC30F platform. This solution is provided by means of two libraries – Symmetric-Key and Asymmetric-Key Embedded Encryption Libraries. The Asymmetric Key Library implements the following:

- Public key encryption/decryption functions
  - RSA (1024 and 2048 bit)
- Key agreement protocol
  - Diffie-Hellman (1024 and 2048 bit)
- Signing and verification
  - DSA (1024 bit)
  - RSA (1024 and 2048 bit)
- Hash and message digest functions
  - SHA-1, MD5
- Random Number Generator (RNG)
  - ANSI X9.82

Typical Applications

The algorithms supported by this library have emerged as the de facto standard for many large-scale, secured applications like web access, E-mail, secure XML transactions, and virtual private networks (VPN). These algorithms are also recommended by most Internet Engineering Task Force (IETF), Federal Information Processing Standards (FIPS) and IPSec standards. Some typical applications for this library include:

- Mobile and wireless devices, PDAs
- Secure banking
- Secure web transactions
  - Secure Socket Layer (SSL)
  - Transport Layer Security (TLS)
  - Secure Multi-purpose Internet Mail Extensions (S/MIME)
- ZigBee™ technology and other monitoring and control applications
- Smart card readers
- Friend/foe identification
- Peripherals interoperating with TCG and NGSCB personal computers

The Trusted Computing Group (TCG) and related Microsoft Next Generation Secure Computing Base (NGSCB), both specify RSA and Triple-DES. AES, Triple DES and other symmetric solutions are featured in the dsPIC30F Symmetric Key Embedded Encryption Library (SW300050).

Execution Time

For a 1024-bit modulus, when the dsPIC® Digital Signal Controller (DSC) operates at 30 MIPS, average execution times are provided below (in milliseconds):

- RSA Encryption and Verification functions execute in 7 ms for a 17-bit exponent
- RSA Decryption and Signing functions execute in 152 ms for a 17-bit exponent
- DSA Signing function executes in 80 ms
- DSA Verification function executes in 151 ms
- Diffie-Hellman key agreement executes in:
  - 78 ms for 160-bit key
  - 487 ms for 1024-bit key

Features

- C-callable library functions developed in MPLAB ASM30 Assembly language
- Optimized for speed, code size and RAM usage
  - RAM usage below 100 bytes
- Library functions extensively tested for adherence to applicable standards
- A comprehensive *dsPIC30F Embedded Encryption Libraries User's Guide* describing the required APIs for the library functions
- Several examples of use provided for each library function

Getting Started

- Review the dsPIC30F Asymmetric Key Embedded Encryption Library web page at www.microchip.com
- Download the *dsPIC30F Embedded Encryption Libraries User's Guide* from the Microchip web site
- Purchase part number SW300055
- If Symmetric Key Embedded Encryption Library support is required (part number SW300050), please visit www.microchip.com and review the applicable information

Cryptographic Functions

Cryptographic Algorithm	Applicable Specification	Cryptographic Function(1)	Security Strength (in bits)	Code Size((in bytes)(2)
Primary Functions				
RSA	PKSC#1 v1.5	Encryption/Decryption	1024, 2048	2574
RSA	PKSC#1 v1.5	Signing/Verification	1024, 2048	2658
Diffie-Hellman	PKCS#3	Key Agreement Protocol	1024, 2048	2067
DSA	FIPS 186-2	Signing/Verification	1024	4341
Auxillary Functions				
Big Integer	–	Modulus Arithmetic Functions	–	927
Deterministic	ANSI X9.82,	Random Number Generator	–	1353
SHA-1	FIPS 180-2	Secure Hash Algorithm	160	912
MD5	RFC 1321	Message Digest MD5	128	1428

Notes:

1. All library functions use the stack and require input and output message buffers to be set up by the calling application. Stack usage is below 100 bytes of RAM.
2. If more than one primary function is used in an application, code size required by the library will be less than the sum of code sizes for individual primary functions.

   For example, if RSA Signing/Verification and Diffie-Hellman Key Agreement are both used by an application, the library code size linked into the application is 3246 bytes, which is significantly lesser than (2658 + 2067) bytes.

MICROCHIP
www.microchip.com

dsPIC30F
Encoding/Decoding Library

Summary

The dsPIC30F Speech Encoding/Decoding Library performs toll-quality voice compression and voice decompression. The library is a modified version of the Speex speech coder made specifically for the dsPIC30F family of Digital Signal Controllers (DSCs) and features a 16:1 compression ratio. Encoding uses Code Excited Linear Prediction (CELP), which is a popular coding technique. CELP provides a reasonable trade-off between performance and computational complexity.

The library is appropriate for half-duplex systems and with its small footprint, it is also ideal for playback-only applications including:

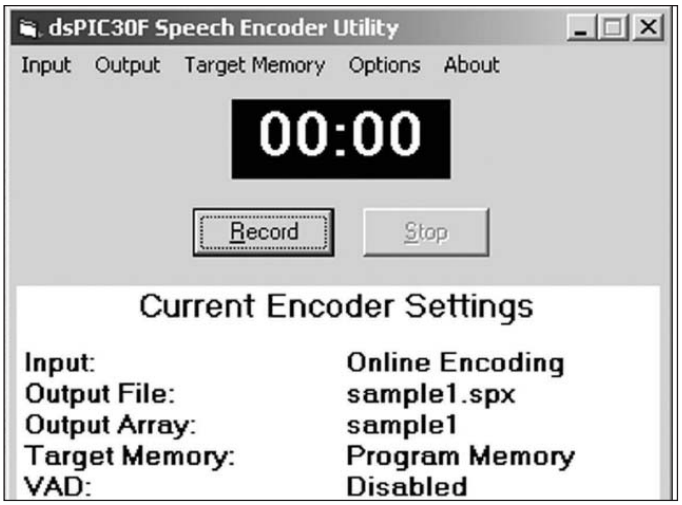
- Answering machines
- Building and home safety systems
- Intercoms
- Smart appliances
- Voice recorders
- Walkie-talkies
- Any application using message playback

Predominantly written in assembly language, the Speech Encoding/Decoding Library optimizes computational performance and minimizes RAM usage. A well-defined API makes it easy to integrate with the application.

A flexible analog interface gives your design several options to consider. The speech encoder samples speech at 8 kHz using either an external codec or the on-chip 12-bit analog-to-digital converter. The speech decoder plays decoded speech through an external codec or the on-chip Pulse Width Modulator (PWM). Storing compressed speech for playback requires approximately 1 Kbyte of memory for each second of speech.

A PC-based Speech Encoder Utility program (pictured above) creates encoded speech files for playback. Encoded speech files are made from either a PC microphone or existing WAV file. Once the encoded speech files are created, they are added to an MPLAB® C30 project, just like a regular source file, and built into the application.

The Speech Encoder Utility allows four target memory areas to store a speech file: program memory, data EEPROM, RAM and external flash memory. External flash memory stored many minutes of speech (1 minute of speech requires 60 KB) and it is supported through a dsPIC30F general purpose I/O port.



Features

Key features of the Speech Encoding/Decoding Library include:

- Fixed 8 kHz sample rate
- Fixed 8 kbps output rate
- PESQ-based Mean Opinion Score: 3.7 – 4.2 (out of 5.0)
- Code Excited Linear Prediction (CELP)-based coding
- Two analog input interfaces – codec or on-chip 12-bit ADC
- Two analog output interfaces – codec or on-chip PWM
- Optional voice activity detection
- Playback-only applications benefit from the Speech Encoder utility; encoded speech files can be created from the desktop using a PC microphone or WAV file
- Storing compressed speech requires 1 KB of memory per second of speech
- Off-chip support for playback of long speech samples
- Royalty free (only one-time license fee)
- Full compliance with Microchip MPLAB® C30 Language Tools
- *dsPIC30F Speech Encoding/Decoding Library User's Guide* assists in using the library (DS70154)
- Designed to run on dsPICDEM™ 1.1 General Purpose Development Board (DM300014)

Resource Requirements

Encoder:
Sampling Interface: Si-3000 Audio Codec or 12-bit ADC
Computational Power: 19 MIPs (worst case)
Program Flash Memory: 33 KB
RAM*: 5.4 KB (1.2 KB is scratch)
* Full-duplex support is now possible and requires 6.8 KB of RAM

Decoder

- Playback Interface: Si-3000 audio codec or PWM
- Computational Power: 3 MIPs
- Program Flash Memory: 15 KB
- RAM*: 3.2 KB

dsPIC30F Math Library

Summary

The dsPIC30F Math Library is the compiled version of the math library that is distributed with the highly optimized, ANSI-compliant dsPIC30F MPLAB® C30 C Compiler (SW006012). It contains advanced single and double-precision floating-point arithmetic and trigonometric functions from the standard C header file <math.h>. The library delivers small program code size and data size, reduced cycles and high accuracy.

Features

- The Math Library is callable from either MPLAB C30 or dsPIC30F assembly language
- The functions are IEEE-754 compliant, with signed zero, signed infinity, NaN (Not a Number) and denormal support and operated in the "round to nearest" mode
- Compatible with MPLAB ASM30 and MPLAB LINK30, which are available at no charge from www.microchip.com
- Total library memory usage[1, 2]:
  - Code size: 5250 bytes
  - Data size: 4 bytes

Function Group	Function	Performance (Cycles)[1, 3, 4]
Basic Floating Point	Addition	122
	Subtraction	124
	Multiplication	109
	Division	361
	Remainder	385
Trigonometric and Hyperbolic	acos	478
	asin	363
	atan	696
	atan2	3206
	cos	3249
	sin	2238
	tan	2460
	cosh	1049
	sinh	525
	tanh	338
Logarithmic and Exponential	exp	530
	frexp	39
	ldexp	44
	log	2889
	log10	3007
Power Functions	pow	2134
	sqrt	493
Rounding Functions	ceil	94
	floor	51
Absolute Value Function	fabs	6
Modular Arithmetic Functions	modf	151
	fmod	129

Notes

1. Results are based on using the dsPIC30F MPLAB C30 Compiler (SW006012) version 1.20
2. Maximum memory usage when all functions in the library are loaded; most applications will use less
3. All performance statistics represented here are for 32-bit IEEE 754 floating-point input and output data types
4. Performance listed represent an average number of instruction cycles required to perform the floating-point operation

dsPIC30F DSP Library

Summary

The dsPIC30F DSP Library provides a set of speed optimized functions for the most common digital signal processing applications. The DSP Library provides significant performance savings over equivalent functions coded in “C” and allows developers to dramatically shorten their development time. The DSP Library may be used with any dsPIC30F variant.

The DSP Library is written predominantly in assembly language and makes extensive use of the dsPIC30F DSP instruction set and hardware resources, including X and Y memory addressing, modulo addressing, bit-reversed addressing, 9.31 saturation and REPEAT and DO loops.

The DSP Library provides functions for the following

- Vector operations
- Matrix operations
- Filtering operations
- Transform operations
- Window operations

Function Execution Times

Function	Cycle Count Equation	Conditions*	Number of Cycles	Execution Time @30 MIPS
Complex FFT**	—	N=64	3739	124.6 µs
Complex FFT**	—	N=128	8485	282.8 µs
Complex FFT**	—	N=256	19055	635.2 µs
Single Tap FIR	—	—	1	33 ns
Block FIR	53+N(4+M)	N=32, M=32	1205	40.2 µs
Block FIR Lattice	41+N(4+7M)	N=32, M=32	7337	244.6 µs
Block IIR Canonic	36+N(8+7S)	N=32, S=4	1188	39.6 µs
Block IIR Lattice	46+N(16+7M)	N=32, M=8	2350	78.3 µs
Matrix Add	20+3(C*R)	C=8, R=8	212	7.1 µs
Matrix Transpose	16+C(6+3(R-1))	C=8, R=8	232	7.7 µs
Vector Dot Product	17+3N	N=32	113	3.8 µs
Vector Max	19+7(N-2)	N=32	229	7.6 µs
Vector Multiply	17+4N	N=32	145	4.8 µs
Vector Power	16+2N	N=32	80	2.7 µs
PID Loop Core	—	—	7	231 ns

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

1 cycle = 33 nanoseconds @ 30 MIPS

Features

Key features of the dsPIC30F DSP Library include:

- 49 total functions
- Full compliance with the Microchip MPLAB® C30 C Compiler, assembler and linker
- Simple user interface – only one library file and one header file
- Functions are both “C” and assembly callable
- FIR filtering functions include support for lattice, decimating, interpolating and LMS filters
- IIR filtering functions include support for canonic, transposed canonic and lattice filters
- FIR and IIR functions may be used with the filter files generated by the dsPIC® DSC Digital Filter Design Tool
- Transform functions include support for in-place and out-of-place DCT, FFT and IFFT transforms
- Window functions include support for Bartlett, Blackman, Hamming, Hanning and Kaiser windows
- Support for srogram space visibility
- Complete function profile information including register usage, cycle count and function size information

Devices Supported

- All processors in the dsPIC30F family

dsPIC30F Peripheral Library

Summary

The dsPIC30F Peripheral Library provides a set of functions for setting up and controlling the operation of all the peripheral modules available in the dsPIC® Digital Signal Controllers (DSCs), as well as functions for interfacing with an external LCD. The dsPIC30F Peripheral Library serves as a convenient layer of abstraction over the specific details of the peripherals and their associated control and status registers.

The dsPIC30F Peripheral Library supports the following hardware peripheral modules:

- Timers
- Input capture
- Output compare
- Quadrature Encoder Interface (QEI)
- Motor control PWM
- I/O ports and external interrupts
- Reset
- UART
- SPI
- I²C™
- Data Converter Interface (DCI)
- 10-bit A/D converter
- 12-bit A/D converter
- CAN
- Functions for controlling an external LCD through configurable I/O Port pins are also provided

Features

Key features of the dsPIC30F Peripheral Library include:

- A library file for each device from the dsPIC30F family, including functions corresponding to peripherals present in that particular device
- C include files that enable pre-defined constants for passing parameters to various library functions, as well as a file for each peripheral module.
- Functions in pre-compiled libraries that may be called from an application program written in either MPLAB® C30 or dsPIC30F assembly language
- C source code is included to customize functions to specific application requirements
- Pre-defined constants in the C include files eliminate the need to refer to the details and structure of every special function register while initializing peripherals or checking status bits

Resource Requirements

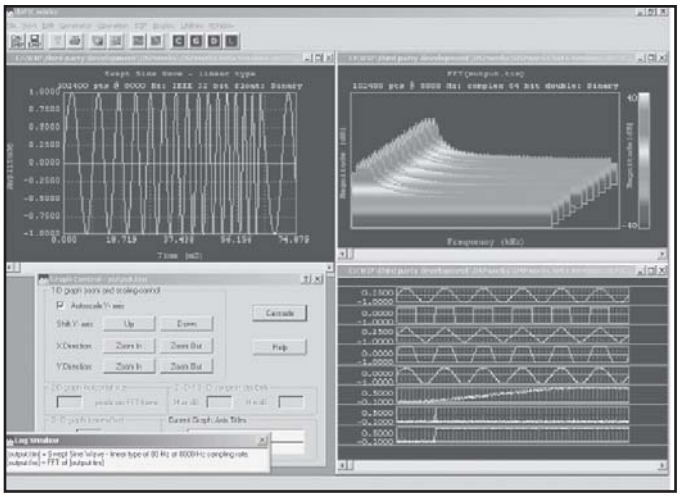
- Program memory: The Peripheral Library functions are optimized for efficient program memory usage
  - Since the functions are in the form of libraries, the actual program memory requirements depend on the functions being called by the application, as well as on the specific dsPIC DSC being used
- Data memory: The vast majority of the functions do not use RAM at all
  - Each of the remaining functions uses less than 10 bytes of RAM

dsPICworks™
Data Analysis and DSP Software

Summary

dsPICworks Data Analysis and DSP software is an easy to use data analysis and signal processing package for designs using dsPIC® Digital Signal Controllers (DSCs). It provides an extensive number of functions encompassing:

- Signal generation
- Arithmetic operations and digital signal processing
- One, two and three-dimensional display and measurement capabilities
- Data import/export compatible with MPLAB® IDE and MPLAB ASM30 assembler



Signal Generation

This software supports an extensive set of signal generators including basic sine, square and triangle wave generators as well as advanced generators for window functions, unit step, unit sample, sinc, exponential and noise functions. Noise, with specified distribution, can be added to any signal. Signals can be generated as 32 bit floating-point or as 16-bit fractional fixed point values for any desired sampling rate. The length of the generated signal is limited only by available disk space. Signals can be imported or exported from or to MPLAB file-register windows. Multi-channel data can be created by a set of multiplexing functions.

Arithmetic and Digital Signal Processing (DSP) Operations

dsPICworks Data Analysis and DSP software has a wide range of DSP and arithmetic functions that can be applied to signals. Standard DSP functions include transform operations: FFT and DCT, convolution and correlation, signal decimation, signal interpolation sample rate conversion and digital filtering. Digital filtering is an important part of dsPICworks. It uses filters designed by the sister-application, Digital Filter Design, and applies them to synthesized or imported signals. dsPICworks also features special operations such as signal clipping, scaling and quantization – which are vital in practical analysis of DSP algorithms.

Display and Measurement

This software has a wide variety of display and measurement options. Frequency domain data may be plotted in the form of two-dimensional “spectrogram” and three-dimensional “waterfall” options. The signals can be measured accurately by a simple mouse-click. The log window shows current cursor coordinates and derived values such as difference from last position and signal frequency. Signal strength may be measured over a particular range of frequencies. Special support exists for displaying multi-channel/multiplexed data. Graphs allow zoom options and a set of color scheme options is available to customize display settings.

File Import/Export – MPLAB and MPLAB ASM30 Support

dsPICworks Data Analysis and DSP software allows data to be imported from the external world in the form of ASCII text or binary files. Conversely, it allows data to be exported in the form of files. The software supports all file formats supported by the MPLAB Import/Export-Table feature.bringing in real-world data from MPLAB into dsPICworks for analysis. dsPICworks can also create ASM30 assembler files that can be included into the MPLAB workspace.

Features

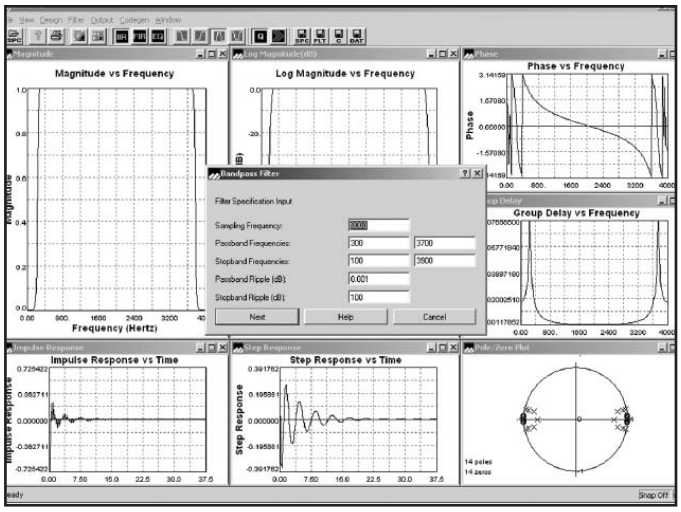
Key features of the dsPICworks Data Analysis and DSP software include:

- Wide variety of signal generators – sine, square, triangular, window functions, noise
- Extensive DSP functions – FFT, DCT, filtering, convolution, interpolation
- Extensive arithmetic functions – algebraic expressions, data-scaling, clipping, etc.
- One, two and three-dimensional displays
- Multiple data quantization and saturation options
- Multi-channel data support
- Automatic “script file”-based execution options available for any user-defined sequence of dsPICworks Data Analysis and DSP software functions
- File import/export interoperable with MPLAB IDE
- Digital filtering options support filters generated by dsPIC DSC Digital Filter Design
- ASM30 assembler file option to export data tables into dsPIC30F RAM

Digital Filter Design/ Digital Filter Design Lite

Summary

The Digital Filter Design tool for the 16-bit dsPIC® Digital Signal Controller (DSC) makes designing, analyzing and implementing Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters easy through a menu-driven and intuitive user interface. The filter design tool performs complex mathematical computations for filter design, provides superior graphical displays and generates comprehensive design reports. Desired filter frequency specifications are entered and the tool generates the filter code and coefficient files ready to use in the MPLAB® IDE Integrated Development Environment. System analysis of the filter transfer function is supported with multiple generated graphs such as: magnitude, phase, group delay, log magnitude, impulse response and pole/zero locations.



Finite Impulse Response Filter Design

- Design method selection
  - FIR windows design
  - FIR equiripple design (Parks-McClellan)
- Low-pass, high-pass, band-pass and band-stop filters
- FIR filters can have up to 513 taps
- Following window functions are supported:

Rectangular	4 term cosine
Hanning (Hann)	4 term cosine with continuous 5th derivative
Hamming	Minimum 4 term cosine
Triangular	Good 4 term Blackman Harris
Blackman	Harris flat top
Exact Blackman	Kaiser
3 term cosine	Dolph-Tschebyscheff
3 term cosine with continuous 3rd derivative	Taylor
Minimum 3 term cosine	Gaussian

- Reports provide design details such as window coefficients and impulse response prior to multiplying by the window function
- Filters are designed for a maximum gain of 1

	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	√	—

Infinite Impulse Response Filter Design

- Low-pass, high-pass, band-pass and band-stop filters
- Filter orders up to 10 for low-pass and high-pass Filters
- Filter orders up to 20 for band-pass and band-stop Filters
- Five analog prototype filters are available:
  - Butterworth
  - Tschebyscheff
  - Inverse Tschebyscheff
  - Elliptic
  - Bessel
- Digital transformations are performed by bilinear transformation method
- Reports show design details such as all transformations from normalized lowpass filter to desired filter

Code Generation Features

- Generated files are compliant with the Microchip MPLAB C30 C Compiler, assembler and linker
- Choice of placement of coefficients in program space or data space
- C wrapper/header code generation

Graphs

- Magnitude response vs. frequency
- Log magnitude vs. frequency
- Phase response vs. frequency
- Group delay vs. frequency
- Impulse response vs. time (per sample)
- Step response vs. time (per sample)
- Pole and zero locations (IIR only)

RTOS/CMX-RTX™ for dsPIC30F

Summary

In some cases, well-structured linear programming is sufficient for a product. In most cases, however, programmers appreciate not having to worry about structuring their code to perform all necessary tasks in a timely manner. This is where RTOS/CMX-RTX can help. RTOS/CMX-RTX allows tasks (pieces of code that do specific duties) to run quasi-concurrently. This means that tasks will seem to run all at the same time – doing many specific jobs simultaneously.

RTOS/CMX-RTX takes the worry and headaches out of real time programming. The software lets embedded programmers concentrate on the overall application while taking care of the little details. Finish projects faster and more efficiently with CMX-RTX.

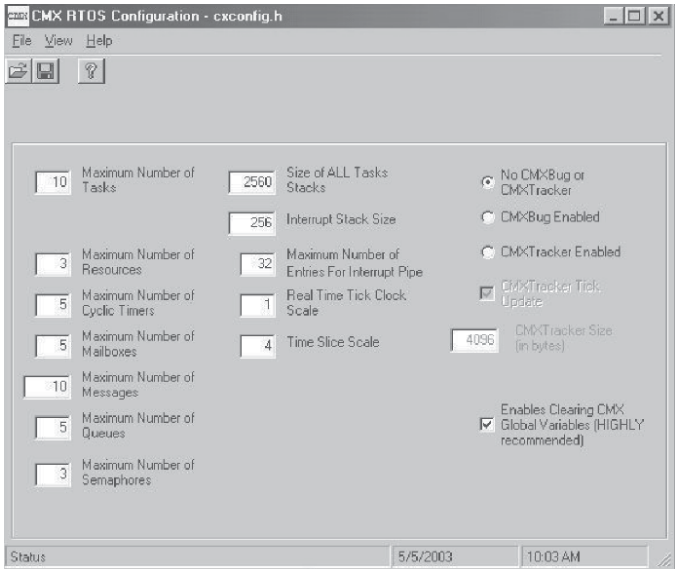
Some RTOS software offer only cooperative scheduling which means that the running task has to call the scheduler to perform a task switch. Others offer time slicing in which each task runs for a certain period of time at which point a task switch takes place no matter what. Also others claim to be fully preemptive, yet they do not allow any interrupt to cause a preemption. All of these models will fail at one point or another.

RTOS/CMX-RTX allows a task of higher priority that is able to run (whether starting or resuming) to preempt the lower priority running task. The scheduler will save the context of the running (lower priority) task and restore the context of the higher priority task so that it is now running. A truly preemptive RTOS allows interrupts to cause an immediate task switch. This means that the interrupts now have the added ability of using the RTOS's functions.

Features

Key features of the RTOS/CMX-RTX for dsPIC30F include:

- The smallest footprint
- The fastest context switch times
- The lowest interrupt latency times
- True preemption
- Scheduler and interrupt handler written in assembly for speed and optimation
- Optional co-operative and time-slicing scheduling
- Nested interrupts
- All functions contained in a library
- Interrupt callable functions
- Scalability
- Free source code provided
- Integrated with TCP/IP CMX-MicroNet™ for optional networking connectivity



CMX-RTX is easy to configure and integrate with your application using the CMX RTOS Configuration Manager.

RTOS/CMX-RTX Specifications for dsPIC DSC Products

Flash

All CMX functions:	3696 bytes
CMX initialize module:	936 bytes
CMX assembly module (scheduler):	645 bytes
RAM, each task control block:	28 bytes
Min. context switch:	92 cycles (starting a task)
	137 cycles (resuming a task)

CMX Functions are contained in a library, thus reducing code size, if not referenced.

Examples of RTOS/CMX-RTX Functionality

Task management
System management
Event management
Memory management
Message management
Queue management
Resource management
Semaphore management
Timer management

RTOS/CMX-Tiny+™ for dsPIC30F

Summary

In some cases, well structured linear programming is sufficient for a product. In most cases, however, programmers appreciate not having to worry about structuring their code to perform all necessary tasks in a timely manner. This is where RTOS/CMX-Tiny+ can help. RTOS/CMX-Tiny+ allows tasks (pieces of code that do specific duties) to run quasi-concurrently. This means that tasks will seem to run all at the same time - doing many specific jobs simultaneously.

RTOS/CMX-Tiny+ takes the worry and headaches out of real time programming. The software lets the embedded programmer concentrate on the overall application while taking care of the little details. Finish projects faster and more efficiently with RTOS/CMX-Tiny+.

Some RTOS software offer only cooperative scheduling which means that the running task has to call the scheduler to perform a task switch. Others offer time slicing in which each task runs for a certain period of time at which point a task switch takes place no matter what. Also others claim to be fully preemptive, yet do not allow any interrupt to cause a preemption. All of these models will fail at one point or another.

RTOS/CMX-Tiny+ allows a task of higher priority that is able to run (whether starting or resuming) to preempt the lower priority running task. This will cause the scheduler to save the context of the running (lower priority) task and restore the context of the higher priority task so that it is now running. A truly preemptive RTOS allows interrupts to cause an immediate task switch. This means that the interrupts now have the added ability of using the RTOS's functions.

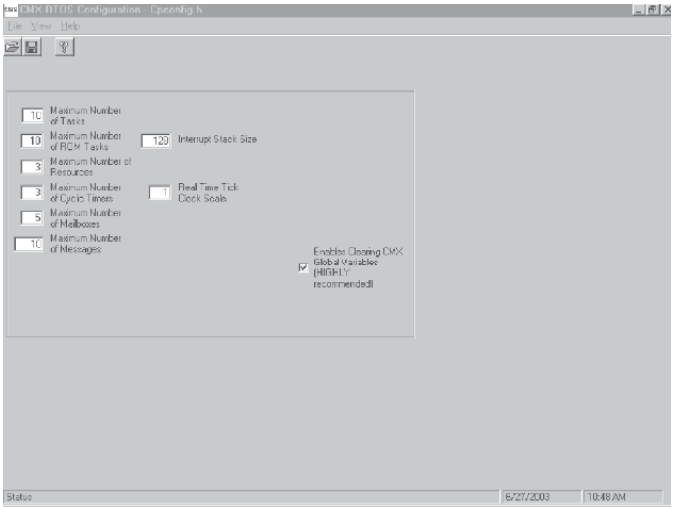
In addition, RTOS/CMX-Tiny+ has been especially designed to offer such a small Flash/RAM footprint that it can be used with only the onboard Flash/RAM of the dsPIC as a single chip solution. Based upon a scaled down version of the popular RTOS/CMX-RTX™, RTOS/CMX-Tiny+ retains most of the power of RTOS/CMX-RTX, as well as the more frequently used functions.

RTOS CMX-Tiny+ Specifications for dsPIC® Digital Signal Controller (DSC)

Flash

All CMX Functions:	2304 bytes
CMX Initialize Module:	249 bytes
CMX Assembly Module (scheduler):	570 bytes
RAM, Each Task Control Block:	13 bytes
Flash, Each Task Control Block:	6 bytes
Min. Context Switch:	71 cycles (starting a task)
	121 cycles (resuming a task)

CMX Functions are contained in a library, thus reducing code size, if not referenced.



RTOS/CMX-Tiny+ is easy to configure and integrate with your application using the CMX RTOS Configuration Manager.

Features

Key features of the RTOS/CMX-Tiny+ for dsPIC DSC include:

- Extremely small Flash/RAM footprint
- Truly preemptive RTOS
- Low power mode supported
- Full source code with every purchase
- Free technical support and updates
- Low, economical pricing
- No royalties on shipped products
- Backward compatible with CMX-Scheduler™
- Integrated with CMX-MicroNet™ for optional networking connectivity

Examples of RTOS/CMX-RTX Functionality

Task Management
System Management
Event Management
Memory Management
Message Management
Queue Management
Resource Management
Semaphore Management
Timer Management

RTOS/CMX-Scheduler™ for dsPIC30F

Summary

RTOS/CMX-Scheduler is the result of a special collaboration between CMX and Microchip. Available in object code only, CMX-Scheduler is available for FREE to embedded systems designers using the dsPIC® Digital Signal Controllers (DSCs). RTOS/CMX-Scheduler is specially designed for developers whose designs do not require a full-blown RTOS and/or who are wondering if a kernel might help their application. The perfect entry-level kernel, RTOS/CMX-Scheduler is intuitive to use and easy to implement.

RTOS/CMX-Scheduler offers many growth paths for future designs. Applications developed with the CMX-Scheduler kernel are upwardly compatible with the popular CMX-Tiny+™ or CMX-RTX™ RTOSes. RTOS/CMX-Scheduler also is tightly integrated with the unique CMX-MicroNet™ TCP/IP stack for those applications that require networking connectivity.

RTOS/CMX-Scheduler software and documentation is delivered in electronic format and is freely licensed for unlimited product usage on the dsPIC DSC devices.

Features

Key features of the RTOS/CMX-Scheduler include:

- FREE for use onany dsPIC DSC device
- Easy to learn and use
- Truly preemptive kernel
- Supports up to five tasks
- Fast performance
- Free bug fixes and updates
- No royalties on shipped products
- Compatible with RTOS/CMX-Tiny+ and RTOS/CMX-RTX
- Complete electronic documentation
- Integrated with TCP/IP-CMX-MicroNet for optional networking connectivity

RTOS/CMX-Scheduler Specifications for dsPIC DSCs

All CMX functions:	972 bytes
CMX initialize module:	153 bytes
CMX assembly module:	567 bytes
RAM, each task control block:	11 bytes
Flash, each task control block:	5 bytes
Min. context switch:	81 cycles (starting a task)
	102 cycles (resuming a task)

CMX Functions are contained in a library, thus reducing code size, if not referenced.

Functionality

- K_Task_Create – creates a task
- K_Task_Start – starts a task
- K_Task_Wake – wake a task
- K_Task_Wait – have a task wait with/without a time out
- K_Task_Kill – delete a task
- K_Task_Coop_Sched – perform a cooperative task switch
- K_Event_Wait – wait on an event
- K_Event_Signal – signal an event from a task
- K_Event_Signal – signal an event from an interrupt
- K_Event_Reset – reset an event for a particular task

TCP/IP-CMX-MicroNet™ for dsPIC30F

Summary

TCP/IP CMX-MicroNet is an embedded TCP/IP stack specifically designed for optimized use of Flash and RAM resources on Microchip's 16-bit dsPIC® Digital Signal Controller (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, TCP/IP CMX-MicroNet offers true TCP/IP networking via direct, dial-up or Ethernet connectivity and wireless Ethernet (802.11b).

Up to 127 Ethernet sockets and/or PPP or SLIP sockets can be open at a time, however PPP and SLIP cannot be used at the same time. An HTTP Web server, FTP server, SMTP client and DHCP client are also available. The RS-232 link, if used, can either be a direct cable link or through a modem.

TCP/IP CMX-MicroNet offers only industry standard protocols running right on your target processor. TCP/IP CMX-MicroNet offers a low, one-time fee and no royalties on deployed products. Full source code is provided.

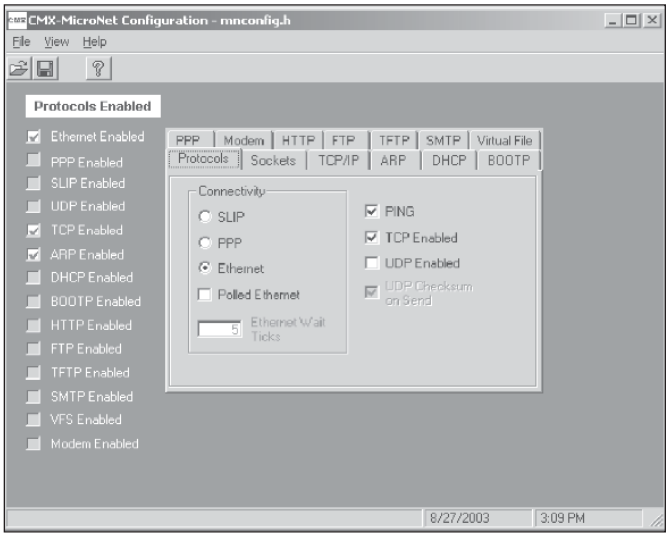
TCP/IP CMX-MicroNet Specifications for dsPIC® DSCs

Flash

UDP/IP + core	4470 bytes
TCP/IP + core	7827 bytes
UDP/TCP/IP + core	8685 bytes
PPP	6681 bytes
Modem	447 bytes
HTTP server	3888 bytes
Virtual file	885 bytes
Ethernet	2652 bytes
DHCP client	2202 bytes
FTP server	3657 bytes
TFTP client	723 bytes
BOOTP	684 bytes
SMTP	1918 bytes
Utility	1314 bytes

RAM (not including buffer sizes)

UDP/SLIP	56 bytes
TCP/HTTP/PPP	304 bytes
Ethernet	38 bytes



TCP/IP CMX-MicroNet is easy to configure and integrate with your application.

Features

Key features of TCP/IP CMX-MicroNet include:

- Tested and proven in hundreds of designs worldwide
- Extremely small Flash/RAM requirements
- Software solution does not require additional processor
- Web pages may contain CGI calls and server side includes
- FTP files, including new firmware
- Send E-mail
- Can serve up Java applets
- No proprietary protocols
- Runs stand-alone or with any RTOS
- Economical one time fee
- Full source code provided
- No royalties on shipped products
- Excellent documentation and support

Supported Protocols

TCP	PPP	UDP	SLIP	IP	DHCP
FTP	TFTP	SMTP	HTTP Web Server		

Connectivity

Ethernet, wireless Ethernet, dial-up, direct, (POP3 coming soon)

MICROCHIP
www.microchip.com

Application Solution: Sensorless BLDC Motor Control Using the dsPIC30F

Ready to Use Solution

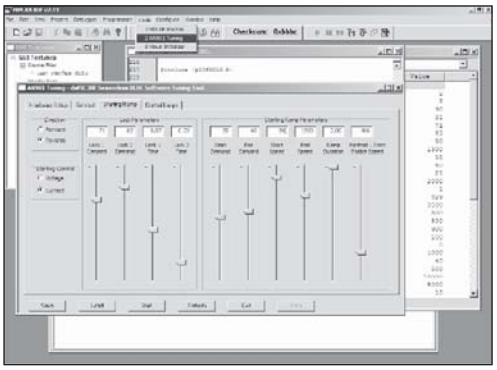
Microchip provides a proven, fully functional and highly flexible solution, for using the dsPIC30F, to control DC Brushless DC (BLDC) motors, without mechanical Hall-effect position sensors. The software makes extensive use of dsPIC30F peripherals for motor control. The algorithm implemented for sensorless control is particularly suitable for use on fans and pumps. The program is written in C and has been specifically optimized and well-annotated for ease of understanding and program modification/configuration.

Proven Software Source Code

The software can be downloaded from the Microchip web site (www.microchip.com) by searching for source code library part number SWAN0901.

Parameter Tuning User Interface

Manipulation of the source code for different motors can be accomplished through the use a graphical interface developed for this Application Solution, that allows you to manage/change certain motor specific parameters and control/tune settings/limits, used by the source code.

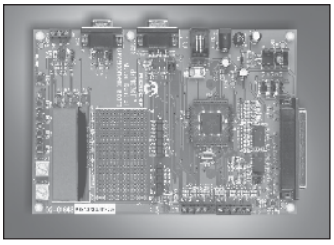


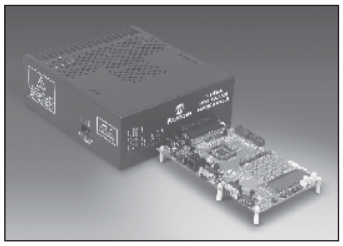
Capabilities of this Application Solution:

- Application includes adjustable parameters and two selectable starting methods to match the particular load
- Back EMF zero-crossing routine precludes the need for position sensing components
- Detects if the sensorless control algorithm gets lost
- Restarts the sensorless control without stopping the motor
- Program code size: 15 KB of Program Flash memory or less, depending on the features used
- RAM size: 276 bytes of data RAM memory

Hardware Development Platform:

- MC1 Motor Control Development Board (P/N DM300020)
- MC1L 3-phase Low-Voltage Power Module (P/N DM300022)
- 3-Phase BLDC Low Voltage Motor (24V) (P/N AC300020)





Additional Development Support:

- A working example of bringing the hardware and software together: Application Note AN901 support document on the Microchip web site
  - Go to www.microchip.com; search for AN901, download the .pdf document and the .zip source code file
- Motor Control Getting Started Guide (DS51406): document available on Microchip web site
- Microchip Motor Control Design Center: Extensive design support material; URL: www.microchip.com/motor
- MPLAB® ICD 2 In Circuit Debugger and Device Programmer (P/N DV164005)

Application Solution:
Using the dsPIC30F for Vector Control of an ACIM

Ready to Use Solution

Microchip's AC Induction Motor (ACIM) vector control solution that is written for the dsPIC30F family of devices. The solution presented requires a basic understanding of ACIM characteristics. The software makes extensive use of dsPIC30F peripherals for motor control. The program is written in C and has been specifically optimized and well annotated for ease of understanding and program modification.

Proven Software Source Code

The software can be downloaded from the Microchip web site by searching for source code library part number SWAN0908.

Hardware Development Platform:

- MC1 Motor Control Development Board (DM300020)
- MC1H 3-phase High-Voltage Power Module (DM300021)
- 3-Phase ACIM High Voltage Motor (208/460V) (AC300021)

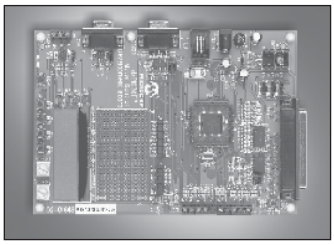
Additional Development Support:

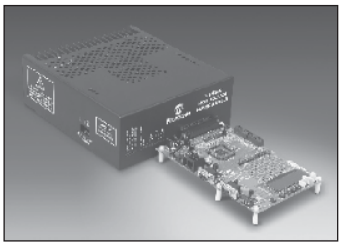
- A working example of bringing the hardware and software together: Application Note AN908 support document on the Microchip web site
  - Go to www.microchip.com; search for AN908, download the .pdf document and the .zip source code file
- Motor Control Getting Started Guide (DS51406): document available on Microchip web site
- Microchip Motor Control Design Center: Extensive design support material; URL: www.microchip.com/motor
- MPLAB® ICD 2 In Circuit Debugger and Device Programmer (P/N DV164005)

Capabilities of this Application Solution:

- The software implements vector control of an ACIM, using the indirect flux control method
- With a 50 usec control loop period, the software requires approximately 9 MIPS of CPU usage (less than one-third of the total available CPU)
- Optional diagnostic mode can be enabled to allow real-time observation of internal program variables on an oscilloscope; also facilitates control loop adjustment
- Program code size: 8 Kbytes of Program Flash memory
- RAM size: 512 bytes of data RAM memory

  NOTE: These memory requirements would be supported by a dsPIC30F2010 – the smallest dsPIC DSC targeted for motor control.





MICROCHIP

www.microchip.com

Application Solution:
Sensored BLDC Motor Control Using dsPIC30F2010

Ready to Use Solution

Microchip provides a fully working and highly flexible solution for using the dsPIC30F2010 to control Brushless DC (BLDC) motors, with the use of Hall Effect position sensors. The software makes extensive use of dsPIC30F peripherals for motor control. The program is written in C and has been specifically optimized and well annotated for ease of understanding and program modification.

Proven Software Source Code

The software can be downloaded from the Microchip web site by searching for source code library part number SWAN0957.

Hardware Development Platform:

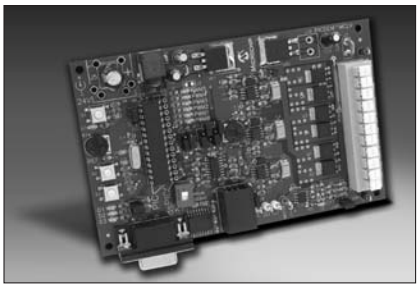
- PICDEM™ MC LV Development Board (DM300021)
- Hurst DMB0224C10002 CLB 6403 24V BLDC Motor (AC300020)

Additional Development Support:

- A working example of bringing the hardware and software together: Application Note AN957 support document on the Microchip web site
  - Go to www.microchip.com; search for AN957, download the .pdf document and the .zip source code file
- Motor Control Getting Started Guide (DS51406): document available on Microchip web site
- Microchip Motor Control Design Center: Extensive design support material; URL: www.microchip.com/motor
- MPLAB® ICD 2 In Circuit Debugger and Device Programmer (P/N DV164005)

Capabilities of this Application Solution:

- Source code provides both Open-Loop control and Closed-Loop control algorithms
- Potentiometer for speed control
- Reference AN901 for BLDC motor details
- Program code size: 2 KB of Program Flash memory
- RAM size: 180 bytes of data RAM memory



Application Solution: An Introduction to AC Induction Motor Control Using the dsPIC30F

Ready to Use Solution

Microchip demonstrates how to use the dsPIC30F to control an AC Induction Motor (ACIM). The solution presented requires a basic understanding of AC Induction Motor (ACIM) characteristics. The solution is based on the dsPICDEM Motor Control Development System, but can be used with alternative hardware, if needed. The program is written in assembly code and has been specifically optimized and well annotated for ease of understanding and program modification. It provides basic variable speed control of an ACIM.

Proven Software Source Code

The software can be downloaded from the Microchip web site by searching for source code library part number SWAN0984.

Hardware Development Platform:

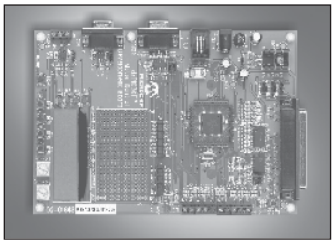
- MC1 Motor Control Development Board (DM300020)
- MC1H 3-phase High-Voltage Power Module (DM300021)
- 3-Phase ACIM High Voltage Motor (208/460V) (AC300021)

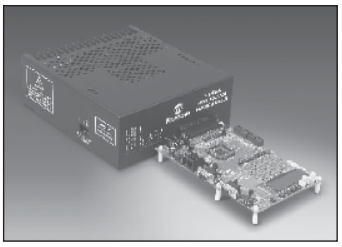
Additional Development Support:

- A working example of bringing the hardware and software together: Application Note AN984 support document on the Microchip web site
  - Go to www.microchip.com; search for AN984, download the .pdf document and the .zip source code file
- Motor Control Getting Started Guide (DS51406): document available on Microchip web site
- Microchip Motor Control Design Center: Extensive design support material; URL: www.microchip.com/motor
- MPLAB® ICD 2 In Circuit Debugger and Device Programmer (P/N DV164005)

Capabilities of this Application Solution:

- Supports Sinusoidal waveforms for motor drive
- Provides volts-hertz drive operation for various torque profiles
- Program code size: 1200 bytes of Program Flash memory
- RAM size: 86 bytes of data RAM memory.





Application Solution: Using the dsPIC30F for Sensorless BLDC Motor Control

Ready to Use Solution

Microchip provides a fully working and highly flexible solution for using the dsPIC30F2010, dsPIC30F3010 or the dsPIC30F4012 to control DC BLDC motors, without mechanical position sensors. The software makes extensive use of dsPIC30F peripherals, for motor control. The algorithm implemented for sensorless control is particularly suitable for use on fans and pumps. The program is written in C and has been specifically optimized and well annotated for ease of understanding and program

Proven Software Source Code

The software can be downloaded from the Microchip web site by searching for source code library part number SWAN0992.

Hardware Development Platform:

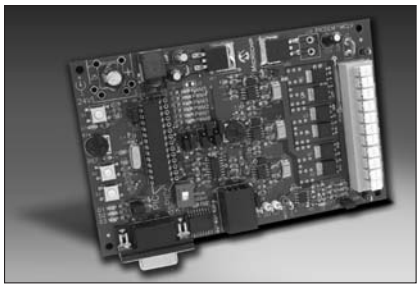
- PICDEM™ MC LV Development Board (DM300021)
- Hurst DMB0224C10002 CLB 6403 24V BLDC Motor (AC300020)

Additional Development Support:

- A working example of bringing the hardware and software together: Application Note AN992 support document on the Microchip web site
  - Go to www.microchip.com; search for AN992, download the .pdf document and the .zip source code file
- Motor Control Getting Started Guide (DS51406): document available on Microchip web site
- Microchip Motor Control Design Center: Extensive design support material; URL: www.microchip.com/motor
- MPLAB® ICD 2 In Circuit Debugger and Device Programmer (P/N DV164005)
- Application Note AN901

Capabilities of this Application Solution:

- Based on Application Note AN901
- This solution uses a 28-pin device (dsPIC30F2010, dsPIC30F3010 or the dsPIC30F4012) instead of a dsPIC30F6010
- Uses a potentiometer to select the motor speed
- A user interface is available to provide control of up to 45 control parameters
- Program code size: 10k bytes of Program Flash memory
- RAM size: 300 bytes of data RAM memory



MPLAB®
Visual Device Initializer

Summary

Configuring a powerful 16-bit MCU or DSP can be a complex and challenging tasks. MPLAB Visual Device Initializer (VDI) allows users to configure the entire processor graphically, and when complete, a mouse-click generates code usable in assembly or C programs.

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

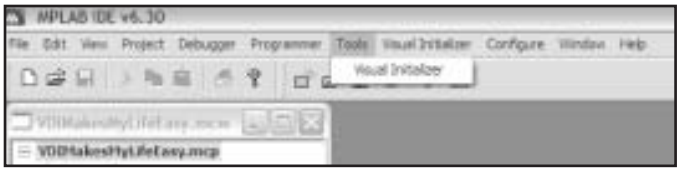
The detailed report on resource assignment and configuration simplifies project documentation.

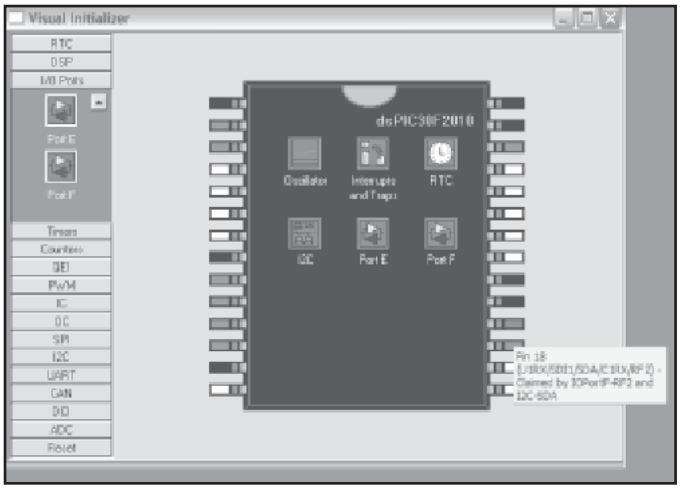
MPLAB VDI is a standard plug-in to MPLAB IDE Integrated Development Environment and can be invoked from within MPLAB under the Tools menu.

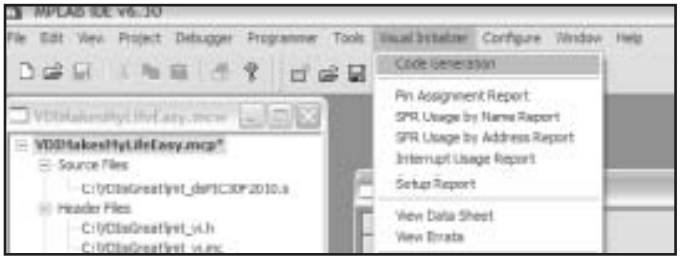
Features

Key features of the MPLAB VDI include:

- Drag and drop feature selection
- One click configuration
- Extensive error checking
- Generates initialization code
- Integrates seamlessly in MPLAB project
- Printed reports eases project documentation requirements







MICROCHIP

www.microchip.com

MPLAB® C30 C Compiler

Summary

The MPLAB C30 C Compiler is a fully ANSI compliant product with standard libraries for the dsPIC® Digital Signal Controller (DSC) architecture. It is highly optimizing and takes advantage of many dsPIC DSC architecture specific features to provide efficient software code generation. The MPLAB C30 C compiler also provides extensions that allow for excellent support of the hardware, such as interrupts and peripherals. It is fully integrated with the MPLAB IDE for high level, source debugging.

This compiler comes complete with its own assembler, linker and librarian to write mixed mode C and assembly programs and link the resulting object files into a single executable file.

The MPLAB C30 C Compiler is distributed with a complete ANSI C standard library. The library includes functions for string manipulation, dynamic memory allocation, data conversion, timekeeping, and math functions (trigonometric, exponential and hyperbolic).

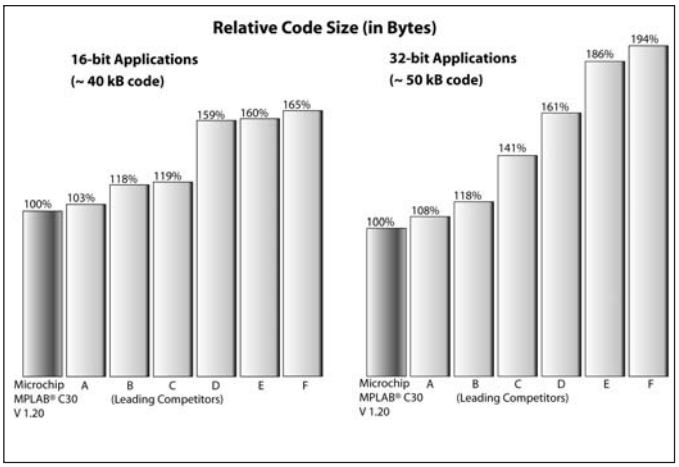
The compiler supports both large and small code and data models. The small code model takes advantage of a more efficient form of call instructions, while the small data model supports the use of compact instructions for accessing data in SFR space.

The MPLAB C30 C Compiler includes a powerful command-line driver program. Using the driver program, application programs can be compiled, assembled, and linked in a single step

Features

Key features of the MPLAB C30 C Compiler include:

- ANSI-compliant
- Integrated with MPLAB IDE for easy-to-use project management and source-level debugging
- Generates relocatable object modules for enhanced code reuse
- Fully compatible with object modules generated with MPLAB ASM30 Assembler, allowing complete freedom to mix Assembly and C in a single project
- Interrupt code can be written in C or Assembly
- Flexible memory models take advantage of small memory applications and the storage of data in SFR space



Features (Continued)

- Strong support for inline assembly when total control is absolutely necessary
- Super-efficient code generator engine with multi-level optimization
- Extensive library support, including standard C, math, DSP and dsPIC30F peripheral libraries
- Software libraries and application development tools are available

Package Contents

- MPLAB C30 C Compiler software
- MPLAB IDE software and documentation CD
- *MPLAB ASM30, MPLAB LINK30 and Utilities User's Guide*
- *MPLAB C30 C Compiler User's Guide*
- *dsPIC DSC Language Tools Getting Started*

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 for dsPIC30F (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 for dsPIC30F	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
	In-Circuit Debugger and Device Programmer with dsPICDEM™ Starter Development Board	DV164030	Microchip	$209
	In-Circuit Debugger and Device Programmer with dsPICDEM™ 1.1 General Purpose Board	DV164032	Microchip	$399
MPLAB® ICE 4000	In-Circuit Emulator Pod	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	Full Featured Device Programmer, Base Unit	DV007003	Microchip	$695
	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	AC1643	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
Starter Development Boards	dsPICDEM™ 28-pin Starter Development Board	DM300017	Microchip	$79
	dsPICDEM™ 64-pin Starter Development Board	DM300016	Microchip	$79
	dsPICDEM™ 80-pin Starter Development Board	DM300019	Microchip	$79.99
	dsPICDEM™ 2 Development Board	DM300018	Microchip	$99.99
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
	dsPICDEM.net™ 2 with CTR-21-compliant and Ethernet NIC support	DM300004-2	Microchip	$389

Plug-in Modules for Development Boards

A Plug-in Module (PIM) is a daughter board with a dsPIC30F device 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 MCU sample; use with DM300004-1, DM300004-2m DM30014 and DM300019 Development Boards	MA300011	Microchip	$25
	PC board with 64-pin dsPIC30F6012 general purpose MCU sample; use with DM300016 Development Board	MA300012	Microchip	$25
	PC board with 80-pin dsPIC30F6010 motor control MCU sample; use with DM300020 Development Board	MA300013	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	Free
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
	dsPIC30F Data Sheet, General Purpose and Sensor Families	DS70083
	dsPIC30F Data Sheet, Motor Control and Power Conversion Family	DS70082
	dsPIC33F Product 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
	dsPIC30F6010 Data Sheet	DS70119
	dsPIC30F6011, dsPIC30F6012, dsPIC30F6013, dsPIC30F6014 Data Sheet	DS70117
Reference Manuals	dsPIC30F Programmer's Reference Manual	DS70030
	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
Technical CD	dsPIC30F Technical CD-ROM (contains all of the above)	DS70084

(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
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

Worldwide Sales and Service

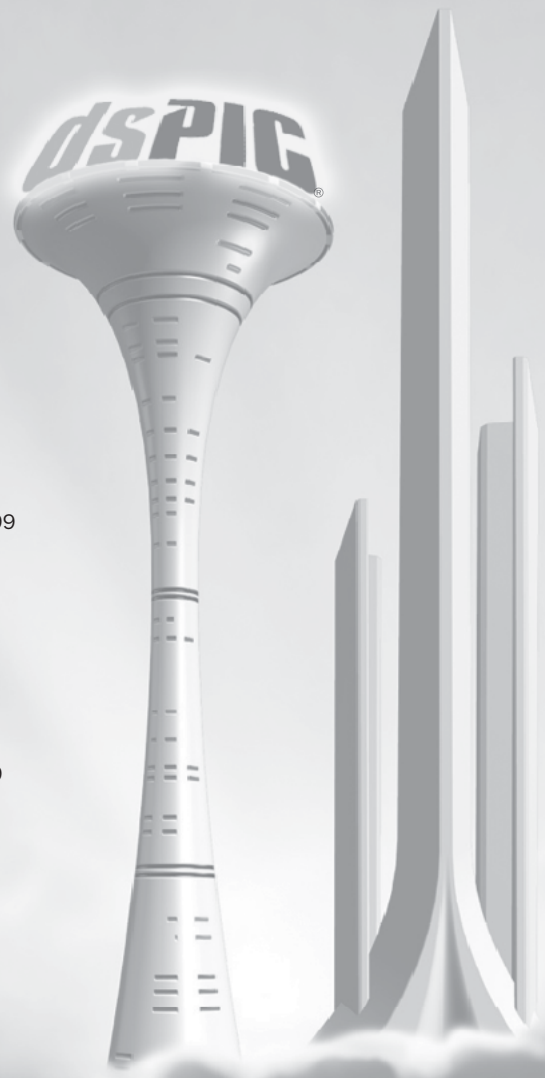
Technical Support: 480-792-7627
Web Address: www.microchip.com

AMERICAS

Atlanta	770-640-0034
Boston	774-760-0087
Chicago	630-285-0071
Dallas	972-818-7423
Detroit	248-538-2250
Kokomo	765-864-8360
Los Angeles	949-462-9523
San Jose	650-215-1444
Toronto	905-673-0699

EUROPE

Austria	43-7242-2244-399
Denmark	45-4450-2828
France	33-1-69-53-63-20
Germany	49-89-627-144-0
Italy	39-0331-742611
Netherlands	31-416-690399
United Kingdom	44-118-921-5869



ASIA/PACIFIC

Australia - Sydney	61-2-9868-6733
China - Beijing	86-10-8528-2100
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
Thailand - Bangkok	66-2-694-1351

MICROCHIP

www.microchip.com

2355 West Chandler Boulevard • Chandler, AZ 85224-6199 • Tel: 480-792-7200

Microcontrollers • Digital Signal Controllers • Analog • Serial EEPROMs