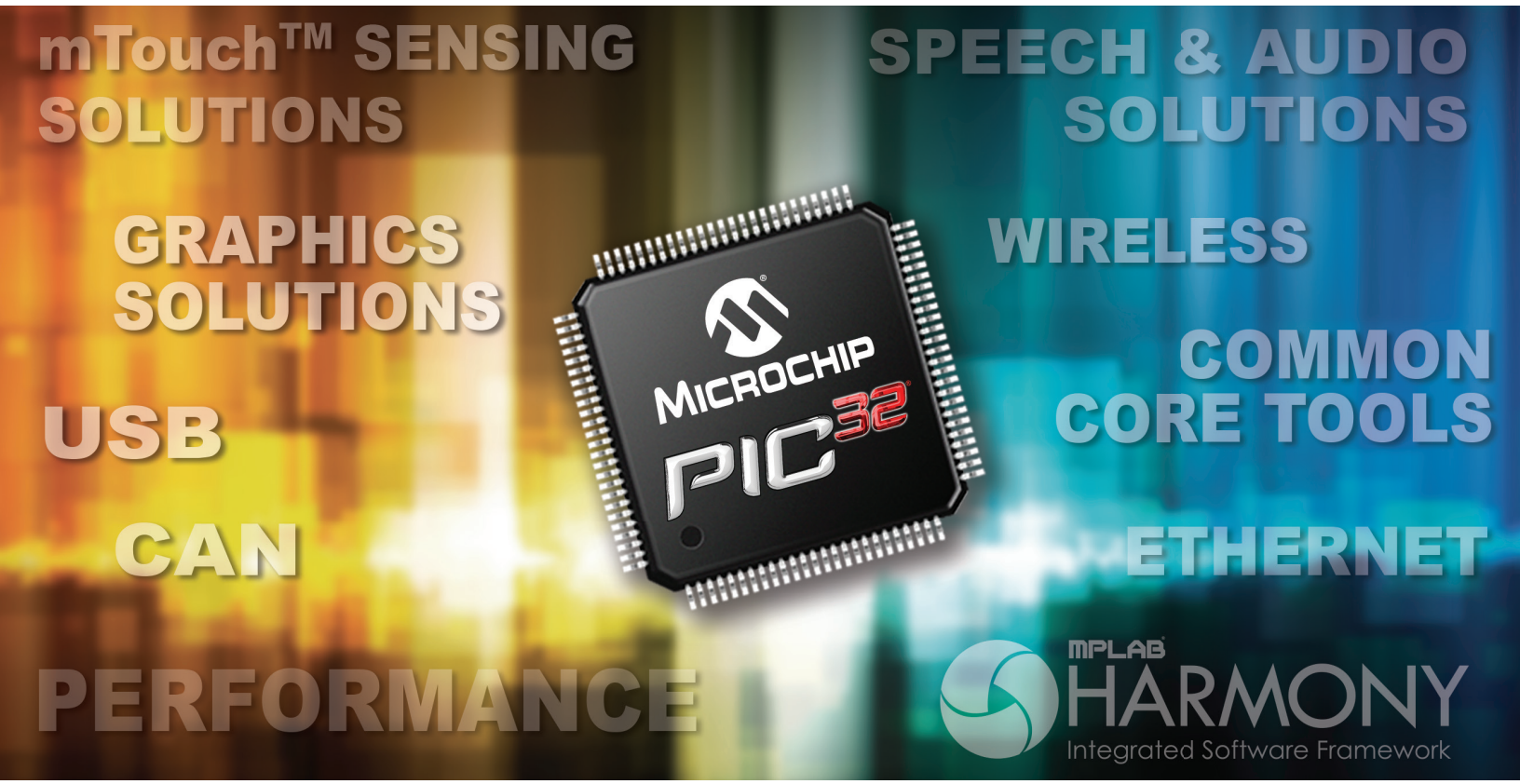
32-bit Software and Hardware Resources

MICROCHIP

Software and Hardware Solutions for the 32-bit Designer



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MPLAB Harmony Software Framework compatible.

Additional software libraries listed in this brochure are planned to be included in MPLAB Harmony in the future.

MPLAB® Harmony for PIC32

Introduction

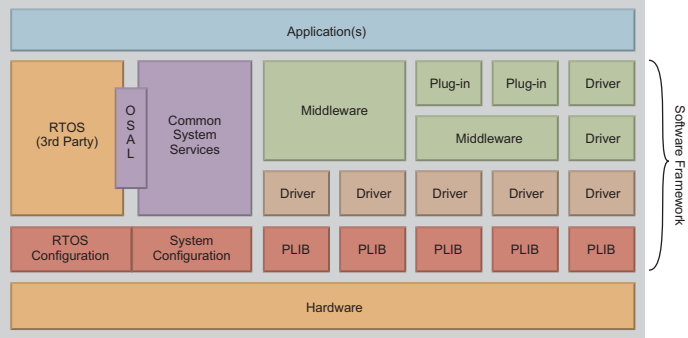
MPLAB Harmony is a flexible, abstracted, fully integrated firmware development environment for PIC32 microcontrollers. It enables robust framework development of interoperable RTOS-friendly libraries with quick and extensive Microchip support for third party software integration. MPLAB Harmony includes a set of peripheral libraries, drivers and system services that are readily accessible for application development. The code development format allows for maximum re-use and reduces time-to-market.

Benefits

- Faster time-to-market
- Improved code interoperability
- Simplified support
- Improved 32-bit scalability
- Enhanced third party software integration

MPLAB HARMONY
Integrated Software Framework

MPLAB Harmony Block Diagram



PIC32 Software Development Tools Available with MPLAB Harmony

Applications	Operating System Abstract Layer (OSAL)	Middleware/ Software Libraries	Device Drivers	Development Software	Third Party Software
■ Graphics applications ■ TCP/IP applications and utilities ■ USB applications	■ OSAL interface with "basic" and "none" implementation ■ OSAL implementation for FreeRTOS ■ OSAL implementation for Micrium µC/OS-III	■ Graphics ■ TCP/IP ■ USB ■ Cryptographic libraries ■ File systems ■ System services	■ ADC ■ Ethernet media access controller ■ Ethernet PHY interface ■ Controllerless graphics ■ Epson LCD controller ■ Non-volatile memory ■ SPI, UART, high-speed USB ■ Timer, parallel master port	■ MPLAB® X IDE ■ MPLAB XC32++	■ FreeRTOS* ■ OpenRTOS* ■ TCP/IP* ■ SSL libraries ■ Micrium µC/OS-III

Additional software components planned
*Sold and front-line support provided directly by Microchip

Application Layer

- Implements desired overall behavior
- Abstracted hardware access
- Allows for easy port across PIC32 parts

Common System Services

- Provides common functionality to avoid duplication and conflicts
- Eliminates complex interactions and interdependencies between modules
- OSAL provides OS compatibility and interface
- Manages shared resources
- Supports low-level configuration and board support package

Middleware Layer

- Implements complex libraries and protocols (USB, TCP/IP, file systems, graphics)
- Provides a highly abstracted application program interface
- Libraries are thread safe and RTOS ready
- Built on drivers, PLIBS, system services
- Supports third party library integration

Device Driver Layer

- Provides highly-abstracted interface to peripheral
- Controls access to the peripheral
- Manages multiple hardware instances and software clients with select drivers
- Manages peripheral state and multiple peripheral instances
- Accesses hardware via PLIB
- Supports blocking or non-blocking code

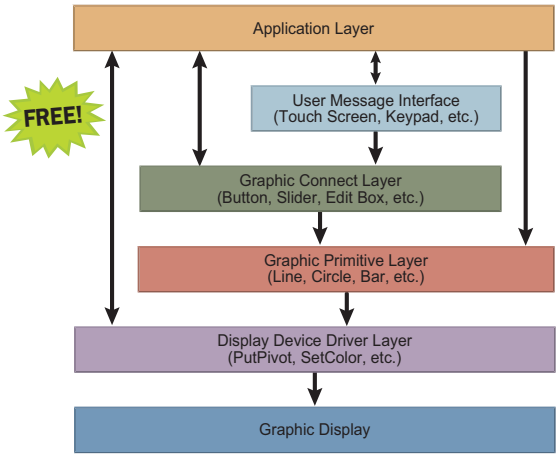
Peripheral Libraries (PLIB) Layer

- Provide functional interface for Microchip PIC32 scalability
- Implements part-specific features

FREE Graphics Library

Summary

Microchip provides a complete graphics library that allows users to quickly and easily implement a Graphical User Interface (GUI) on small, color, touch screen displays. The complete graphics display solution that will enable designer to quickly evaluate a graphics display solution at minimal cost.



Key Features

- Up to 16-bit or 65K colors
- 2D objects such as line, circle, text, rectangle, polygon, bar
- 3D objects such as buttons, panels, window, group box, slider
- Image, animation
- Resistive touch screen, keypad
- Multiple fonts

Applications

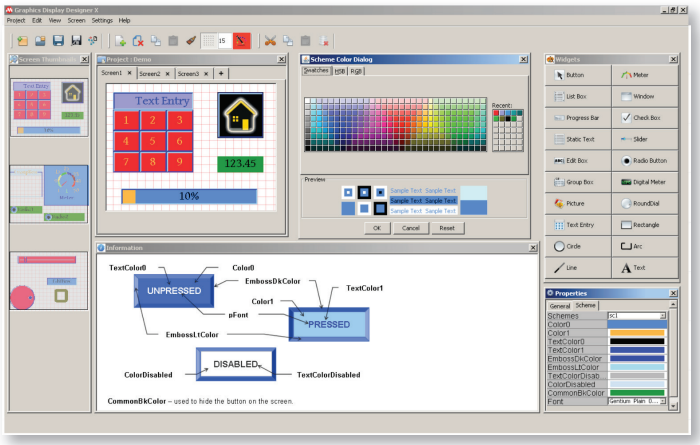
- MIMIC panels
- Hand-held devices
- Many other applications that require front-end graphics display

Related Application Notes

- AN1182: *Fonts in the Microchip Graphics Library*
- AN1246: *How to Create Widgets in the Microchip Graphics Library*
- AN1227: *Using a Keyboard with the Microchip Graphics Library*
- AN1136: *How to Use Widgets in the Microchip Graphics Library*

Graphics Display Designer X

The Microchip's New Graphics Display Designer X (GDD X) is an enhanced visual design tool that provides customers with a quick and easy way of creating GUI screens for graphical interface applications on Microchip MCUs. It can be used with Microchip Graphics Library as a standalone tool or as an MPLAB X IDE plug-in.



What's New?

- WYSIWYG design
- Multi-platform
  - Windows® , Linux® , Mac®
- Improved design tools
  - Drawing grid, auto widget alignment and other drawing short cuts/productivity features
  - Cut, copy, paste properties
- Improved Screen navigation
  - PowerPoint® style screen listing

Key Features

- Allows you to resize, align and move widgets, create color schemes, and add fonts and images to your application
- Generates source code ready for PIC32 microcontrollers
- Provides the user with the same visual representation of the embedded screen to draw objects on the PC screen, this is referred to as "what you see, is what you get" (WYSIWYG)
- Eliminates the need to manually calculate the (x, y) coordinates for on-screen object placements

USB Library

Summary

Microchip's USB software includes royalty-free source code and example projects. It provides support for USB device mode, embedded host and On-The-Go for PIC32 microcontrollers.

Key Features

- Drivers and resources to use with a PC
- Demonstration examples
- Class driver examples for:
  - HID
  - Mass Storage
  - CDC
  - Audio
  - Printers
  - Chargers
  - Custom

Applications

- USB mouse and keypads
- Thumb drive data loggers
- Mass storage devices
- Printers
- Bar code scanners
- CDC serial emulators

Related Application Notes

- AN1140: *USB Embedded Host Stack*
- AN1141: *USB Embedded Host Stack Programmer's Guide*
- AN1142: *USB Mass Storage Class on an Embedded Host*
- AN1143: *Generic Client Driver for a USB Embedded Host*
- AN1145: *Using a USB Flash Drive with an Embedded Host*
- AN1233: *USB Printer Class on an Embedded Host*
- AN1247: *Communication Device Class (CDC) Host*

TCP/IP Stack

Summary

Communication over the Internet is accomplished by implementing the IP protocol. Functions like web pages, email and FTP are advanced services that are part of a full IP stack implementation. Microchip offers free full TCP/IP software stack optimized for the PIC32 family of MCUs and operate seamlessly with the ENC28J60/ENC624J600 standalone Ethernet controllers and MRF24WG0M and MRF24WB0M Wi-Fi modules as well as built-in MAC modules. This provides an out-of-box solution to many Internet services such as web server. The user does not need to understand RFCs or write detailed IP standards-based code to implement the stack.

Microchip offers an IPv4/v6 stack that supports multiple communication ports (eg. Ethernet and Wi-Fi) in the MPLAB Harmony environment for the 32-bit device family. Microchip's MPLAB Harmony (v4/v6) TCP/IP stack supports the PIC32MX6/7 and PIC32MZ 32-bit MCU family for both Ethernet and Wi-Fi.

In addition, Microchip offers seamless integration with tested third party add-ons for professional stacks and other capabilities in MPLAB Harmony.

Key Features of Free Stacks

- Socket (TCP and UDP) and advanced service support
- Support for MPLAB XC compilers
- RTOS independent
- Full TCP state machine
- Modular design

Supported Services/Protocols

- ARP
- ICMP v4/v6
- TCP
- NDP
- Telnet
- SMTP
- DHCP
- NBNS
- Bonjor
- NetBios
- DDNS
- IP
- UDP
- SNMP v1/2/3
- HTTP
- SNTP
- DNS
- FTP
- TFTP
- mDNS
- Announce

Applications

- UART to TCP bridge
- Ethernet to Wi-Fi bridge
- ZigBee® to Wi-Fi/Ethernet bridge
- Cloud and remote sensor monitoring and control

File System Library for PIC32 Microcontrollers

Summary

The File System Library for PIC32 MCUs provides an application programming interface (API) through which a utility or user program requests services of a file system. Some file system APIs may also include interfaces for maintenance operations, such as creating or initializing a file system and verifying the file system for integrity. The File System Library is designed as per the manifesto of MPLAB Harmony. It supports access to multiple media such as USD and SD Cards, and it also supports multiple native file systems such as FatFs and MPFS.

Key Features

- Modular structure: The File System is written in a modular structure where the layers are defined and separated
- Portability: Uses hardware-dependent low-level interface layers that are clearly defined and separated, making the File System easy to port
- Supports multiple native file systems including FatFs and MPFs
- Supports multiple media: Each media appears as individual volumes to the user code. With the File System library, the user application can access each of the volumes without bothering about the physical media used.
- Supports both static media (SD Card, non-volatile memory etc.) and dynamic media (mass storage device). Dynamic media can be attached or detached from the system dynamically and the FS supports such media.
- Support for long file names is available
- Supports media with multiple partitions

Cryptographic Library

Summary

Microchip offers a reliable security solution for embedded applications built on the 32-bit MCU platform. The Cryptographic Library features cryptographic, authentication, compression and random number routines for use on PIC32MX and PIC32MZ families.

- Authentication capabilities
  - MD5
  - SHA-1
  - SHA-256
  - SHA-384
  - SHA-512
  - HMAC
- Cryptographic capabilities
  - AES
    - 128-, 192-, 256-bit key lengths
    - CBC, CTR, GCM, and CCM-8 modes
  - RSA
  - DES/Triple DES
  - Elliptic Curve Cryptography (ECC)
- Random number capabilities
  - Single random number
  - Block of random numbers
- Compression capabilities
  - Huffman encoding

PIC32 Microcontroller Peripheral Library

Summary

Peripheral libraries provide a set of C language functions for setting up and controlling PIC32 MCU peripherals. The function implementations are provided as “inline” headers and pre-built binaries. Their implementations may change from one PIC32 MCU family to another, but the function names and data types remain the same to make it easy to port code from one PIC32 MCU to another.

Key Features

- C language functional abstraction of peripherals
- Consistent interface across all PIC32 MCU families
- PIC32 MCU part-family variant specific implementations
- Index parameter provides access to multiple identical peripherals on parts that support them (ex. PIC32MX795F512L has 6 UARTs but only requires one peripheral library to control them all)
- Functions are defined as “inline” within C language header “.h” files for greater efficiency, but are also provided as highly optimized pre-build binary “.a” files for users of free versions of the XC32 compiler
- Pre-built binary libraries can be called from C-language or assembly language code
- Provides thin, direct access, abstraction layer (no blocking, no global data)
- Used primarily to implement MPLAB Harmony drivers and system services, but are completely documented and available to applications if required

MP3 Decoder Library

Summary

MP3 is a compression format for storing digital audio data. It is an audio codec that has the capability to compress the original audio sources with minor loss in sound quality. The higher the compression ratio, the lower the audio quality, which requires designers to perform a delicate balancing act between the file size and audio quality. With the right combination, MP3 encoded data can provide very high-quality audio.

Microchip offers a compact MP3 Decoder Library that enables usage on small memory-footprint PIC32 devices, which reduces system level cost. The library requires only 28 MIPS of performance (CD quality audio), 42 KB and 11 KB RAM memory for operation on the PIC32 device. It is available as modifiable source code and non-modifiable binary code.

AAC Decoder Library

Summary

Microchip provides an Advanced Audio Coding (AAC) Decoder library featuring easy-to-use APIs for decoding an audio stream using AAC encoding. The AAC Decoder is designed for 80 MHz or greater PIC32 MCUs. This code requires 62 MIPS peak/34 MIPS average performance, 61 KB Flash and 12 KB RAM without frame buffer memory for operation on the PIC32 MCU. The AAC Decoder library is available in both non-modifiable binary code and source code formats for use that enables on high-performance PIC32 devices.

The AAC Decoder library supports the following:

- Sample rates:
  8, 11.025, 12, 16, 22.05, 24, 32, 44.1, 48, 64, 88.2 and 96 kHz
- Bit rates:
  32, 40, 48, 56, 64, 80, 96, 112, 128, 160, 192, 224, 256, 320, 384 kbps and VBR

FREE Fixed Point Math Library

Summary

The LibQ Fixed Point Math Library simplifies writing fixed point algorithms, supporting Q15, Q31 and other 16-bit and 32-bit data formats. Using the simple, C-Callable functions contained in the library, fast fixed-point mathematical operations can be easily executed. Fixed point mathematical calculations may replace some functions implemented in the floating point library (math.h), depending on performance and resolution requirements.

Functions included in the LibQ library include capabilities for trigonometric, power and logarithms, and data conversion. These functions are implemented in efficient assembly, and generally tuned to optimize performance over code size. In some cases the library breaks out functions that enable one to be optimized for accuracy, while another version is optimized for speed. Each of these functions is typically used in computationally intensive real-time applications where execution time is a critical parameter.

Key Features

- C-Callable functions for easy execution of fast fixed point mathematical operations
- Functions include capabilities for trigonometric, power and logarithms and data conversion
- Contains functions for supporting Q15, Q31 and other intermediate integer representations
- Implemented in efficient assembly and tuned to optimize for performance and accuracy

Sample Function	Details	Clock Cycles (Operating from Instruction Cache, Typical)	Completion Time (µs) @ 200 MHz (PIC32MZXXX)
Power (x^y)	Q16 power	882	4.41
Sine	Q15 result, sine(Q2.13)	100	0.5
Sqrt	Q16 square root	240	1.2
Ln	Q4.11 result, natural log(Q16)	301	1.51
Exp (e^x)	Q16 exponential	170	0.85
Tangent	Q7.8 result, tan(Q2.13)	288	1.44

The LibQ Fixed Point Math Library is available for the PIC32MZ family of micrcocontrollers. This library was created from optimized assembly routines written specifically for the microAptiv™ core.

FREE Fixed Point DSP Library

Summary

The Fixed Point DSP Library contains building block functions for developing digital signal processing algorithms. The library supports the Q15 and Q31 fractional data formats, which are integer fixed point data types that represent floating point values. The functions are implemented in efficient assembly specifically targeted at the DSP extensions in this core family. The library makes these functions available in a simple C-callable structure. Functions included in the Fixed Point DSP Library include complex math, vector math, matrix math, digital filters and transforms. In many cases, these functions require specific data structures to operate, which are detailed in the header file and examples. Some functions in the library also take advantage of the floating point math library.

The Fixed Point DSP Library is a superset of the original PIC32 Microcontroller DSP library still offered with the MPLAB XC32 compiler. The library has been improved to contain more than 90 functions, and will continue to grow.

Key Features

- C-Callable DSP functions optimized in assembly
- Digital filtering structures including parallel and series (cascade) Infinite Impulse Response (IIR) biquad functions
- Vector manipulation (reverse, shift, inverse), comparison and statistics functions
- The PIC32 DSP Library provides functions including the following:
  - 16- and 32-bit vector basic math, trigonometric and power functions
  - Vector RMS, power, max / min, mean, dot product
  - Complex math
  - Matrix math
  - Finite Impulse Response (FIR) filters, decimation, interpolation
  - Infinite Impulse Response (IIR) filters with different biquad architectures
  - Least Mean Squares (LMS) filter
  - 16- and 32-bit Fast Fourier Transforms (FFTs), inverse FFT
  - Six different windowing functions, each 16- and 32-bit
  - Quick support functions for numerical transforms

Function	Details	Clock Cycles (Operating from Instruction Cache)	Completion Time (µs) @ 200 MHz (PIC32MZXXX)
IIR Filter (Biquad Transposed Direct Form 2)	Serial processing 16-bit daya through pipeline 8-stage serial filter	198	0.99
FIR Interpolation Filter	32-bit, 8 inputs, 6 taps, 3× interpolation	1048	5.24
FIR Decimation Filter	32-bit, 5 taps, decimation rate 3, 8 outputs	1002	5.01
Complex FFT	64-point, 16-bit data	3546	17.73
Complex FFT	128-point, 16-bit data	8066	40.3
Complex FFT	256-point, 16-bit data	18866	94.3
Complex FFT	512-point, 16-bit data	67354	366
Matrix Add	32-bit, each matrix 4 × 4 elements	246	1.23
Matrix Transpose	32-bit, 4 × 4 matrix	152	0.76
Vector Maximum	16-bit, 8-element vector	64	0.32
Vector RMS	16-bit, 8-element vector	370	1.85
Vector Dot Product	16-bit, 8-element vector	102	0.51
Vector Power (Sum of Squares)	16-bit, 8-element vector	78	0.39
Vector Variance	16-bit, 8-element vector	192	0.96
Vector Standard Deviation	16-bit, 8-element vector	444	2.22
Complex Dot Product	32-bit	24	0.12

The Fixed Point DSP Library is available for the PIC32MZ family of microcontrollers. The library was created from optimized assembly routines written specifically for the microAptiv core.

PIC32 Microcontroller Floating Point Math Library

Summary

The optimized PIC32 Math Library is packaged within the MPLAB XC32 Compiler for PIC32 MCUs. The floating-point math library provided with the compiler has been significantly optimized to take full advantage of the PIC32 MCU instruction set. Single- and double-precision math library functions are now available, giving users a choice between these operations. The library provides the greatest benefit for the more complex operations and offers a greater than 5 × performance improvement over the previous versions of library for many operations.

Key Features

- 22 optimized math library functions for faster execution and less power consumption
- Available in single- or double-precision
- The functions are ANSI-89 compliant
- IEEE 754 Compliant

Math Table

Function	Description	Average Single Precision Performance (Cycles)	Time (µs) PIC32 MCU @ 80 MHz	Time (µs) PIC32 MCU @ 200 MHz
sin/sinf*	Sin of a double/single precision floating point variable	299	3.7375	1.495
cos/cosf*	Cos of a double/single precision floating point variable	299	3.7375	1.495
tan/tanf*	Tan of a double/single precision floating point variable	389	4.8625	1.945
exp/expf*	Calculates the exponential function of a double/single precision floating point variable	133	1.6625	0.665
fabs/fabsf*	Calculates the absolute value of a double/single precision floating point variable	6	0.075	0.03
fmod/fmodf*	Calculates the remainder of x/y as a double/single precision floating point value	86	1.075	0.43
log/logf*	Calculates the log of a double/single precision variable	301	3.7625	1.505
sqrt/sqrtf*	Calculates the square root of a double/single precision variable	237	2.9625	1.19
pow/powf*	Calculates x raised to the power of y	367	4.5875	1.835
floor/floorf*	Calculates the floor of a double/single precision floating point variable	33	0.4125	0.165
ceil/ceilf*	Calculates the ceiling of a double/single precision floating point variable	34	0.425	0.17
asin/asinf*	Arc sin of a double/single precision floating point variable	618	7.725	3.09
acos/acosf*	Arc cos of a double/single precision floating point variable	685	8.5625	3.425
atan/atanf*	Arc tan of a double/single precision floating point variable	353	4.4125	1.765

*"f" denotes single precision floating point number.
A complete list of floating point math functions is available in the MPLAB XC32 C Libraries Manual.

FREE PIC32 Microcontroller DSP Library

Summary

Microchip's PIC32 DSP Library enables developers to add DSP capabilities to many applications by taking advantage of the highly optimized hardware features inside the PIC32 MCU, including its multiply-accumulate, math unit with parallel execution and two full sets of CPU registers. Additionally, this DSP Library's use of a RADIX-2 based FFT provides more options for sample size than the RADIX-4 designs. The PIC32 DSP Library allows users to select from the common 64-, 128-, 256-, 512- and 1024-point FFTs as well as other sizes. The PIC32 DSP Library also includes support for 32-bit FFTs. PIC32 DSP Library is a part of Microchip's free DSP Library package in MPLAB XC32 Compiler for PIC32 MCUs.

Key Features

- C callable DSP functions written in assembly using the standard MIPS DSP library APIs
- Easy FFT eliminates setup function
- Complete function profile information including register usage, cycle count and function size information

FFT Benchmarks (Radix-2) Measured on PIC32 MCUs @ 80 MHz	
16-bit, 256 point	283 µs
16-bit, 512 point	630 µs
16-bit, 1024 point	1.39 ms
32-bit, 512 point	617 µs

The PIC32 DSP Library provides functions for the following:

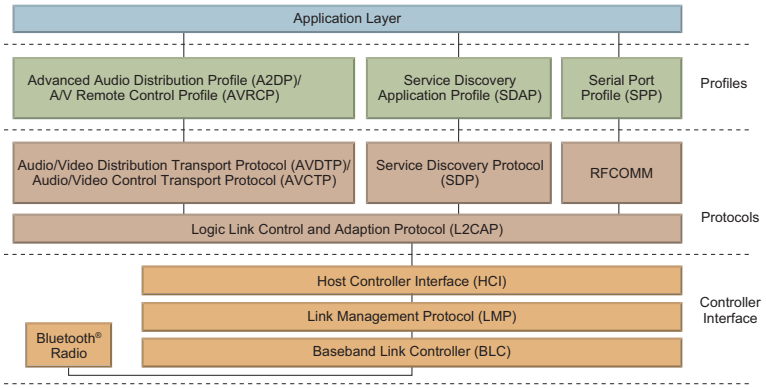
- 16- and 32-bit vector math
- Finite Impulse Response (FIR) Filter
- Infinite Impulse Response (IIR) Filter
- Least Mean Squares (LMS) Filter
- 16- and 32-bit Fast Fourier Transforms (FFTs)

PIC32 Bluetooth® Audio Software Suites

Summary

The Bluetooth audio software stack enables Bluetooth devices to locate each other and establish connections to exchange data and interact with one another. Here is the block diagram of Microchip's Bluetooth audio stack illustrating its various protocols and profiles. It consists of the controller interface, the Bluetooth protocols which form the Bluetooth core and the Bluetooth profiles.

Microchip offers two Bluetooth audio software suites, one with SBC CODEC and the other with both SBC and AAC CODEC. The Advanced Audio Distribution Profile A2DP, Audio/Video Remote Control Profile AVRCP, Serial Port Profile SPP and Service Discovery Protocol SDP are common to both suites.



PIC32 Bluetooth Audio Software Suite 1

This suite contains projects for USB and Bluetooth audio. One project supports Bluetooth audio (SBC decoding) and another supports Bluetooth (SBC) and USB audio. The Microchip Bluetooth stack for audio streaming with the standard SBC software CODEC is provided as a non-modifiable binary file combined with source code for usability. It includes the Advanced Audio Distribution Profile A2DP, Audio/Video Remote Control Profile AVRCP, Serial Port Profile SPP and Service Discovery Protocol SDP. This binary code is combined with source code for operation on the PIC32 Bluetooth Audio Development Kit (DV320032). Users have the option of accessing the USB Audio functionality or just the streamlined stack. This Bluetooth-only stack with graphics, based on FreeRTOS, requires 182 KB Flash and 41 KB RAM and operates efficiently on PIC32 microcontrollers.

PIC32 Bluetooth Audio Software Suite 2

This suite contains projects for USB and Bluetooth audio. One project supports Bluetooth audio (SBC and AAC decoding) and another supports Bluetooth (SBC) and USB audio. The Microchip Bluetooth stack for audio streaming with the standard SBC software CODEC plus the "Advanced Audio Coding" AAC software CODEC is provided as a non-modifiable binary file combined with source code for usability. It includes the Advanced Audio Distribution Profile A2DP, Audio/Video Remote Control Profile AVRCP, Serial Port Profile SPP and Service Discovery Protocol SDP. This binary code is combined with source code for operation on the PIC32 Bluetooth Audio Development Kit (DV320032). This complete Bluetooth with AAC-only stack, based on FreeRTOS, requires 248 KB Flash and 51 KB of RAM and operates efficiently on high-performance PIC32 microcontrollers.

FREE ADPCM and Speex (Audio) Library for PIC32 Microcontrollers

Summary

The audio library for PIC32 MCUs consists of APIs for Pulse Code Modulation, Adaptive Differential Pulse Code Modulation and Speex encoding and decoding algorithms. Speex is a Code Excited Linear Prediction (CELP) based, open source, patent-free audio compression format designed for speech. The ADPCM algorithm takes advantage of the high correlation between consecutive speech samples, which enables future sample values to be predicted.

Key Features

- Free software/open source, patent- and royalty-free
- Portable across all PIC32 microcontrollers
- Supported encoding formats: PCM (raw, uncompressed), IMA ADPCM, Speex
- Implements an audio player behavior with play, record, pause, stop functionality
- Supports standard input/output stream formats: Wave, Ogg for Speex, as well as a raw format containing just data
- Supports various sampling rates in both play and record mode
- Supports narrowband (8 kHz) and wideband (16 kHz) bit-streams for Speex
- Provides information about the missed samples
- User-selectable ratio between the sampling frequency and the play/record frequency

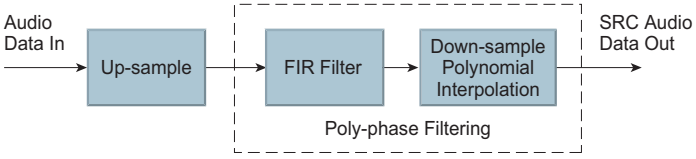
Applications

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

FREE Sample Rate Conversion Library

Summary

The Sample Rate Conversion (SRC) library, which can be used with Microchip's PIC32 and dsPIC33E families of devices, provides the ability to upconvert the sampling rate of real-time 16-bit stereo audio data. At run-time, the input sampling rate can be selected between 32 kHz or 44.1 kHz, with a fixed output sample rate of 48 kHz.



Key Features

- Stereo 16-bit audio sample rate conversion library
- Two common audio modes:
  - 32 kHz to 48 kHz conversion
  - 44.1 kHz to 48 kHz conversion
- Low MIPS and resource requirement
- Both PIC32 MCUs and dsPIC33E DSCs supported
- Can be used with low-cost DAC with limited sample rate capability
- Designed for streaming audio applications

Performance and Resource Consumption for PIC32 Library Modes

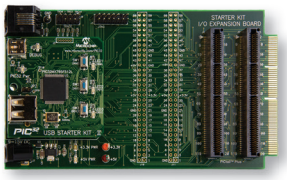
SRC Library Version	SRC Mode	MIPS	Code Size (bytes)	Data Size (bytes)	SNR (dB)
Lite Version	32k to 48 kHz	27.4	5684	1284	82
	44.1k to 48 kHz	30.1			82
Full Version	32k to 48 kHz	33.5	5760	1364	84
	44.1k to 48 kHz	36.7			82

Note: Tested with a 1 kHz full-scale sinusoidal signal.

FREE Software Library for Android™ Accessories

The PIC32 Accessory Development Starter Kit for Android provides all of the tools and resources required to get an accessory developer quickly started on Android devices. The platform provides a library for accessing and talking to Android devices through the accessory framework found in Android OS versions 2.3.4, 3.1 and later. Example applications show how to connect and communicate over the accessory framework using a simple bi-directional application. Firmware examples show how to complete the design using the Android accessory library, providing interface from the hardware portion of the design to the example application. Example schematics provide a starting point to get a hardware design started.

PIC32 Accessory Development Kit for Android (DM320412)

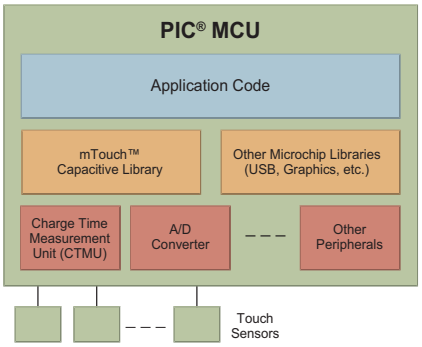


FREE mTouch™ Capacitive Touch Library

Summary

The mTouch software packages enable designers to easily integrate touch technologies into their applications. They allow capacitive touch implementation in a small dedicated controller as well as the integration of the complete application in a single MCU. Separate packages are available depending on the microcontroller: mTouch PIC16F Framework, mTouch PIC18/24/32 or dsPIC libraries. Software package features include:

- Multiple demo projects:
  - Swiping gesture
  - Proximity detection
  - Direct key sensing
  - Matrix key sensing: 2-channel sliders, 4-channel sliders
- Graphics integration with keys (runs on DM240312 board)
- Interoperability with Microchip Graphics and USB libraries
- Demo projects can be run directly on the enhanced mTouch Capacitive Evaluation Kit.



Application Notes for Capacitive Touch

- AN1334: *Techniques for Robust Capacitive Touch Sensing*
- AN1325: *mTouch Metal Over Cap Technology*
- AN1317: *mTouch Conducted Noise Immunity Techniques for CTMU Peripheral*
- AN1298: *Capacitive Touch Using Only an ADC (CVD) (suitable for PIC10/12/16/24H/32 MCUs and dsPIC DSCs)*
- AN1250: *Microchip CTMU for Capacitive Touch Applications (suitable for PIC18 and PIC24F MCUs)*
- AN1254: *Capacitive Touch Algorithm Simulation*

Smart Card ISO-7816 Library for PIC18F, PIC24, PIC32 Microcontrollers and dsPIC Digital Signal Controllers

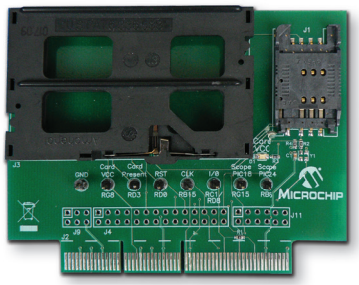
Summary

Microchip's Smart Card Library supports PIC18, PIC24, PIC32 microcontrollers and dsPIC digital signal controllers. It provides the API necessary to communicate with an ISO7816-3/4 compliant smart card. The Smart Card ISO-7816 Library is part of the Microchip Applications Library.

Key Features

- USART driver for ISO-7816-3 protocol
- High-level modular code with separate file for the high-level library code for easy scalability

Smart Card PICtail™ Daughter Card (AC164141)



Class B Safety Software Library for PIC Microcontrollers and dsPIC Digital Signal Controllers

Ref Application Note: AN1229, Ready-to-Use Solution

Summary

The Class B Safety Software Library routine detects the occurrence of faults in a single channel CPU. These routines have been developed in accordance with the IEC 60730 standard to support the Class B certification process. These routines can be directly integrated with the end user's application to test and verify the critical functionalities of a controller without affecting the end user's application. Application Note, AN1229 describes the Application Programming Interface (API) functions that are available in the Class B Safety Software Library.

Key Features

The following tests can be implemented using this library:

- CPU register test
- Program counter test
- Variable memory test
- Invariable memory (Flash/EEPROM) test
- Interrupt test
- Clock test

Applications

- Automotive applications
- Home appliances
- Home security devices

PIC32 CAN Library Using MCP2515 CAN Controller*

Summary

The PIC32 CAN Library is based on the MCP2515 CAN controller. The MCP2515 is connected to the PIC32 microcontroller via the SPI port. The Library provides seamless access to the CAN controller over the SPI bus.

Key Features

- Library provides enumerated interface
- Well-documented API functions
- The library supports 125 kbps, 250 kbps and 500 kbps bus speeds
- The MCP2515 supports a maximum SPI clock speed of 10 MHz

Applications

- Automotive applications
- Data loggers
- Physical layer for custom communication protocols

**This library is not for use with PIC32 MCUs with integrated CAN controllers. The CAN APIs for integrated CAN controllers are available in the MPLAB XC32 Compiler.*

IEEE 802.15.4 and Sub-GHz MiWi™ Development Environment

Summary

The MiWi Development Environment (MiWi DE) is Microchip's proprietary wireless solution which helps customers develop wireless applications and reduce the time to market. The protocol is optimized for low-power, low-data-rate, cost-sensitive application. It also offers a smaller footprint relative to the open standard-based ZigBee compliant protocol stack.

The main advantages of the MiWi Development Environment are:

- Ease in architecting and deploying wireless networks
- Portability of applications across different Microchip RF transceivers
- Ease in scaling network topologies under the MiWi protocol framework

The MiWi Development Environment package includes support for Microchip's proprietary protocols.

MiWi™

Your wireless connectivity made simple.

MiWi P2P

- Peer-to-peer network protocol stack
- Ultra-small footprint (4 KB of program Flash)

MiWi PRO

- Highly-optimized Mesh network protocol
- Up to 64 Hops of routing capability
- Up to 8000 nodes in a single network
- Small size ~25 KB program Flash

Applications

- Home, building and industrial automation
- Security systems
- Low-power wirless sensor networks
- Proprietary wireless products

Related Application Notes

- AN1066: *MiWi Wireless Networking Protocol Stack*
- AN1204: *Microchip MiWi P2P Wireless Protocol*
- AN1371: *MiWi PRO Wireless Networking Protocol*
- AN1284: *MiWi Application Programming Interface–MiApp*
- AN1283: *MiWi Media Access Controller–MiMAC*

Data EEPROM Emulation for PIC18, PIC24 and PIC32 Microcontrollers and dsPIC Digital Signal Controllers

Ref Application Note: AN1095, Ready-to-Use Solution

Summary

Microchip has expanded its product portfolio to include a wide variety of cost-effective PIC microcontrollers without an internal data EEPROM. Many applications store non-volatile information in the Flash program memory using table write and read operations. Applications that need to frequently update this data may have greater endurance requirements than the specified Flash endurance for the device. The alternate solution of using an external, serial EEPROM device may not be appropriate for cost-sensitive or pin-constrained applications. This application library presents a third alternative that addresses these issues. This algorithm features an interface similar to an internal data EEPROM, uses available program memory and can improve endurance by a factor as high as 500.

Key Features

- Easy-to-use application interface
- Memory sizes of 0 to 255 words per block
- Total EEPROM memory size limited only by Flash size
- Endurance increased by a factor of up to 500
- Endurance can be further increased by allocating additional program memory

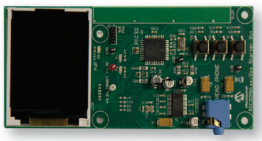
Applications

- Designs require to stored user-definable parameters
- Frequently updated calibration or adjustable parameters
- Saving critical data due to power failure

Starter Kits

PIC32 Starter Kits are the fastest and easiest way to start development. All starter kits have an on-board programmer/debugger, making this the only tool you need to get started.

PIC32MX1/MX2 Starter Kit (DM320013)



The PIC32 MX1/MX2 Starter kit (DM320013) is a complete solution for exploring the low-cost, high-performance PIC32MX1/MX2 devices. This kit is perfect for development of basic user interfaces with mTouch technology buttons and high-quality audio. The board is pre-loaded with demo code for an audio player. Simply download a free copy of MPLAB X IDE and the demo code source from the web to jump start your development effort.

Key Features:

- 24-bit audio playback
- Integrated programmer/debugger
- USB Powered
- 2" Color TFT Display: 220 × 176 pixels
- mTouch technology sliders and buttons
- PIC32MX250F128 with 128 KB of Flash and 32 KB RAM
- microSD™ Flash Card

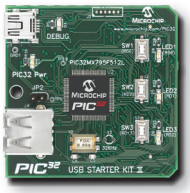
PIC32 Starter Kit (DM320001)

The PIC32 Starter Kit provides the easiest and lowest-cost method to experience the PIC32 microcontroller for the first time. With over 35 source code examples and a getting started project, users quickly learn Microchip's 32-bit family of microcontrollers and development tools. The kit includes everything needed to write, program, debug, and execute code on a high-performance PIC32 microcontroller.

Key Features:

- USB-powered board
- Integrated programmer/debugger
- USB connectors, user switches and LEDs
- USB Mini-B cable
- PIC32 running at 80 MHz with 512K Flash, 32K RAM, 4 channel DMA
- Expansion connector enables the addition of Microchip's PIC32 expansion boards or the creation of your own board

PIC32 USB Starter Kit II (DM320003-2)



The PIC32 USB Starter Kit II provides the easiest and lowest-cost method to experience the USB and CAN functionality of PIC32 microcontrollers. Users can develop CAN applications using PIC32 expansion board. The board contains everything need to develop USB embedded host/device/OTG applications by combining this board with Microchip's free USB software.

Key Features:

- USB-powered board
- Integrated programmer/debugger
- PIC32 running at 80 MHz with 512K Flash, 128K RAM, 8 channel DMA + 4 channel DMA dedicated to USB and CAN
- USB connectors, user switches and LEDs
- Standard A to mini-B cable for debugger
- Standard A to micro-B cable for USB application development
- Expansion connector enables the addition of Microchip's PIC32 expansion boards or the creation your own board

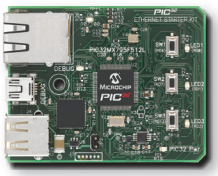
PIC32 USB Starter Kit III (DM320003-3)

The new PIC32 USB Starter Kit III provides the user with an easy and cost-effective option to experience the USB connectivity, mTouch technology and SPI/I^2S functionality of the new PIC32MX3/MX4 microcontrollers. This board comes equipped with everything that is needed including Microchip's free USB software to develop USB embedded host/device/OTG applications. The PIC32 USB Starter Kit III has a form factor and expansion connector that are compatible with other PIC32 Starter Kits.

Key Features:

- PIC32MX450F256L MCU
- Integrated debugger/programmer
- USB host, device, dual role and OTG
- Online tools and software download
- Support for Windows XP and Windows Vista (32- and 64-bit)

PIC32 Ethernet Starter Kit (DM320004)



The PIC32 Ethernet Starter Kit provides the easiest and lowest-cost method to experience 10/100 Ethernet development with PIC32. Combined with Microchip's free TCP/IP software, this kit helps your project running quickly. The PIC32 has an available CAN 2.0b peripheral and USB host/device/OTG. The Ethernet Starter Kit has a form factor and expansion connector that are compatible with other PIC32 Starter Kits.

Key Features:

- USB-powered board
- USB and Ethernet connectors, user switches and LEDs
- Integrated Programmer/Debugger
- Standard A to mini-B cable for debugger
- Standard A to micro-B cable for USB application development
- PIC32 running at 80 MHz with 512K Flash, 128K RAM, 8 channel DMA + 8 channel DMA dedicated to Ethernet, CAN and USB
- Expansion connector enables the addition of Microchip's PIC32 expansion boards or the creation of your own board

Starter Kits

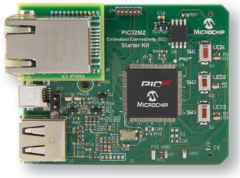
Microstick II (DM330013-2)

Microstick II delivers a complete development hardware platform for Microchip's 16-bit and 32-bit microcontrollers and digital signal controllers. It's the perfect solution to those looking for a low-cost, easy-to-use development platform. The USB-powered kit includes an on-board debugger/programmer, a DUT socket for easy device swapping, a user LED and reset button. It is designed for insertion into a standard prototyping board for easy connection to additional circuitry. This extremely portable kit is about the size of a stick of gum.

Key Features:

- Integrated USB programmer/debugger, no external debugger required
- USB powered: ease of use, no external power required
- DUT socket: flexible, easy device replacement
- 0.025" pin headers, enables plug-in to breadboard with room for jumper wires
- Small size: smaller than a stick of gum at 20 × 76 mm, easily portable
- On-board user LED and reset switch

PIC32MZ EC Starter Kit (DM320006)

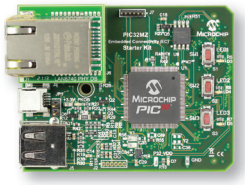


The PIC32MZ EC Starter Kit provides the easiest and lowest-cost method to experience the high performance and advanced peripherals integrated in the PIC32MZ Embedded Connectivity MCUs. This starter kit features a socket that can accommodate 10/100 Ethernet transceiver (RJ-45) plug-in connectors from various vendors for prototyping and development.

Key Features:

- On-board high-performance PIC32MZ: 200 MHz, 2 MB Flash and 512 KB RAM
- Integrated debugger/programmer
- USB powered
- 10/100 Ethernet development using PIC32 MCUs
- CAN 2.0b, high-speed USB host, device, dual-role and OTG
- 4 MB SQI Flash
- On-line tools and software download
- Enables addition of PIC32 Expansion Board

PIC32MZ EC Starter Kit with Crypto Engine (DM320006-C)

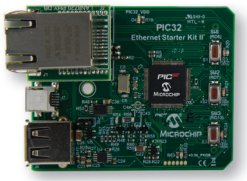


The PIC32MZ EC Starter Kit with Crypto Engine provides the easiest and lowest-cost method to experience the high performance and advanced peripherals integrated in the PIC32MZ Embedded Connectivity MCUs. It features a crypto engine that reduces software overhead and quickly executes actions such as encryption, decryption, and authentication. This starter kit features a socket that can accommodate 10/100 Ethernet transceiver (RJ-45) plug-in connectors from various vendors for prototyping and development.

Key Features:

- On-board high-performance PIC32MZ: 200 MHz, 2 MB Flash and 512 KB RAM with crypto engine
- Integrated debugger/programmer
- USB powered
- 10/100 Ethernet development using PIC32 MCUs
- CAN 2.0b, high-speed USB host, device, dual-role and OTG
- 4 MB SQI Flash
- On-line tools and software download
- Enables addition of PIC32 Expansion Board

PIC32 Ethernet Starter Kit II (DM320004-2)



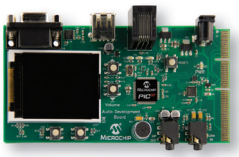
The PIC32 Ethernet Starter Kit II provides the easiest and lowest-cost method to experience 10/100 Ethernet development with PIC32 microcontrollers. Combined with Microchip's free TCP/IP software, this kit gets your project running quickly. The PIC32 microcontroller has an available CAN 2.0b peripheral and USB host/device/OTG. This starter kit features a socket that can accommodate 10/100 Ethernet transceiver (RJ-45) plug-in connectors from various vendors for prototyping and development.

Key Features:

- USB-powered board
- USB and Ethernet connectors, user switches and LEDs
- Integrated programmer/debugger
- Standard A to mini-B cable for debugger
- Standard A to micro-B cable for USB application development
- PIC32 running at 80 MHz with 512K Flash, 128K RAM, 8 channel DMA + 8 channel DMA dedicated to Ethernet, CAN and USB
- Expansion connector enables the addition of Microchip's PIC32 expansion boards or the creation of your own board

PIC32 Audio Solutions

Audio Development Board for PIC32 (DM320011)

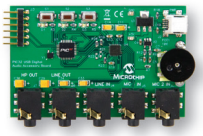


Audio Development Board for PIC32 MCUs features an 80 MIPS PIC32 MCU, a 24-bit Wolfson audio codec, a two-inch color LCD display, a USB interface and an on-board microphone. Supported by Microchip's free software libraries, the kit provides a perfect solution for the development of speech and audio recording and playback products. Target applications include docks for portable audio players, home entertainment systems and automotive sound systems.

Key Features:

- On-board PIC32MX795F512 with 80 MHz of performance, 512 KB Flash and 128 KB of RAM
- 24-bit Wolfson CODEC
- USB Type A interface
- On-board microphone
- Headphone out and line in
- High quality 2" color LCD
- Pre-loaded demo code
- MFi dock edge connector

PIC32 USB Digital Audio Mixer Board (DM320014)



The PIC32 USB Digital Audio Accessory Board showcases a 16/24-bit quality digital stereo audio development platform using the PIC32 microcontroller. It can be used for 16/24-bit stereo audio playback and recording with a sample rate of up to 48 kHz. This accessory board is powered by the USB Host and can be used with any personal computer (PC), tablet, gaming station, or mobile device that supports the USB Audio Device Class.

Key Features:

- PIC32MX250F128B MCU: 50 MHz, 128 KB of program memory and 32 KB of RAM
- PIC32 I^2S support (LJ, RJ, DSP/PCM modes supported), all modes can be 16/24-bit
- PIC32 reference clock output for codec master clock
- Audio codec (AK4645A) with up to 48 kHz sampling rate and 16/24-bit resolution
- Supported codec-based audio processing features:
  - 5-band equalizer
  - Analog output mixing
  - Stereo separation emphasis and wind-noise filtering
  - Auto-level control

Bluetooth Audio Development Kit (DV320032)

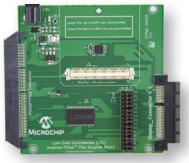
The PIC32 Bluetooth Audio Development Kit provides a complete turnkey solution to develop streaming digital audio solutions. The board is coupled with two daughter cards: the Bluetooth HCI Radio Daughter Card that demonstrates a low-cost Bluetooth implementation and the Audio DAC Daughter Card that demonstrates a high quality 24-bit, 192 kHz audio conversion/amplification for line or headphones. The kit ships with demo code that enables wireless streaming of digital audio from any Bluetooth-enabled smartphone or portable music player or over USB.

Key Features:

- PIC32MX450/470 @ 100 MHz
- Bluetooth A2DP Daughter Board
  - Streaming with low-cost HCI module
- 24-bit 192 kHz DAC DB
- USB Memory Stick® playback
- 2 inch color LCD display
- Headphone/line out
- Audio control function

PIC32 Graphics Solutions

Low-Cost Controllerless (LCC) Graphics PICtail Plus Daughter Board (AC164144)



The Low-Cost Controllerless (LCC) Graphics PICtail Plus Daughter Board enables development of graphics solutions without an external graphics controller, reducing system BOM cost for many applications. The board is designed to attach to a PIC32 starter kit (DM320001, DM320003-2, DM320004) or an Explorer 16 development board (DM240001) and one of Microchip LCD Modules including the Truly 3.2" QVGA board and the 4.3" WQVGA Powertip display panel.

Key Features:

- Can drive QVGA 8 bpp with PIC32 alone
- Can drive WQVGA 16 bpp with external 256 KB SRAM Frame buffer
- Display connector for interfacing with different display boards
- PICtail Plus Interface for connecting to Explorer 16 development board
- Starter kit connector

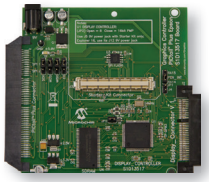
Graphics LCD Controller PICtail Plus SSD1926 Board (AC164127-5)

The Graphics LCD Controller PICtail Plus SSD1926 Board is a demonstration board for evaluating Microchip Technology's graphic display solution and graphics library for 16- and 32-bit microcontrollers. It is an expansion board compatible with the Explorer 16 development board (DM240001) or one of the PIC32 starter boards (DM320001, DM320003). The controller board has a connection for the display boards, such as the Graphics Display Truly 3.2", 240 × 320 Board (AC164127-4).

Key Features:

- Graphics display controller: Solomon Systech SSD1926 supporting 4/8-bit STN, 4/8-bit CSTN, 18-bit HR-TFT, and 9/12/18/24-bit TFT interface
- SD/MMC socket, connected to SSD1926 via 4-wire interface
- 16 Megabit (2M × 8) serial flash memory for additional data storage
- Display connector for interfacing with different display boards
- PICtail Plus Interface for connecting to Explorer 16 development board
- PIC32 Starter Kit connector

Graphics PICtail Plus Epson S1D13517 Board (AC164127-7)



The Graphics Controller PICtail Plus Epson S1D13517 Board is used to evaluate Microchip Technology's graphic display solution and graphics library for 16- and 32-bit microcontrollers. The Epson S1D13517 offers hardware acceleration for alpha-blending, transparency, animation, multiple buffering, and picture-in-picture. The kit is compatible with the Explorer 16 development board (DM240001) or one of the PIC32 Starter Boards (DM320001, DM320003).

Key Features:

- Support for VGA, WVGA, QVGA, WQVGA displays
- Alpha blending
- Support for 24 bpp
- Touch interface
- 128 megabit (8M × 16) SDRAM for frame buffering
- 64 MB serial Flash memory for additional data storage

PIC32 GUI Development Board with Projected Capacitive Touch (DM320015)

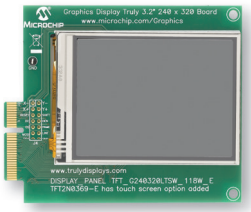
The PIC32 GUI Development Board with Projected Capacitive Touch enables the development of cost-effective multi-touch graphical user interfaces. It provides USB host and device connectivity and supports I/O connections via through-hole pads for custom board attachment. Multi-touch user input is supported by Microchip's Turnkey Projected Capacitive Touch Controller, MTCH6301. The board is a standalone development platform that can be programmed/debugged via the on-board 5-pin in-circuit serial programmer interface designed for Microchip's PICkit™ 3 In-Circuit Debugger.

Key Features:

- Based on PIC32MX795F512 device with 512 KB Flash and 128 KB RAM
- Projected capacitive touch controller MTCH6301
- WQVGA 4.3" display
- USB port for Device or Host functionality
- Expansion header
  - Access to PIC32 I/Os and peripherals

Display Boards

Graphics Display Truly 3.2" 320 × 240 Board (AC164127-4)

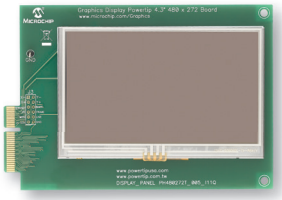


The Graphics Display Truly 3.2" 240 × 320 Board is a demonstration board for evaluating Microchip's graphic display solution and graphics library for 16- and 32-bit microcontrollers.

Key Features:

- 3.2 QVGA (320 × 240) TFT LCD with 18-bit parallel RGB interface
- Resistive 4-wire touch screen

Graphics Display Powertip 4.3" 480 × 272 Board (AC164127-6)

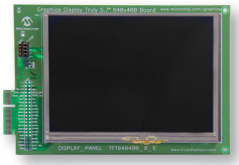


The Graphics Display Powertip 4.3" 480 × 272 Board is a demonstration board for evaluating Microchip's graphic display solution and graphics library for 16- and 32-bit microcontrollers.

Key Features:

- Powertip PH480272T-005-I11Q TFT module
- 4.3 WQVGA (480 × 272) TFT LCD with 24-bit parallel RGB interface
- Resistive 4-wire touch screen

Graphics Display Truly 5.7" 640 × 480 Board (AC164127-8)

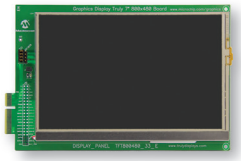


The Graphics Display Truly 5.7" 640 × 480 Board is a demonstration board for evaluating Microchip graphic display solution and graphics library for 16- and 32-bit microcontrollers.

Key Features:

- TFT Display with 24-bit parallel RGB interface and 4-wire, resistive-touch interface
- Resistive-touch controller (AR1020) interfaced to the MCU through the SPI module
- Additional direct interface to MCU for 4-wire, resistive-touch signals

Graphics Display Truly 7" 800 × 480 Board (AC164127-9)

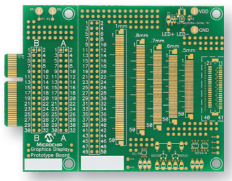


The Graphics Display Truly 7" 800 × 480 Board is a demonstration board for evaluating Microchip's graphic display solution and graphics library for 16- and 32-bit microcontrollers.

Key Features:

- TFT Display with 24-bit parallel RGB interface and 4-wire, resistive-touch interface
- Resistive-touch controller (AR1020) interfaced to the MCU through the SPI module
- Additional direct interface to MCU for 4-wire, resistive-touch signals

Graphics Display Prototype Board (AC164139)



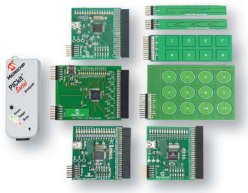
The Graphics Display Prototype Board (set of three) provides an easy path to integrate various graphics LCD panels.

Key Features:

- Microchip display connector V1
- Footprints of flat flexible connectors (FFC) with up to 50-pins with varying pitch sizes (1.0, 0.8, 0.7, 0.6, 0.5 mm), and VESA FPDI-1
- Prototyping area for power supply circuits
- Flexible mapping of V1 connector signals to FFC connector signals
- Compatible with Prototype PICtail Plus Daughter Board (AC164126)

PIC32 Touch Solutions

Enhanced mTouch Capacitive Touch Evaluation Kit (DM183026-2)

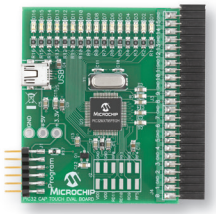


The enhanced mTouch Capacitive Evaluation Kit provides a simple platform for developing a variety of capacitive touch sense applications using PIC16F, PIC24F, PIC18F and PIC32 microcontrollers.

Kit Contents:

- PIC16F CVD evaluation board
- PIC18F CTMU evaluation board
- PIC24F CTMU evaluation board
- PIC32MX CVD evaluation board
- Direct 8 keyboard
- 12-Key matrix sensor board
- 4-Channel slider sensor board
- 2-Channel slider sensor board
- PICkit serial analyzer
- USB cable

PIC32 Capacitive Touch Evaluation Board (AC323026)



The PIC32 mTouch Capacitive Touch Evaluation Board is designed to facilitate the development of capacitive touch-based applications using PIC32-series microcontrollers. This evaluation board includes an on-board PICkit serial interface, an ICSP™ header, a USB connector (for power only), and 16 LEDs. The board also includes a 24-pin header that can be used to interface the 2-channel and 4-channel slider plug-in boards, the 12-matrix key plug-in board and the 8-direct key plug-in board. These plug-in boards are included in the mTouch Capacitive Touch Evaluation Kit (sold separately, DM183026-2).

Key Features:

- PICkit serial interface via an on-board ICSP header
- USB connector (for power only)
- 16-bit LED display

PIC32MX CTMU Evaluation Board (AC323027)

The PIC32 CTMU Evaluation Board is designed to facilitate the development of capacitive touch-based applications using the low-cost high-performance PIC32 MX1/MX2 series microcontrollers. This evaluation board includes an on-board PICkit serial interface, an ICSP header, a USB connector (for power only), and 16 LEDs. The board also includes a 24-pin header that can be used to interface the 2-channel and 4-channel slider plug-in boards, the 12-matrix key plug-in board and the 8-direct key plug-in board. These plug-in boards are included in the mTouch Capacitive Touch Evaluation Kit (sold separately, DM183026-2).

Key Features:

- PICkit serial interface via an on-board ICSP header
- On-board PIC32MX250F128D
- USB connector (for power only)
- 16-bit LED display

PIC32 Connectivity Solutions

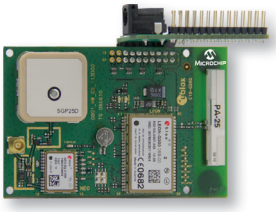
PIC32 Wi-Fi® Comm Demo Board (DV102411)

The PIC32 Wi-Fi Comm Demo board provides a compact development platform for customers to evaluate Microchip's Wi-Fi product offering. The demo board comes with on-board FCC-IC-ETSI-certified MRF24WB0MA Wi-Fi module and a PIC32 microcontroller.

Key Features:

- Wi-Fi solution compatible with IEEE 802.11 b/g/n Access Points
- Supports Infrastructure and Ad hoc networks
- MRF24WB0MA module is FCC, IC, Wi-Fi certified and ETSI compliant
- Powered by two AAA batteries
- Supports WEP, WPA and WPA2 security protocols
- The board has sensor I/O interface enabling application-specific demos

Machine-to-Machine (M2M) PICtail Daughter Board (AC320011)

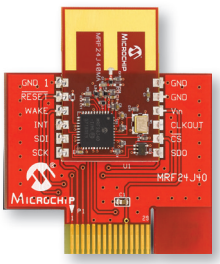


Microchip's Machine-to-Machine (M2M) PICtail Daughter Board (AC320011) based upon u-blox GPS and GSM/GPRS modules makes it easy to create low-cost M2M applications with location-awareness capabilities. The daughter board can be interfaced with Microchip's Multimedia Expansion Board and a PIC32 starter kit to provide developers with a turnkey platform to get started with apps such as texting, email and GPS.

Key Features:

- Quad band support: GSM 850 MHz, EGSM 900 MHz, DCS 1800 MHz and PCS 1900 MHz
- Power Class 4 (33 dBm nominal maximum output power) for GSM/EGSM bands
- Power Class 1 (30 dBm nominal maximum output power) for DCS/PCS bands
- GPRS multislot class 10
- All GPRS coding schemes from CS1 to CS4 are supported
- GPRS bit rate: 53.6 kbps

MRF24J40MA PICtail Plus 2.4 GHz RF Card (AC164134)

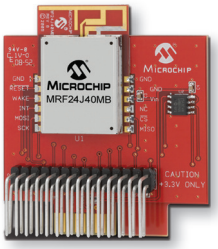


The MRF24J40MA PICtail Plus 2.4 GHz Radio Frequency Card is built with the new agency-certified MRF24J40MA IEEE 802.15.4 RF transceiver module. The module is attached to a PICtail Plus carrier board allowing the RF Board to be used with an Explorer 16 Development Kit. Targeted for ZigBee, MiWi, and MiWi P2P wireless protocol applications, the MRF24J40MA is a perfect solution for low-cost, low-power complete embedded wireless PAN applications.

MRF24J40MA PICtail/PICtail Plus (AC164134-1)

The MRF24J40MA PICtail/PICtail Plus Daughter Board is a demonstration and development daughter board for the agency-certified MRF24J40MA 2.4 GHz IEEE Std. 802.15.4 + 0 dBm RF Transceiver Module. The module is surface-mounted to a PICtail/PICtail Plus daughter board that allows it to plug into the PIC18 Explorer Board (DM183032) or the Explorer 16 Development Board (DM240001).Targeted for ZigBee and MiWi wireless protocol applications, the MRF24J40MA is a perfect solution for low-cost, low-power complete embedded wireless PAN applications.

MRF24J40MB PICtail/PICtail Plus (AC164134-2)



The MRF24J40MB PICtail/PICtail Plus Daughter Board is a demonstration and development daughter board for the MRF24J40MB 2.4 GHz IEEE Std. 802.15.4 20 dBm RF Tranceiver Module. The daughter board can plug into multiple Microchip demonstration and development boards such as the PIC18 Explorer Board (DM183032) or Explorer 16 Development Board (DM240001).

IrDA® PICtail Plus Daughter Board (AC164124)

The IrDA PICtail Plus Daughter Board is designed to operate in conjunction with Microchip's Explorer 16 or other development boards with a PICtail Plus connector and AN1071 IrDA Standard Stack for Microchip 16-bit and PIC32 devices to create an IrDA-enabled development and evaluation platform.

Key Features:

- Infrared optical sensor
- PICtail Plus Daughter Board connection interface

Ethernet PICtail Plus Daughter Board (AC164123)

The Ethernet PICtail Plus Daughter Board provides a cost-effective method of evaluating and developing Ethernet control applications. The board is designed for flexibility and can be plugged into Microchip's Explorer 16 Development Board (DM240001).

Key Features:

- IEEE 802.3 compliant
- 10Base-T Ethernet
- RJ-45 female Ethernet connector
- Plug-in compatible with the Explorer 16 Development Board (DM240001)

PIC32 Connectivity Solutions

Wi-Fi G Demo Board (DV102412)

The Wi-Fi G Demo Board is a compact demonstration platform for customers to easily evaluate and configure Microchip's new MRF24WG0MA Wi-Fi module. The demo board is a fully-functional standalone web server powered by two AAA batteries. It comes with a PIC32 pre-programmed with the Microchip TCP/IP stack, connected to an on-board, fully-certified MRF24WG0MA Wi-Fi module.

Key Features:

- Complete IEEE 802.11 b/g Wi-Fi solution
- Supports Infrastructure/Ad hoc networks and SoftAP networking
- Web server allows for configuration of network settings
- Headers bring out signals for quick prototyping

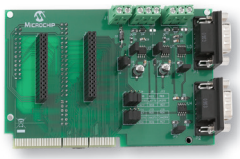
Machine-to-Machine Development Platform for CDMA (DM320017)

Microchip's M2M Development Platform for CDMA enables the addition of Machine-to-Machine communications to your application. The platform includes CDMA, MiWi protocol and Ethernet connectivity, GPS, on-board temperature sensor and accelerometer, two expansion connections for customization and support for a microSD card.

Key Features:

- PIC32MX795F512L @ 80 MHz, 512 KB Flash/128 KB RAM
- GPS, 10/100 Ethernet and MiWi protocol connectivity
- Serial communication interface for simple wired connectivity
- microSD card support for code, event or image storage
- On-board 3-axis accelerometer, temperature and light sensors
- Two expansion ports for custom sensing or connectivity development

CAN/LIN PICtail Plus Daughter Card for Explorer 16 (AC164130-2)

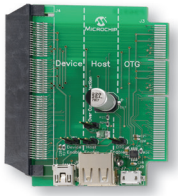


This daughter board is used to facilitate rapid implementation and evaluation of applications that use CAN and LIN interfaces. The PICtail Plus interface is used for connection to the Explorer 16 Development Board for 16-bit and 32-bit MCUs.

Key Features:

- Connector to Explorer 16 Development Board and PIC18 Explorer Board
- Two CAN communication channels interfacing to ECAN module
- Two LIN communication channels interfacing to UART module

USB PICtail Plus Daughter Card for Explorer 16 (AC164131)



The USB PICtail Plus Daughter Board is a USB demonstration board for evaluating Microchip's 16- and 32-bit USB product lines using the Explorer 16 Development Board.

There are four jumpers on the board to select the operational mode and optional features.

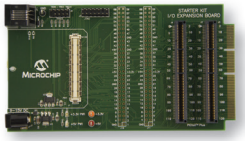
Key Features:

- Example circuits for USB device, embedded host and On-The-Go (OTG)
- Both horizontal and vertical PICtail Plus Daughter Board connection interfaces

Expansion and Development Boards

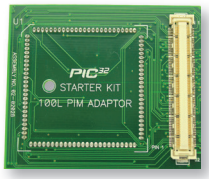
Expansion boards make prototyping fast. Connectors for all starter kits allow the additon of any PICtail/PICtail Plus as well as Human Interface and Multimedia peripherals.

PIC32 I/O Expansion Board (DM320002)



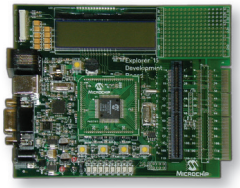
The PIC32 I/O Expansion Board provides starter kit and starter board users with full access to MCU signals, additional debug headers, and connection of PICtail Plus daughter cards. MCU signals are available for attaching prototype circuits or monitoring signals with logic probes. Headers are provided for connecting JTAG tools or Microchip tools using the 2-wire (ICSP) interface. The PIC32 starter kits (DM320001, DM320003-2, DM320004) can provide power to the I/O Expansion Board. The amount of power is determined by the drive capability of the USB port connected to the starter board's debugger at connector J1. If additional power is required, connect an optional 9V power supply (AC16203) to the I/O Expansion Board.

PIC32 Starter Kit to Explorer 16 Plug-In Module (PIM) Adapter (AC320002)



The PIC32 Starter Kit PIM Adapter is designed to enable the PIC32 Starter Board to work with the Explorer 16 Development Board. This allows users to customize functionality using PICtail Plus daughter cards or eliminates the need for external debugging hardware.

Explorer 16 Development Board (DM240001)

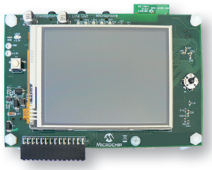


The Explorer 16 is a low-cost, efficient development board to evaluate the features and performance of Microchip's 32-bit PIC32MX devices, PIC24 MCU and the dsPIC33 DSC families. Coupled with the MPLAB ICD 3 In-Circuit Debugger or MPLAB REAL ICE™ In-Circuit Emulator, real-time emulation and debug facilities speed evaluation and prototyping of application circuitry.

Key Features:

- Includes PIC24FJ128GA010 and the dsPIC33FJ256GP710A DSC Digital Signal Controller PIMs (100-pin version) or the PIC24FJ64GA004 PIM (44-pin version)
- Alpha-numeric 16 × 2 LCD
- Interfaces to MPLAB ICD 3, MPLAB REAL ICE In-Circuit Emulator, USB, and RS-232
- Includes Microchip's TC1047A high accuracy, analog output temperature sensor
- Expansion connector to access full devices pin-out and breadboard prototyping area
- PICtail Plus connector for expansion boards
- Full documentation CD includes user's guide, schematics and layout

Multimedia Expansion Board (DM320005)



The Multimedia Expansion Board (MEB) provides PIC32 Starter Kit, dsPIC33E USB Starter Kit or PIC24E USB Starter Kit users with an integrated yet flexible solution for development of high-impact user interfaces. The board comes with a 3.2" Color TFT touch-screen QVGA display, an on-board FCC-certified Wi-Fi module, a 24-bit stereo audio codec, a three-axis accelerometer, a joystick and a microSD memory card slot. Simply connect any DM320001, DM320003-2, DM320004, DM330012 or DM240012 Starter Kit to the MEB and you're ready to develop, program and debug code for the user interface features.

Key Features:

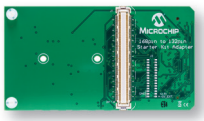
- Power via USB through the starter kit or external 9V supply
- Fast high-color images, localized fonts, visual prompts and buttons
- 24-bit stereo audio, Speex voice playback, MP3 music
- Touch screen buttons, eight position joystick with fire button, three-axis orientation/acceleration
- FCC-certified Wi-Fi, 10/100 Ethernet via PIC32 Ethernet Starter Kit

Multimedia Expansion Board II (DM320005-2)

The Multimedia Expansion Board II (MEB-II) is a highly integrated, compact and flexible development platform which works with PIC32MZ Starter Kit. The MEB-II kit features a 4.3" WQVGA PCAP touch display daughter board. The kit also features:

- 24-bit stereo audio codec
- Integrated 802.11bg wireless module
- Low-cost Bluetooth HCI transceiver
- Optional EBI SRAM memory
- microSD slot
- mTouch sensing solutions buttons
- Analog accelerometer
- Analog temperature sensor
- VGA camera
- PICtail connector

PIC32MZ Embedded Connectivity (EC) Adapter Board (AC320006)



The PIC32MZ EC Adapter Board, which features a 168-pin to 132-pin connector, enables the use of PIC32 starter kits that have a 168-pin interface with the following boards:

- Multimedia Expansion Board (MEB) (DM320005)
- PIC32 I/O Expansion Board (DM320002)
- Low-Cost Controllerless (LCC) Graphics PICtail Plus Daughter Board (AC164144)
- Graphics LCD Controller PICtail Plus SSD1926 Board (AC164127-5)
- Graphics PICtail Plus Epson S1D13517 Board (AC164127-7)

Plug-In Modules

Processor plug-in modules (PIMs) are small circuit boards which can be used with the various Microchip development boards to evaluate various MCU families. These plug into the main processor socket of the development boards so that different microcontrollers can be quickly and easily used for prototyping, demonstration or development.

PIC32 General Purpose (MA320001)

This plug-in module enables PIC32 development on the Explorer 16 Development Board (DM24000X) and supports the MPLAB REAL ICE In-Circuit Emulator Trace Kit (AC244006). An 80 MHz PIC32MX360F512L with 512 KB of Flash, 32 KB of RAM, four channels of hardware DMA and instruction trace is installed on the plug-in module.

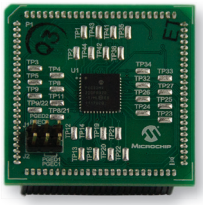
PIC32 USB Plug-In Module (MA320002)

This plug-in module enables USB development using a PIC32 on the Explorer 16 development board. It requires a USB PICtail Plus (AC164131) for connecting USB hardware. An 80 MHz PIC32MX460F512L with 512 KB of Flash, 32 KB of RAM, USB On-The-Go controller, four channels of hardware DMA and instruction trace is installed on the plug-in module.

PIC32 USB/CAN Plug-In Module (MA320003)

This plug-in module enables USB and CAN development with the PIC32MX7 series. An 80 MHz PIC32MX795F512L with 512 KB of Flash, 128 KB of RAM, USB On-The-Go controller, 2 × CAN 2.0b modules, eight channels of dedicated DMA and eight general channels of dedicated DMA is installed on this plug-in module.

PIC32MX1/MX2 Plug-In-Module (MA320011)

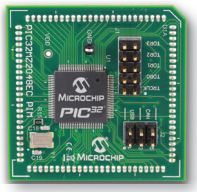


The PIC32MX250F128D plug-in module is designed to demonstrate the capabilities of the PIC32MX1XX/2XX family of devices using the Explorer 16 Development Board. It enables USB and graphics development with the PIC32MX2XX series.

PIC32MX450/470 USB Plug-In Module (MA320002-2)

The capabilities of PIC32MX3/MX4 family of devices can be demonstrated using the PIC32MX450 PIM and the Explorer 16 Development Board. It enables USB development with the PIC32MX4XX series.

PIC32MZ EC Processor Plug-In Module (MA320012)



The PIC32MZ EC PIM is designed to demonstrate the capabilities of the PIC32MZ Embedded Connectivity family of devices using the Explorer 16 Development Board. It enables USB, Ethernet and CAN development with the PIC32MZ series. A 200 MHz PIC32MZ2048ECH100 MCU with 2 MB Flash, 512 KB RAM, 40 ch. ADC, high-speed USB, CAN 2.0b and 10/100 Ethernet is installed on the plug-in module.

Microchip M2M Development Kit for CDMA

Application Note: AN1529, Ready-to-Use Solution

Summary

This application note describes the implementation of Machine-to-Machine communications over a CDMA network using Microchip's PIC32 M2M Development Kit. The kit has a variety of on-board sensors and interfaces to allow the designer to tailor the solution for a specific application. It enables designers to develop on a standard 32-bit platform to collect data, share locally over 10/100 Ethernet and MiWi and communicate to a cloud application.

M2M Development Platform for CDMA (DM320017)

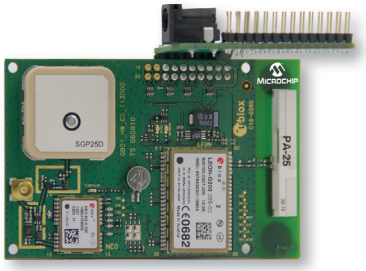
Using PIC32 Microcontrollers to Develop GSM/GPRS/GPS Solutions

Application Note: AN1373, Ready-to-Use Solution

Summary

Machine-to-Machine (M2M) technologies allow both wireless and wired systems to communicate with other devices of the same ability. This application note describes an M2M reference design that enables the implementation of GSM/GPRS/GPS connectivity using a PIC32 microcontroller, the Microchip M2M PICtail Plus Daughter Board and the Multimedia Expansion Board.

M2M PICtail Plus Daughter Board (AC320011)



PIC32 High-Quality Audio Applications

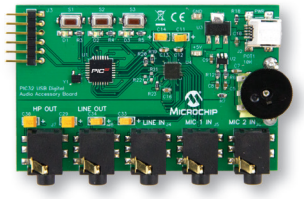
Application Note: AN1422, Ready-to-Use Solution

Proven Software Source Code

Summary

This application note describes the high-quality audio capabilities of PIC32 MCUs to address the design needs of audio docking stations, accessories for portable audio devices and other digital audio sources. The versatility and flexibility of the features on the PIC32 MCUs can be used to deliver a professional audio-quality solution while keeping the cost and power consumption low. All features discussed in the application note are implemented in the demo that is available for PIC32 USB Digital Audio Accessory Board. For more information about the board and the demo, please visit www.microchip.com/pic32tools.

PIC32 USB Digital Audio Accessory Board (DM320014)



Capabilities of this Application Solution

- Implement SPI module with I^2S and other data format modes
- Ability to handle 16 and 24-bit stereo audio data streams
- Flexible reference clock output that can be used to generate the standard audio master clocks and can be tuned on-the-fly
- Loss of quality due to USB clock mismatch is addressed by tuning the sample rate
- USB OTG module with the ability to stream digital audio

Porting the Helix MP3 Decoder onto Microchip's PIC32MX 32-bit Microcontrollers

Application Note: AN1367, Ready-to-Use Solution

Proven Software Source Code

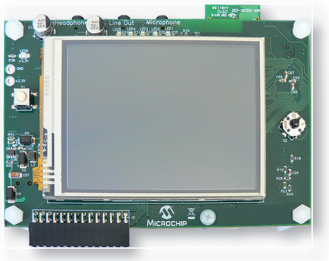
Summary

This application note describes the procedure to port the open source Helix MP3 decoder algorithm onto Microchip's PIC32MX 32-bit microcontrollers (MCUs). The source code provided with this document demonstrates a MP3 player application using the Helix MP3 decoder. The MP3 player application uses Microchip's USB stack to read MP3 files from a USB flash drive (thumb drive), and the Microchip graphics stack to implement a graphical user interface (GUI) with touch screen support.

The Helix MP3 decoder is available as both floating point and fixed point implementations. The fixed point implementation is considered for porting the algorithm onto the PIC32MX microcontroller. The algorithm runs on any 32-bit fixed point processor and is coded entirely in the C language with options to replace certain code sections with optimized assembly instructions.

The Helix MP3 decoder provides Layer 3 support for MPEG-1, MPEG-2 and MPEG-2.5. It supports variable bit rates, constant bit rates and stereo and mono audio formats.

Multimedia Expansion Board (DM320005)



Using PIC32 Microcontrollers to Develop Low-Cost Controllerless Graphics Solutions

Application Note: AN1387, Ready-to-Use Solution

Proven Software Source Code

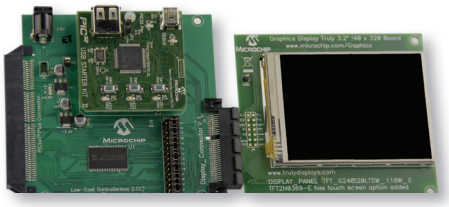
Summary

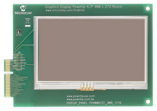
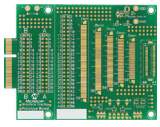
Many vendors today offer graphics solutions involving an internal or external graphics controller as part of the system, which may result in higher costs and complex design. In most cases, these graphics controllers are not necessary to create a simple embedded graphical user interface (GUI), but a suitable solution may not be available. This application note provides a technique in which the microcontroller peripherals are used to create "virtual" graphics controller for graphics rendering without taking up large amounts of CPU time to implement a low-cost controllerless graphics system using PIC32 and the Low-Cost Controllerless (LCC) Graphics PICtail Plus Daughter Board.

Capabilities of this Application Solution

- Implementation of a low-cost controllerless graphics system
- Basic graphics definitions
- Basics of thin-film transistor (TFT) LCD panels
- DMA and PMP initializations
- Demo software including alpha-blending demo

Low-Cost Controllerless Graphics PICtail Plus Daughter Board (AC164144) with Graphics Display Powertip 4.3" 480 × 272 Board (AC164127-6)



Graphics Development Board	Display Boards Supported			
				
PIC32 Starter Kit (DM320001 or DM320003) + LCC Graphics Board (AC164144)	QVGA 3.2" Graphics Display Truly 320 × 240 Board (AC164127-4)	WQVGA 4.3" Graphics Display Powertip 480 × 272 Board (AC164127-6)	VGA 5.7" Graphics Display Truly 640 × 480 Board (AC164127-8)	Prototype Boards Connect Your Glass (AC164139)

Video Playback and Streaming Solutions Using the PIC32 Microcontroller

Application Note: AN1415, Ready-to-Use Solution

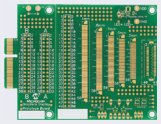
Proven Software Source Code

Summary

This application note provides methods that can be used for video playback and video streaming applications using a PIC32 device and hardware solutions available from Microchip. These techniques can be used in applications such as distance education or surveillance cameras, as well as news and entertainment videos for display on the Internet. In addition, video playback from a Secure Digital card can find uses in situations where data needs to be stored for future review, such as video from surveillance cameras or educational lectures.

Capabilities of this Application Solution

- Video playback with PIC32 using upscaling by interpolation
- Streaming raw video from a microSD card using the Solomon SSD1926 LCD Graphics Controller on the MEB and PIC32
- Streaming uncompressed AVI video over ethernet and the MEB using PIC32
- Streating uncompressed AVI video over ethernet on WVGA using PIC32

Graphics Development Board	Display Boards Supported				
	 QVGA 3.2" Graphics Display Truly 320 × 240 Board (AC164127-4)	 WQVGA 4.3" Graphics Display Powertip 480 × 272 Board (AC164127-6)	 VGA 5.7" Graphics Display Truly 640 × 480 Board (AC164127-8)	 WVGA 7" Graphics Display Truly 800 × 480 Board (AC164127-9)	 Prototype Boards Connect Your Glass (AC164139)
 PIC32 Starter Kit (DM320001 or DM320003) + Solomon GFX (AC164127-5)	Yes	Yes	No	No	Yes
 PIC32 Starter Kit (DM320001 or DM320003) + Epson GFX Board (AC164127-7)	Yes	Yes	Yes	Yes	Yes

IrDA Standard Stack

Application Note: AN1071, Ready-to-Use Solution

Proven Software Source Code

Summary

Infrared communication is a low-cost method of providing wireless, point-to-point communication between two devices. A wide variety of devices implement the IrDA standard specification, including computers, printers, PDAs, cell phones, watches and other instruments. AN1071 implements a complete IrDA Standard Stack on Microchip's PIC24F, PIC24H and PIC32 microcontrollers and dsPIC30F and dsPIC33F DSCs. With the free source code these low-cost microcontrollers, with their built-in IrDA standard support, provide an inexpensive solution with plenty of computing power.

Capabilities of this Application Solution

The stack layers perform the following functions:

- Driver
- Framer
- IrLAP (Infrared Link Access Protocol)
- IrLMP (Link Management Protocol)
- IAS (Information Access Service)
- TinyTP (Tiny Transport Protocol)
- IrCOMM 3-wire raw
- IrCOMM 9-wire cooked
- OBEX

IrDA PICtail Plus Daughter Board (AC164124)

PIC32 Bootloader

Application Note: AN1388, Ready-to-Use Solution

Proven Software Source Code

Summary

The bootloader for PIC32 devices is used to upgrade firmware on a target device without the need for an external programmer or debugger. This application note provides the concepts of the PIC32 bootloader, bootloader memory mapping, bootloader framework API calls, and usage of the bootloader PC application.

Capabilities of this Application Solution

- Five bootloader firmware implementations:
  - Universal Asynchronous Receiver Transmitter (UART)
  - Universal Serial Bus (USB) device based on the Human Interface Device (HID) class
  - USB host based on the Mass Storage Device (MSD) class
  - Ethernet
  - Secure Digital (SD) card
- A demonstration application, which can be downloaded into the target PIC32 device using the bootloader
- A PC host application (required for UART, USB HID and Ethernet bootloaders only) to communicate with the bootloader firmware running inside the PIC32 device.

MPLAB ICD 3 In-Circuit Debugger *(DV164035)*

Summary

The MPLAB ICD 3 In-Circuit Debugger System is Microchip's most cost-effective high-speed hardware debugger/programmer for its Flash DSC and MCU devices. It debugs and programs PIC MCUs and dsPIC DSCs with the powerful yet easy-to-use graphical user interface of the MPLAB X Integrated Development Environment (IDE).

The MPLAB ICD In-Circuit Debugger probe is connected to the design engineer's PC using a high-speed USB 2.0 interface and is connected to the target with a connector compatible with the MPLAB ICD or MPLAB REAL ICE In-Circuit Emulator systems (RJ-11). MPLAB ICD supports all emulation headers.

Key Features

- Real-time debugging
- Ruggedized probe interface
- Microchip standard connectivity
- Portable, USB-powered and RoHS-Compliant
- High speed programming
- Low voltage emulation
- Test interface module
- Ease of maintenance and feature upgrade
- Low cost
- Powerful debugging

Products Supported

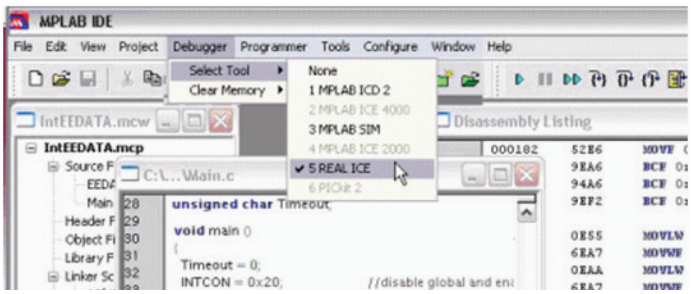
MPLAB ICD In-Circuit Debugger/Programmer supports most Flash PIC MCUs and dsPIC DSCs. For the current list of supported parts, review the latest release notes. The firmware is regularly updated to add support for new devices. As new device firmware is released, it can be downloaded free of charge with the latest version of MPLAB X IDE.

MPLAB REAL ICE In-Circuit Emulator *(DV244005)*

Summary

The MPLAB REAL ICE In-Circuit Emulator System is Microchip's high-speed emulator for Microchip Flash DSC and MCU devices. It debugs and programs PIC MCUs and dsPIC DSCs with the easy-to-use but powerful graphical user interface of the MPLAB X IDE, included with each kit.

The MPLAB REAL ICE In-Circuit Emulator probe is connected to the design engineer's PC using a high-speed USB 2.0 interface and is connected to the target with either a connector compatible with the popular MPLAB ICD system (RJ11) or with the high-speed, noise-tolerant, low-voltage differential signal (LVDS) interconnection (CAT5).



The MPLAB REAL ICE In-Circuit Emulator offers the following advantages:

- Low cost
- Full speed emulation
- Fast debugging and programming
- Ruggedized probe interface
- High-speed connectivity (high-speed option)
- Long cable interconnects (validated to 3 meters)
- MPLAB X IDE integration (included free)
- Small footprint (3 3/8" × 4 5/8" × 3/4")

Key Features

- Real-time execution and real-time trace collection
- Stopwatch
- Real-time watch
- Full hardware debugging: breakpoints, single-step, variable inspect/modify
- Logic probe inputs/outputs (8)
- I/O port trace and SPI trace options for high-speed upload of trace data
- Over voltage/short-circuit monitor protection
- Low voltage: to 2.0 volts (2.0V to 5.5V range)
- High-speed USB 2.0 communication protocol

PICkit 3 In-Circuit Debugger *(PG164130)*

Summary

The PICkit 3 In-Circuit Debugger allows debugging and programming of Flash PIC MCUs and dsPIC DSCs at an affordable price point using the powerful MPLAB X IDE graphical user interface. The PICkit 3 ICD is connected to the design engineer's PC using a full speed USB interface and can be connected to the target via a Microchip debug (RJ-11) connector (compatible with MPLAB ICD and MPLAB REAL ICE In-Circuit Emulator). The connector uses two device I/O pins and a reset line to implement in-circuit debugging and In-Circuit Serial Programming™.

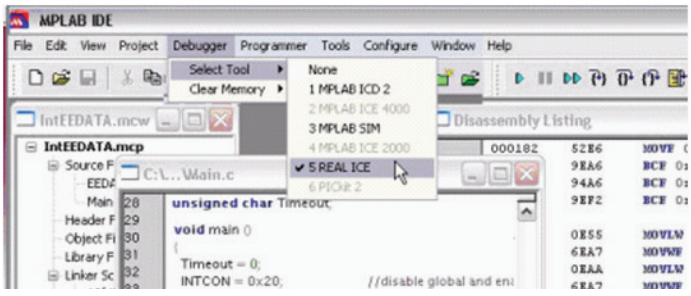
Key Features

- USB (full-speed 12 Mbits/s interface to host PC)
- Real-time execution
- MPLAB X IDE compatible (free copy included)
- Built-in over-voltage/short circuit monitor
- Firmware upgradeable from PC/web download
- Totally enclosed
- Supports low voltage to 2.0 volts (2.0V to 6.0V range)
- Diagnostic LEDs (power, busy, error)
- Read/write program and data memory of microcontroller
- Erase of program memory space with verification
- Freeze-peripherals at breakpoint
- Program up to 512 KB Flash with the Programmer-to-Go

MPLAB PM3 Universal Device Programmer *(DV007004)*

Summary

The MPLAB PM3 Universal Device Programmer is easy to use and operates with a PC or as a stand alone unit. This development tool programs Microchip's entire line of PIC MCUs as well as the latest dsPIC DSC devices. When used standalone, data can be loaded and saved with the SD/MMC card.



Key Features

- RS-232 or USB interface
- Integrated In Circuit Serial Programming (ICSP) interface
- Fast programming time
- Three operating modes:
  - PC host mode for full control
  - Safe mode for secure data
  - Standalone mode for programming without a PC
- Complete line of interchangeable socket modules to support all Microchip devices and package options (sold separately)
- SQTP℠ serialization for programming unique serial numbers while in PC host mode
- An alternate DOS command line interface is available for batch control
- Supports PROMATE® II socket modules via adapter (sold separately)
- Large easy-to-read display
- Field upgradable firmware allows quick new device support
- Secure Digital (SD) and Multimedia Card (MMC)
- Buzzer notification for noisy environments

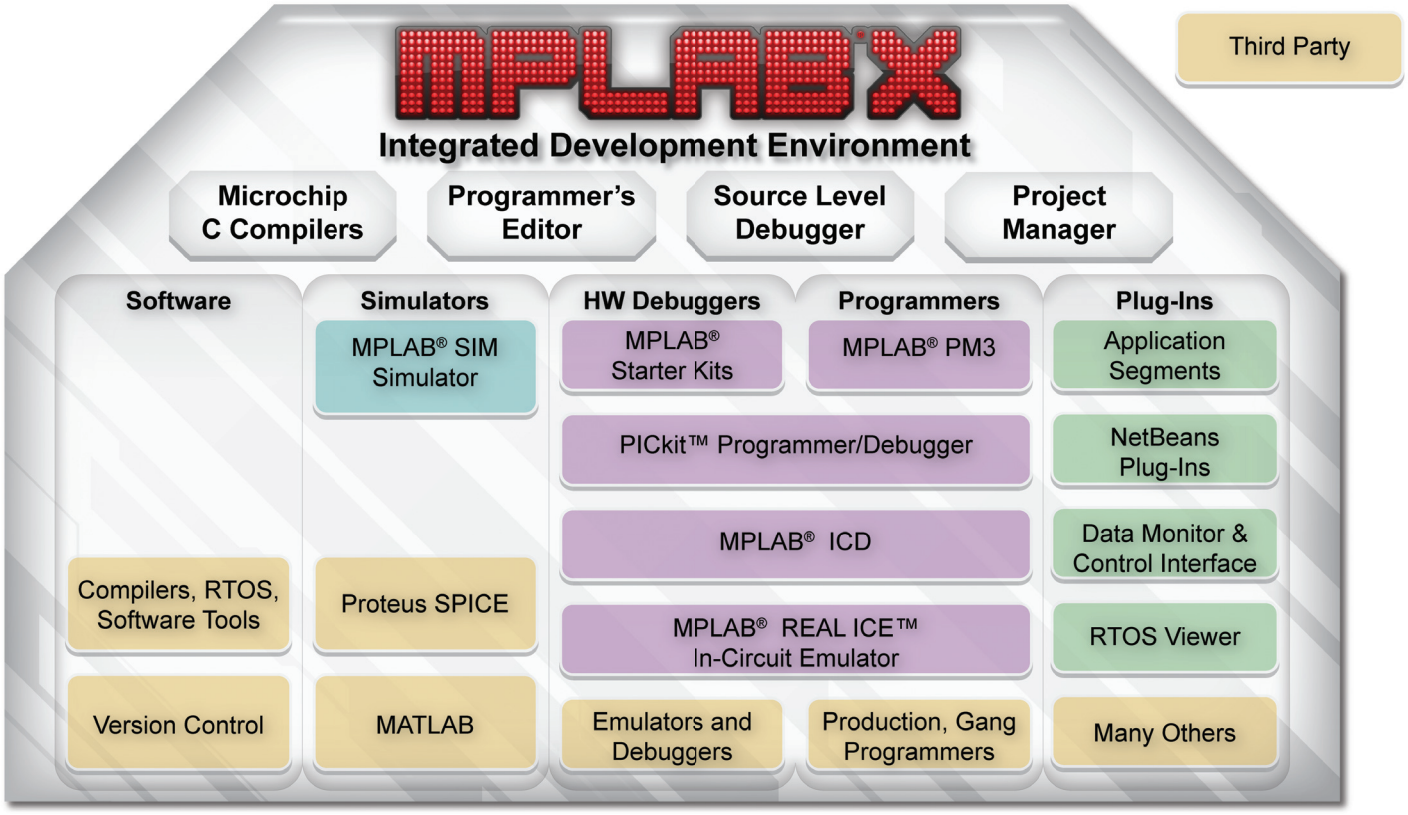
MPLAB X IDE

Summary

The MPLAB X IDE is a software program that runs on a PC (Windows, Mac OS, Linux) to develop applications for Microchip's microcontrollers and digital signal controllers. The MPLAB X IDE brings many changes to the PIC microcontroller development tool chain. Unlike previous versions of MPLAB IDE which were developed completely in-house, MPLAB X IDE is based on the open source NetBeans IDE from Oracle. The open source path enablesthe additional of many frequently requested features very quickly and easily while also providing a much more extensible architecture to deliver more new features in the future.

Key Features

- Provides a new Call Graph for navigating complex code
- Supports Multiple Configurations within your projects
- Supports Multiple Versions of the same compiler
- Support for multiple Debug Tools of the same type
- Supports Live Parsing
- Import existing MPLAB 8 projects and use either IDE for the same source
- Supports hyperlinks for fast navigation to declarations and includes
- Supports Live Code Templates
- Supports the ability to enter File Code Templates with license headers or template code
- MPLAB X IDE can Track Changes within your own system using local history
- Within MPLAB X IDE, users can configure their own Code Format Styles
- Seamless interface for MPLAB X IDE tools
- Easy migration between tools from software simulators to hardware debugging and programming tools



MPLAB XC32/XC32++ Compilers

Summary

The MPLAB XC32 is a full-featured, highly optimized ANSI C compiler for the PIC32 microcontroller family. This compiler integrates into Microchip's MPLAB X IDE, is compatible with all Microchip debuggers and emulators, and runs on Windows, Linux and Mac OS X. The MPLAB XC32 Compiler also comes with 12 months of High Priority Access, a maintenance subscription providing web access to new version releases and priority technical support for the compiler. Floating network licenses are also available.

Key Features

- XC32 now offers C++, with non-GPL v3 STL and standard libraries
- ANSI-compliant with standard, math, memory and data conversion libraries
- Includes floating point math library
- Even smaller code size: use 16-bit instruction mode for up to 40% code size reduction
- Small and fast: mix 16- and 32-bit instruction types in the same source file; 32-bit instructions for performance-critical code and 16-bit instructions for size reduction
- Supports in-line assembly
- Single and multi-vector interrupt support
- Generates relocatable object modules for enhanced code reuse
- Allows code and data to be located at absolute addresses
- DSP library: C callable DSP functions written in assembly using the standard MIPS DSP library APIs
- Quick migration: Complete run-time optimized peripheral libraries that are API compatible with Microchip's compiler libraries for 16-bit products

Below are the different versions of MPLAB XC32/XC32++ compiler that are being offered:

MPLAB® XC32/XC32++ Compilers	Part #
MPLAB XC32 Compiler Free Version	–
MPLAB XC32 Compiler Standard (Workstation License)	SW006023-1
MPLAB XC32 Compiler Standard (Network Server License)	SW006023-1N
MPLAB XC32 Compiler Pro (Workstation License)	SW006023-2
MPLAB XC32 Compiler Pro (Network Server License)	SW006023-2N
MPLAB XC32++ Compiler Free Edition	–
MPLAB XC32++ Compiler Pro (Workstation License)	SW006023-3
MPLAB XC32++ Compiler Pro (Network Server License)	SW006023-3N

Third Party Software Tools, RTOS and Libraries

Company	Features	IDE	C Compiler	C++ Compiler	Program/ Debug Hardware	RTOS	Software and Design	Development Boards
Ashling	Demo	Customized Eclipse	MPLAB C32 and GNU	GNU	✓	–	–	–
AVIX-RT	16-32, Demo	–	XC32/XC16	–	–	✓	–	–
chipKIT.net	32, Articles, Sample Code	Arduino-compatible IDE	–	✓	–	–	–	–
CMX Systems	16-32, Appnote, Demo	–	–	–	–	✓	Filesys, Network, USB, CAN	–
Digilent	8-16-32, App Note, Demo	–	–	–	–	–	–	Chipkit™ and Cerebot platform
E.E. Tools	8-16-32t	–	–	–	✓	–	–	–
EasyCode	8-32, Integrates with MPLAB® X IDE	Design Tool and IDE	–	–	–	–	–	–
easyGUI	16-32, Demo	–	–	–	–	–	GUI	–
eflightworks	–	–	–	–	–	–	–	Starter Kit Expansion Board: AV-32
ELNEC	8-16-32,	–	–	–	✓	–	–	–
Express Logic	16-32, Appnote, Demo	–	–	–	–	✓	Networking, GUI, Filesys	–
FreeRTOS	16-32, Demo	MPLAB X IDE RTOS Viewer	–	–	–	✓	–	Resells PIC32 Starter Kit
Fubarino	Schematics, Sample Code, Demo	–	–	–	–	–	–	Fubarino™ Mini, Fubarino SD
Green Hills Software	–	Multi IDE	✓	✓	✓	–	–	–
HCC-Embedded	–	–	–	–	–	–	Secure Filesys, Network, USB	–
Interniche Technologies, Inc.	16-32, Demo	–	–	–	–	–	Networking, Filesys	–

MPLAB Harmony Software Framework compatible.

Third Party Software Tools, RTOS and Libraries

Company	Features	IDE	C Compiler	C++ Compiler	Program/ Debug Hardware	RTOS	Software and Design	Development Boards
Lauterbach	–	Trace32 IDE	MPLAB® C32 & GNU	–	✓	–	–	–
Macraigor Systems	Demo	Standard Eclipse	GNU	GNU	Yes	–	–	–
Micrium	16-32, App Note, Demo	–	–	–	–	✓	Networking, GUI, Filesys, Probe	–
Micro/Sys	16-32	–	–	–	–	–	–	Eval Board USB1132
Microchip Technology, Inc.	8-16-32, App Note, Demo	MPLAB X	✓	–	✓	–	Networking, GUI, Filesys	PIC32 Platform
MicroElektronika	8-16-32, App Note, Demo	–	✓	–	✓	–	–	EasyPIC Fusion platform
Olimex	8-32	–	–	–	–	–	–	PIC-32MX, PIC32-Pinguino, PIC32-Web, PIC32-MX460
OpenRTOS	–	–	–	–	–	✓	–	–
Pumpkin	8-16-32, Demo	–	–	–	–	✓	–	–
Rowebots	16-32, App Note, Demo	–	–	–	–	✓	Networking, Filesys	–
Schmalzhaus	Electrical Design, Software, Motor Control	–	–	–	–	–	Custom	EiBotBoard, Big Easy Driver, USB Bit Whacker
SEGGER	16-32, Demo	–	–	–	–	✓	Networking, GUI, Filesys	–
Serious Integrated	Graphic/Touch	Rapid GUI Design Tool	–	–	–	–	Graphics	SIM102-SIM535
Softlog	8-16-32	–	–	–	✓	–	–	–
Sparkfun	8-16-32, App Note, Demo	–	–	–	–	–	–	UBW32
Tech Toys	16-32, App Note, Demo	–	–	–	–	–	–	Eval Board
Virtual Fab	Graphics	Rapid GUI Design Tool	–	–	–	–	–	–
wolfSSL	–	–	–	–	–	–	Crypto Libraries	–

MPLAB Harmony Software Framework compatible.

Support

Microchip is committed to supporting its customers in developing products faster and more efficiently. We maintain a worldwide network of field applications engineers and technical support ready to provide product and system assistance. In addition, the following service areas are available at **www.microchip.com:**

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- **Forum** link provides access to knowledge base and peer help: **http://forum.microchip.com**
- **Buy** link provides locations of Microchip Sales Channel Partners: **www.microchip.com/sales**

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