
Section 26. Development Tool Support

HIGHLIGHTS

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Note: Some development tools described in this section are not available at the time of this writing, however they are currently under development. Some of the product details may change. For the most current information and availability of each product, check the Microchip web site (www.microchip.com), or your local Microchip sales office.

26.1 INTRODUCTION

Microchip offers a comprehensive package of development tools and libraries to support the PIC24H Microcontroller (MCU) architecture. In addition, the company is partnering with many third party tool manufacturers for additional dsPIC device support.

26.2 PIC24H SOFTWARE AND HARDWARE DEVELOPMENT TOOLS

This section briefly describes some of the software and hardware development tools that are available for PIC24H family devices. For additional information, please refer to *“Tools and Solutions for the 16-bit Designer”* (DS01033), which is available from the Microchip web site (www.microchip.com).

The Microchip tools proposed include:

- MPLAB® Integrated Development Environment (IDE)
- PIC24H MCU Language Suite, including MPLAB C30 C Compiler, Assembler, Linker and Librarian
- Data Monitoring and Control Interface (DMCI)
- MPLAB SIM Software Simulator
- MPLAB Visual Device Initializer (VDI)
- MPLAB REAL ICE™
- MPLAB ICD 2 In-Circuit Debugger
- MPLAB PM3

26.2.1 MPLAB Integrated Development Environment Software

Note: This product is currently available on Microchip's web site, www.microchip.com.

The MPLAB Integrated Development Environment (IDE) is available at no cost. MPLAB IDE software is a desktop development environment with tool sets for developing and debugging a MCU design application. MPLAB IDE allows quick changes between different development and debugging activities. Designed for use with the Windows® operating environment, it is a powerful, affordable, run-time development tool. It is also the common user interface for Microchip's development systems tools, including MPLAB Editor, MPLAB ASM30 Assembler, MPLAB SIM software simulator, MPLAB LIB30 Library, MPLAB LINK30 Linker, MPLAB REAL ICE emulator, MPLAB PM3 programmer, and MPLAB ICD 2 In-Circuit Debugger.

The MPLAB IDE allows the user to:

- Edit source files in either Assembly or C
- Use one-touch compile and download to dsPIC MCU program memory on emulator or simulator (all project information is updated)
- Debug using:
 - Source files
 - Machine code
 - Mixed mode source and machine code

The MPLAB IDE supports multiple development tools with a single user interface. This means that if new tools are required in the development life-cycle, moving from the free simulator to a full-featured hardware debugger requires minimal effort.

26.2.2 MPLAB C30 C Compiler

The MPLAB C30 C compiler is a fully ANSI-compliant product with standard libraries for Microchip's 16-bit architectures. It is highly optimized and takes advantage of many PIC24H MCU-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.

26.2.3 MPLAB ASM30 Assembler, Linker and Librarian

MPLAB ASM30 Assembler produces relocatable machine code from symbolic assembly language for PIC24H MCU devices. MPLAB C30 C Compiler uses the assembler to produce its object file. The assembler generates relocatable object files that can then be archived or linked with other relocatable object files and archives to create an executable file.

26.2.4 MPLAB SIM Software Simulator

Note: This product is included with MPLAB IDE.

The MPLAB SIM Software Simulator allows code development in a PC-hosted environment by simulating PIC24H MCUs on an instruction level. On any given instruction, the data areas can be examined or modified and stimuli can be applied from a comprehensive stimulus controller. Registers can be logged to files for further run-time analysis. The trace buffer and logic analyzer display extend the power of the simulator to record and track program execution, actions on I/O, most peripherals and internal registers.

26.2.5 MPLAB Visual Device Initializer (VDI)

Note: This product is included with MPLAB IDE.

Configuring a powerful 16-bit MCU can be a complex and challenging task. MPLAB Visual Device Initializer (VDI) allows users to configure the entire processor graphically, and automatically generate code usable in assembly or C programs.

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

26.2.6 Data Monitoring and Control Interface (DMCI)

Note: This product is included with MPLAB IDE.

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

Feature highlights include:

- **MPLAB Project Aware** – The current device and software variables are recognized automatically by DMCI. Configuration is easy using property dialogs that simplify the details of attaching a variable to a particular control
- **Compiler Independent** – All Microchip C compiler tool suites are supported. Programs written in assembly language can be controlled as well
- **Debug Tool Independent** – DMCI works with all Microchip debug tools including the MPLAB SIM simulator
- **Provides Effortless Graphical Analysis of Application Historical Data** – Application data is accessed directly within MPLAB. Data can be easily plotted to any of 4 graphs for visual analysis. The application developer is required to develop code to export and view the data via alternative means such as an oscilloscope or external applications
- **Configuration Management** - All DMCI control settings can be saved to a configuration file for easy re-use and portability

26.2.7 MPLAB REAL ICE In-Circuit Emulator System

MPLAB REAL ICE In-circuit Emulation System is Microchip's next generation emulation and debugging system. This in-circuit emulation system provides a powerful in-circuit emulation platform for easy and rapid application development and debugging. The emulation is performed using special hardware logic on the target device, eliminating the need for a separate emulator device as well as ensuring that the emulator is the same as the target device. The REAL ICE system supports full-speed emulation, communicating with the target device through a traditional In-Circuit Serial Programming™ (ICSP™) interface (standard) or a high-speed, low-voltage differential signaling connection (for high noise immunity with longer cable lengths, especially for in-system emulation). Communication with MPLAB IDE on the host workstation is handled through a high-speed USB 2.0 interface.

26.2.8 MPLAB ICD 2 In-Circuit Debugger

Microchip's In-Circuit Debugger, MPLAB ICD 2, is a powerful, low-cost, hardware debugger, connecting to the host PC via an RS-232 or high-speed USB interface. The MPLAB ICD 2 utilizes the in-circuit debugging capability built into Microchip's Flash devices. This feature, along with Microchip's ICSP protocol, offers cost-effective, in-circuit debugging from the graphical user interface (GUI) of the MPLAB Integrated Development Environment. A designer can set breakpoints, single step and watch variables, CPU status, and peripheral registers. Hardware and applications can be tested in real time while running at full speed. MPLAB ICD 2 also serves as a development programmer for selected PIC devices.

26.2.9 MPLAB PM3 Device Programmer

MPLAB PM3 Device Programmer is a universal, CE-compliant device programmer with programmable voltage verification at VDDMIN and VDDMAX for maximum reliability. It features a large LCD display (128 x 64) for menus and error messages and a modular, detachable socket assembly to support various package types. The ICSP cable assembly is included as a standard item.

In Stand-Alone mode, MPLAB PM3 Device Programmer can read, verify and program MCU devices without a PC connection. It can also set code protection in this mode. MPLAB PM3 connects to the host PC via an RS-232 or USB cable. MPLAB PM3 has high-speed communications and optimized algorithms for quick programming of large memory devices and incorporates an SD/MMC card for file storage and secure data applications.

26.3 PIC24H DEVELOPMENT BOARDS

A full suite of cost-effective hardware development boards is available to support the PIC24H device family. This section provides a brief overview of these boards and their features. For additional information, refer to *“Tools and Solutions for the 16-bit Designer”* (DS01033), available from the Microchip web site (www.microchip.com).

26.3.1 Explorer 16 Development Board

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

Key features of the Explorer 16 Development Board include:

- Supports 100-pin PIC24HJ256GP610 (MA240012) plug-in module
- Supports the dsPIC33FJ256GP710 and the PIC24FJ128GA010
- Modular design for plug-in demonstration boards, expansion header
- RS-232 serial channel
- MPLAB ICD 2 support ready
- 2x16 LCD
- LEDs, switches and potentiometer

26.3.2 PICtail™ Plus Daughter Boards

The Explorer 16 board has been designed with the PICtail Plus modular expansion interface, allowing the board to provide basic generic functionality and still be easily extendable to new technologies as they become available.

PICtail Plus is based on a 120-pin connection divided into three sections of 30 pins, 30 pins and 56 pins. The two 30-pin connections have parallel functionality. For example, pins 1, 3, 5 and 7 have SPI1 functionality on the top 30-pin segment, with similar SPI functionality on the corresponding pins in the middle 30-pin segment.

Each 30-pin section provides connections to all of the serial communication peripherals, as well as many I/O ports, external interrupts and A/D channels. This provides enough signals to develop many different expansion interfaces, such as Ethernet, ZigBee™ Technology, IrDA® Protocol and so on. The 30-pin PICtail Plus daughter boards can be used in either the top or middle 30-pin sections.

The Explorer 16 board provides footprints for two edge connectors for daughter boards, one populated (J5, Samtec # MEC1-160-02-S-D-A) and one unpopulated (J6). The board also has a matching male edge connection (J9), allowing it to also be used as an expansion card.

- SD/MMC PICtail Plus Daughter Board (AC164122)
- Ethernet PICtail Plus Daughter Board (AC164123)
- Speech Playback PICtail Plus Daughter Board (AC164125)
- IrDA® Protocol PICtail Plus Daughter Board (Future)
- CompactFlash® PICtail Plus Daughter Board (Future)
- Wireless Communications PICtail Plus Daughter Board (Future)
- ADC/PWM Audio PICtail Plus Daughter Board (Future)

26.3.3 dsPICDEM 80-pin Starter Development Board

This development board offers an economical way to evaluate both the PIC24 and dsPIC MCU General Purpose and Motor Control families. This board is an ideal prototyping tool to help you quickly develop and validate key design requirements.

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

- 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

26.3.4 dsPICDEM 1.1 Plus Development Board

The dsPICDEM™ 1.1 Plus Development Board provides the application designer with a low-cost development tool to become familiar with the PIC24H 16-bit MCU.

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

Key features of the dsPICDEM 1.1 Plus Development Board include:

- Serial communication channels interface (two UARTs, SPI, CAN, RS-485)
- Si3000 voice band 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
- LEDs, switches and potentiometers
- Temperature sensor
- Separate digital and analog voltage regulators
- Digital potentiometer for DAC capability

26.3.5 16-bit 28-pin Starter Development Board

The 16-bit 28-pin Starter Development Board is an easy-to-use tool that allows you to begin development with 28-pin devices. The following capabilities are provided:

- Development Board Power
 - On-board +5V regulator or +3.3V regulator for VDD and AVDD
 - USB power source or 9V DC power source input jack
 - Power-on indicator LED
- MPLAB ICD 2 programming connector
- Single UART communication channel via USB bridge
- 7.37 MHz crystal device clocking
- Reset push button for resetting the device
- Four LEDs for status indicators
- Push button switch (SW1)
- Potentiometer (RP1) for use with ADC
- All device I/O pins are brought out to a header for test point and prototyping accessPIC24H Software Application Libraries and utilities

26.4 PIC24H SOFTWARE APPLICATION LIBRARIES AND UTILITIES

This section provides brief descriptions of application libraries and utilities available for use with PIC24H devices. For additional information, please refer to *Tools and Solutions for the 16-bit Designer* (DS01033), which is available from the Microchip web site (www.microchip.com).

26.4.1 Peripheral Library

The PIC24H/dsPIC Peripheral Library provides a set of functions for setting up and controlling the operation of all the peripheral modules available in the PIC24H MCUs, as well as functions for interfacing with an external LCD. The Peripheral Library serves as a convenient layer of abstraction over the specific details of the peripherals and their associated control and status registers.

The Peripheral Library supports the following hardware peripheral modules:

- Timers
- Input Capture
- Output Compare
- Real Time Clock Calendar (RTCC)
- Cyclic Redundancy Check (CRC)
- I/O ports and external interrupts
- Reset
- UART
- SPI
- I²C™
- Analog-to-Digital converter
- ECAN
- Direct Memory Access (DMA)
- Peripheral Pin Select
- Functions for controlling an external LCD through configurable I/O port pins are also provided

26.4.2 Math Library

The PIC24/dsPIC MCU Math Library is the compiled version of the math library that is distributed with the highly optimized, ANSI-compliant 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 include:

- Math Library that is callable from either MPLAB C30 or PIC24/dsPIC MCU Assembly language
- IEEE-754 compliant functions, with signed zero, signed infinity, NaN (Not a Number) and denormal support and operated in the “round to nearest” mode
- Compatibility with MPLAB ASM30 and MPLAB LINK30, which are available at no charge from www.microchip.com

26.4.3 Microchip TCP/IP Stack

Communication over the Internet is accomplished by implementing the TCP/IP protocol. Microchip offers a Free TCP/IP software stack optimized for the PIC18 microcontroller family and all 16-bit devices. The stack is a suite of programs that provide services to all TCP/IP-based applications. Users do not need to know all the intricacies of the TCP/IP specifications to use the stack. Based on the TCP/IP reference model, the stack is divided into multiple layers, where each layer accesses services from one or more layers directly below it. Per specifications, many of the TCP/IP layers are “live,” in the sense that they not only act when a service is requested, but also when events like time-out or new packet arrival occurs. The stack is modular in design and is written in the ‘C’ programming language. Effective implementations can be accomplished in roughly 20 Kbytes of code leaving plenty of code space available for the user’s application.

Key features of the Microchip TCP/IP Stack (ENC28J60 Driver) include:

- Available free for use on Microchip microcontrollers
- Socket support for TCP and UDP
- Portable across all PIC18, PIC24, dsPIC30F and dsPIC33F products
- Support for MPLAB C18, MPLAB C30 and Hi-TECH PIC-18 C compilers
- RTOS independent
- Full TCP state machine
- Modular design
- Supported by Ethernet PICtail Plus Daughter Board (AC164123)
- Supports the ENC28J60 Ethernet controller

26.4.4 FAT16 File System Library

The FAT 16 File System Library allows the designer to easily integrate a removable Flash-based media card up to 2 gigabytes into their application. The FAT16 File System Library is modular and provided in C source code to easily integrate into any application. This library requires 16 Kbytes of program memory to implement all the standard FAT16 functions: *fopen*, *fread*, *fwrite*, *fseek*, among others. The library also requires 1.5 Kbytes of RAM for the heap, read/write buffer, disk structures, and so on.

Key features of the FAT16 File System Library include:

- Available free for use on Microchip microcontrollers
- Portable across all PIC18, PIC24 MCU and dsPIC DSC products
- Support for MPLAB C18 C Compiler and MPLAB C30 C Compiler
- Supports SD/MMC and CompactFlash memory cards
- Supports up to 2 GB
- Supported by SD/MMC PICtail Plus Daughter Board (AC164122) and future CompactFlash PICtail Plus Daughter Board
- 16 Kbytes of program memory, 1.5 Kbytes of RAM

26.4.5 G.711 Speech Encoding/Decoding Library

The PIC24/dsPIC MCU G.711 Speech Encoding/Decoding Library performs toll-quality voice compression and voice decompression. The library is an implementation of the ITU-T G.711 standard on the PIC24H MCU. The encoding algorithm used is either A-law or μ -law companding (user-selectable), and features a 2:1 compression ratio. G.711 uses minimal computational resources, and a well-defined API makes it easy to integrate with the application.

The G.711 library can be used for both half-duplex and full-duplex systems. However, due to its high output data rate, it is most suitable for full-duplex communications applications that do not need to store the encoded speech for subsequent playback. Some target applications include:

- Intercoms
- Emergency phones
- Walkie-talkies
- Mobile hands-free kits
- Digital radios
- Voice-over-IP (VoIP) telephony

Key features of the G.711 Speech Encoding/Decoding Library include:

- Fixed 8 kHz input sample rate
- Fixed 64 kbps output data rate
- PESQ-based Mean Opinion Score (MOS): 4.3 to 4.5 (out of 5.0)
- A-law or μ -law based coding
- Two analog input interfaces – codec or on-chip ADC
- Two analog output interfaces – codec or on-chip PWM
- Playback-only applications benefit from the Speech Encoder Utility. Encoded files can be created from the desktop using a PC microphone or WAV file
- Storing compressed speech requires 8 KB of memory per second of speech
- FREE library
- Full compliance with Microchip's MPLAB C30 C compiler language tools
- Comprehensive user's guide is included to assist in utilizing the library
- Designed to run on dsPICDEM™ 1.1 Plus Development Board

26.4.6 Triple DES/AES Encryption Libraries

Microchip offers a reliable security solution for embedded applications built on the 16-bit microcontroller platform. This solution is provided by means of a single library. This library features the symmetric key encryption/decryption functions Advanced Encryption Standard (AES) and Triple-Data Encryption Algorithm (Triple-DES).

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:
 - AES
 - Triple-DES
- Random number generator functions: Deterministic Random Bit Generator ANSI X9.82

Encryption library features include:

- Optimized for speed, code size and RAM usage
- Library functions tested for adherence to applicable standards
- Application note describing APIs
- Several examples of use are provided for each library function

26.5 RELATED APPLICATION NOTES

This section lists application notes that are related to this section of the manual. These application notes may not be written specifically for the PIC24H device family, but the concepts are pertinent and could be used with modification and possible limitations. The current application notes related to the Development Tool Support are:

Title	Application Note #
No related application notes at this time.	

Note: For additional application notes and code examples for the PIC24H device family, visit the Microchip web site (www.microchip.com).
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26.6 REVISION HISTORY

Revision A (May 2007)

This is the initial released version of the PIC24H Development Tool Support section.

NOTES: