



**Software & Hardware Solutions
for the 32-bit Designer**

**mTouch™ SENSING
SOLUTIONS**

**SPEECH & AUDIO
SOLUTIONS**

**GRAPHICS
SOLUTIONS**

WIRELESS

USB

**COMMON
CORE
TOOLS**

CAN

ETHERNET

PERFORMANCE

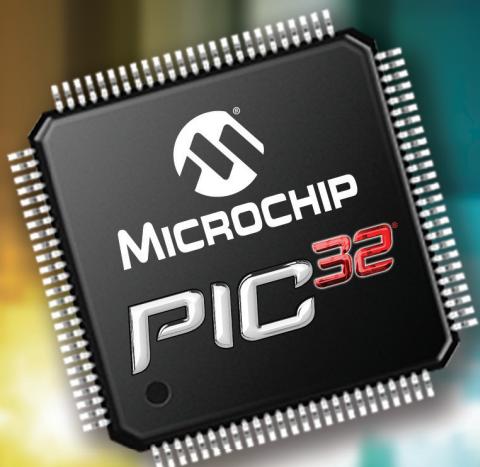


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ADPCM & Speex (Audio) Library for PIC32 MCUs

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 an 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

PIC32 MCU 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
- Easier 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)

Data Encryption Libraries (SW300052)

Summary

Microchip offers a reliable security solution for embedded applications built on the 16- and 32-bit microcontroller platform. This solution is provided by means of a single library. This library features the symmetric key encryption/decryption functions Advanced Encryption Standard (AES) and Triple-Data Encryption Algorithm (Triple-DES). These algorithms are also recommended by most Internet Engineering Task Force (IETF), Federal Information Processing Standards (FIPS) and IPSec standards.

Key Features

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

Applications

- Web access
- E-mail
- Secure XML transactions
- Virtual Private Networks (VPN)
- Secure transfer of stored calibration data

Cryptographic Functions: 16-bit MCUs and DSCs

Cryptographic Algorithm	Applicable Specification	Cryptographic Function ⁽¹⁾	Code Size (bytes)	Data Rate ⁽²⁾ (ksp/s)
T-DES	FIPS 46-3	Basic Encryption and Decryption	7500	19.8 (16 MIPS) 49.5 (40 MIPS)
AES (128-bit)	FIPS 197	Basic Encryption	3018	74.1 (16 MIPS) 184.7 (40 MIPS)

Note 1. Wrapper functions are used in combination with the underlying basic encryption and/or decryption functions for the respective algorithm (AES,T-DES).

2. AES and T-DES data rate represents the average of the data rates for performing basic encryption and decryption functions for a single block of data.

Cryptographic Functions: 32-bit MCUs

Cryptographic Algorithm	Cryptographic Function	CPU Cycle Times in µSecs ^(1, 2)	Throughput (Kbytes/Sec)
AES (128-bit)	Create Session Key	40.45	764
	Encrypt Block	20.45	
	Decrypt Block	20.45	
AES (128-bit)	Create Session Key	48.83	634.4
	Encrypt Block	24.63	
	Decrypt Block	24.63	
AES (128-bit)	Create Session Key	57.68	544.4
	Encrypt Block	28.70	
	Decrypt Block	28.70	

AES Library for PIC32 MCUs Memory Usage:

With MIPS32 Instructions: 14.9 KB

With MIPS16 Instructions: 13.9 KB

Note 1. Speed (Time) optimized –O3 loops unrolled.

2. PIC32 MCU running at 80 MHz.



PIC32 MCU 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-precision and double precision math library functions are now available, giving users a choice between double- and single-precision operations. The library provides the greatest benefit for the more complex operations offering 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)**
<code>sin/sinf*</code>	Sin of a double/single precision floating point variable	299	3.7375
<code>cos/cosf*</code>	Cos of a double/single precision floating point variable	299	3.7375
<code>tan/tanf*</code>	Tan of a double/single precision floating point variable	389	4.8625
<code>exp/expf*</code>	Calculates the exponential function of a double/single precision floating point variable	133	1.6625
<code>fabs/fabsf*</code>	Calculates the absolute value of a double/single precision floating point variable	6	0.075
<code>fmod/fmodf*</code>	Calculates the remainder of x/y as a double/single precision floating point value	86	1.075
<code>log/logf*</code>	Calculates the log of a double/single precision variable	301	3.7625
<code>sqrt/sqrtf*</code>	Calculates the square root of a double/single precision variable	237	2.9625
<code>pow/powf*</code>	Calculates x raised to the power of y	367	4.5875
<code>floor/floorf*</code>	Calculates the floor of a double/single precision floating point variable	33	0.4125
<code>ceil/ceilf*</code>	Calculates the ceiling of a double/single precision floating point variable	34	0.425
<code>asin/asinf*</code>	Arc sin of a double/single precision floating point variable	618	7.725
<code>acos/acosf*</code>	Arc cos of a double/single precision floating point variable	685	8.5625
<code>atan/atanf*</code>	Arc tan of a double/single precision floating point variable	353	4.4125

*“f” denotes single precision floating point number.

** PIC32 MCU at 80 MHz.

A complete list of floating point math functions is available in the MPLAB® XC32 C Libraries Manual.

PIC32 MCU Peripheral Library

Summary

PIC32 Peripheral Library provides functions and macros for setting up and controlling the 32-bit peripherals. Applications wishing to use peripheral libraries need to include one single file in their source file <plib.h> to access any of the supported functions and macros.

The PIC32 Peripheral Library supports the following peripheral module functions:

- System level function
- Prefetch cache
- DMA
- Bus matrix function
- Reset/control, power saving functions
- Oscillator, timer, input capture/output compare
- I/O ports and external interrupts
- PMP function
- UART, SPI, I²C™, CAN, Ethernet and USB functions
- RTCC functions
- 10-bit/A/D converter
- Comparator
- CVREF
- Watchdog timer

Key Features

- Peripheral library is optimized for faster execution and lower code memory
- One single peripheral library file to access many peripheral module functions
- C include files that enable pre-defined constants for passing parameters to various library functions, as well as a file for each peripheral module
- Functions in pre-compiled libraries that may be called from an application program written in either MPLAB XC32 Compiler for PIC32 MCUs or PIC32 assembly languages
- C source code is included to customize functions to specific application requirements
- Pre-defined constants in the C include files eliminate the need to refer to the details and structure of every special function register, while initializing peripherals or checking status bits
- API compatible with 16-bit devices

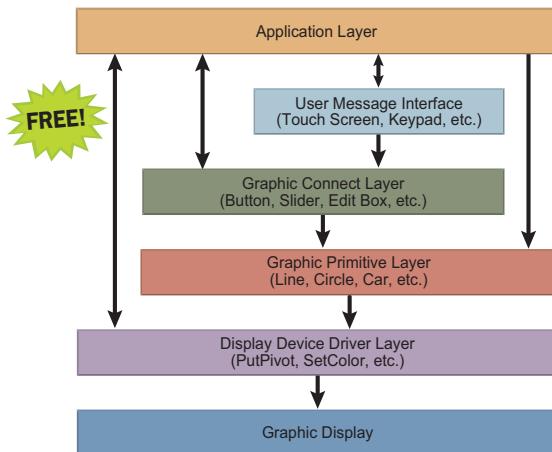
Microchip Graphics Library

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. Graphics library is highly modular and is optimized for Microchip's 16- and 32-bit microcontrollers (PIC24F, PIC24H/E, dsPIC33F/E and PIC32 MCUs).

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

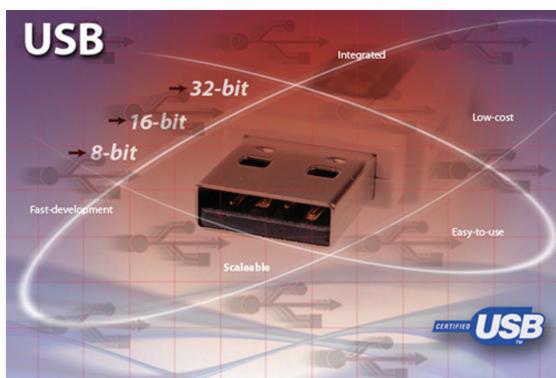
Microchip USB Framework

Summary

Microchip's USB software supports USB on 8-, 16- and 32-bit MCUs. This software is royalty free source code and also includes example projects. The 8-bit PIC18 family supports USB device mode. The 16-bit PIC24F, PIC24E and dsPIC33E and 32-bit PIC32 products with USB support device mode, embedded host and On-The-Go.

Key Features

- Supports 8-bit, 16-bit and 32-bit PIC MCUs
- Includes related drivers and resources to use with PC
- Includes various demonstration examples
- Includes class driver examples for:
 - HID
 - Mass Storage
 - CDC
 - Audio
 - Printer
 - Charger
 - Custom



Applications

- USB mouse and keypad
- Thumb drive data logger
- Mass storage devices
- Printers
- Bar code scanner
- CDC serial emulator

Microchip TCP/IP Stack

Summary

Communication over the Internet is accomplished by implementing the TCP/IP protocol. Microchip offers a free TCP/IP software stack that is optimized for the PIC18, 16-bit and 32-bit device family. The stack is a suite of programs that provide services to all TCP/IP based applications. Users do not need to know all the intricacies of the TCP/IP specifications in order to use the stack. Microchip's TCP/IP stack supports the PIC32MX6/7 32-bit MCU family with Ethernet MAC and the PIC18F97J60 family of 8-bit microcontrollers with Ethernet MAC and PHY and ENC28J60/ENC624J600 stand alone Ethernet controllers.



Key Features

- Socket support for TCP and UDP
- Portable across all PIC18, PIC24, dsPIC30F, dsPIC33F/E and PIC32MX products
- Support for MPLAB XC compilers
- RTOS independent
- Full TCP state machine
- Modular design

Supported Protocols

- | | |
|----------|-------------|
| ■ ARP | ■ IP |
| ■ ICMP | ■ UDP |
| ■ TCP | ■ SHOUTcast |
| ■ SNMP | ■ HTTP |
| ■ Telnet | ■ SNTP |
| ■ SMTP | ■ DNS |
| ■ DHCP | ■ FTP |
| ■ NBNS | ■ TFTP |

Additional Algorithm Support

- MD5 and SHA-1 Hashing
- MIME
- MPFS
- Base64
- Secure Random Number

Applications

- Streaming MP3 internet radio
- UART to TCP bridge
- Ethernet/Internet bootloader
- Web monitorable and configurable vending machine
- Remote sensor monitoring and control



IEEE 802.15.4: Microchip MiWi and MiWi P2P Protocol

Summary

MiWi and MiWi P2P are proprietary protocol stacks developed by Microchip for short-range wireless networking applications based on the IEEE 802.15.4 wireless personal area network (WPAN) specification. The MiWi protocol stacks are optimized for low-power, low data rate, cost sensitive application and offer a small footprint alternative to the standard based ZigBee compliant protocol stack. This protocol stack supports 8-, 16- and 32-bit PIC MCUs and dsPIC DSCs.

MiWi

- Microchip wireless proprietary protocol stack
- Based on IEEE 802.15.4 standard
- Small footprint, highly optimized Mesh and Star network protocol



Your wireless connectivity made simple.

MiWi P2P

- Microchip wireless proprietary peer-to-peer protocol stack
- Based on IEEE 802.15.4 standard
- Ultra-Small footprint (3 KB), Peer-to-Peer network protocol

Applications

- Data loggers
- Security systems
- Display controllers
- Photo display frames

IEEE 802.15.4: ZigBee, ZigBee PRO and ZigBee Smart Energy Profile Suite

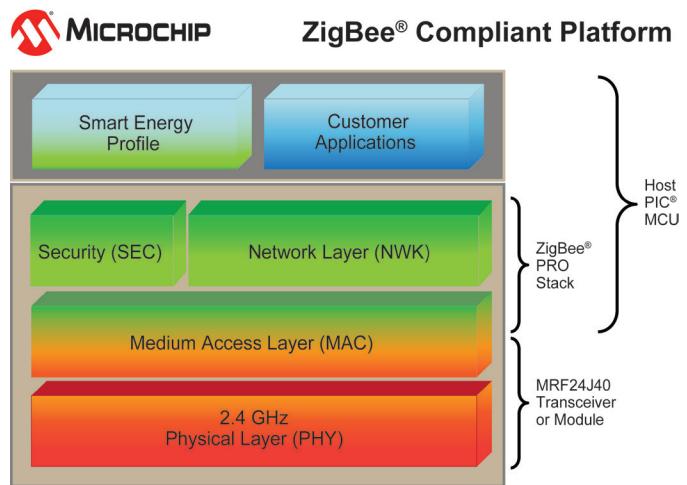
Summary

As a member of the ZigBee Alliance, Microchip offers certified ZigBee Compliant Platform (ZCP) for the ZigBee 2006, ZigBee PRO and ZigBee Smart Energy Suite protocol stacks.

Key Features

ZigBee Smart Energy Profile Suite

- Support for the following Smart Energy devices:
 - Energy Service Portal (ESP)
 - Meter (MTR)
 - In Premise Display (IPD)
 - Load Control Device (LCD)
 - Programmable Communicating Thermostat (PCT)
 - Smart Appliance (SAP)
 - Range Extender (RED)
- Support for Certificate Based Key Exchange (CBKE) security mechanism
- The ZigBee Cluster Library (ZCL) (SE profile clusters only)
- Support for commissioning via the Startup Attribute Set (SAS)
- Portable across the PIC24, PIC32 MX MCUs and dsPIC DSCs
- ZigBee PRO
- Microchip's Certified ZigBee PRO Compliant Platform (ZCP)
 - Certified ZigBee PRO Stack
 - PIC24 MCUs or dsPIC DSC family of microcontrollers
 - MRF24J40, MRF24J40MA, MRF24J40MB 2.4 GHz IEEE 802.15.4 transceiver/modules
- Full featured, interoperable, Mesh and Star network protocol



ZigBee 2006

- Zero-cost-license and royalty-free ZigBee 2006 protocol stack
- Microchip's Certified ZigBee 2006 Compliant Platform (ZCP)
 - Certified ZigBee 2006 Stack
 - PIC18 or PIC24 MCUs or dsPIC DSCs
 - MRF24J40, MRF24J40MA, MRF24J40MB 2.4 GHz IEEE 802.15.4 transceiver/modules
- Full featured, interoperable, Mesh and Star network protocol

PIC32 CAN Library Using MCP2515 CAN Controller*

Summary

PIC32 CAN library is based on the MCP2515 CAN controller. The MCP2515 is connected to the PIC32 microcontroller via 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 support max 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.*

Bluetooth Stack for PIC24 and PIC32 MCUs and dsPIC DSCs

Summary

Microchip has partnered with CandleDragon to offer the Bluetooth® software stack. The dotstack™ Bluetooth stack was designed for low cost and low power embedded devices. The Bluetooth stack is SIG compliant and has a small footprint.

Key Features

- Written in ANSI C
- Well defined protocols and profile application interface
- Supports Bluetooth specification version 1.2, 2.0, 2.1, +EDR
- Supported profiles: SPP, HID, HFP, Headset, Simple Secure Pairing, FTP, HDP and PBAP
- Bluetooth chipsets supported CSR

Microchip FAT File System for PIC24 and PIC32 MCUs and dsPIC DSCs

Summary

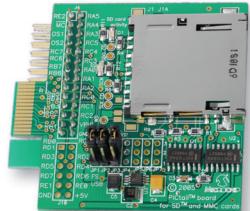
Microchip's FAT file system interface library brings the ability to transfer and share portable memory devices between an embedded system and a personal computer. Most SD cards, CF cards and MultiMedia Cards (MMCs), particularly those sized below 2 GB, use the FAT16 standard. The FAT32 standard can be used to address memory sized between 2 GB and 2 TB. This library with complimentary application note provides a method to read and/or write to these storage devices through a microcontroller. The data of these storage devices can be read by a PC, and the data written by a PC can be read by a microcontroller. Most operating systems (i.e., Windows® XP) support the FAT16 and FAT32 file systems.

Key Features

- Based on ISO/IEC 9293 specifications
- Provides a method of interfacing to files and directories on FAT12, FAT16 and FAT32 file systems.

- FAT16 and FAT32 allow access to up to 2 GB and 2 TB of memory, respectively
- Most popular file system with SecureDigital (SD) cards, CompactFlash® (CF) cards and USB thumb drives
- Hardware evaluation supported by PICtail Plus SD and MMC Daughter Card and USB PICtail Plus Daughter Card

PICtail Plus Daughter Board for SD and MMC Cards (AC164122)





FATFs File System for PIC32 MCUs

Summary

FATFs is an open source file system software stack designed for microcontrollers to easily access multiple media sources during run-time. This small footprint low-overhead software supports FAT32, FAT16 and FAT12 formats using an 8.3 file name format. FatFs can be modified to use multiple media sources (ATA, USD, SD Card, etc.). FatFs is an open source module that can be used, modified, and/or republished for personal, non-profit, education, R&D or commercial use without any restriction.

Key Features

- Large number of media drive support and easy drive addition
- Write buffer flushing
- Compile time options to minimize memory footprint
- Simultaneous multiple media access
- Application software control of file structure
- No pre-defined limit to the number of files structures that can be used



Data EEPROM Emulation for PIC18, PIC24 and PIC32 MCUs and dsPIC DSCs

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

- Applications which require to store user definable parameters
- Frequently updated calibration or adjustable parameters
- Saving critical data due to power failure



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 the 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)





Memory Disk Drive File System for PIC18, PIC24 and PIC32 MCUs and dsPIC DSCs

Summary

Microchip's Memory Disk Drive (MDD) file system interface library brings the ability to transfer and share portable memory devices between an embedded system and a personal computer. The MDD library provides a method to read and/or write to these storage devices through a microcontroller. The data of these storage devices can be read by a PC, and the data written by a PC can be read by a microcontroller. Most operating systems (i.e., Windows® XP) support the FAT16 and FAT32 file systems.

Key Features

- Based on ISO/IEC 9293 specifications
- Provides a method of interfacing to files and directories on FAT12, FAT16 and FAT32 file systems
- FAT16 and FAT32 allow access to up to 2 GB and 2 TB of memory, respectively
 - FAT16 standard used for most SecureDigital (SD) cards, CompactFlash® (CF) cards and MMCs MultiMedia Cards sized below 2 GB
 - FAT32 standard can be used to address memory sized between 2 GB and 2 TB

- Most popular file system with SD cards, CF cards and USB thumb drives
- Hardware evaluation supported by PICtail Plus SD and MMC Daughter Card (AC164122) and USB PICtail Plus Daughter Card (AC164131)
- MDD file system library supports the 8-bit PIC18 devices as well as the 16-bit PIC24F, PIC24H/E, dsPIC30 and dsPIC33 devices and 32-bit PIC32 devices

PICtail Plus Daughter Board for SD and MMC Cards (AC164122)



Class B Safety Software Library for PIC MCUs and dsPIC DSCs

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

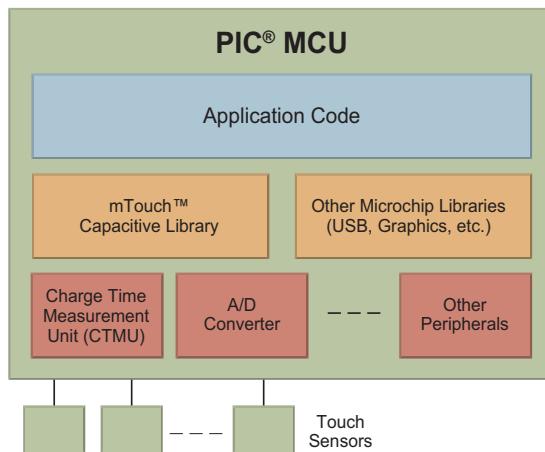


mTouch Capacitive Touch Library

Summary

The mTouch software packages enables designers to easily integrate touch technologies into their application. It allows the implementation in a small dedicated controller as well as integrating 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

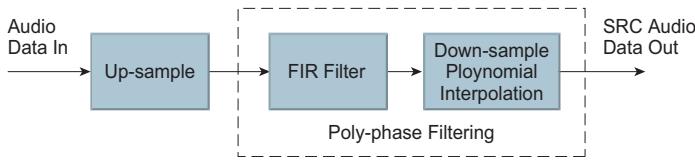
- Techniques for Robust Capacitive Touch Sensing, AN1334
- mTouch Metal Over Cap Technology, AN1325
- mTouch Conducted Noise Immunity Techniques for CTMU Peripheral, AN1317
- Capacitive Touch Using Only an ADC (CVD) (suitable for PIC10/12/16/24H/32 MCUs and dsPIC DSCs), AN1298
- Microchip CTMU for Capacitive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



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.

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 sensing solutions slider and buttons
- PIC32MX250F128 with 128 KB of Flash, 32 KB RAM
- Micro SD 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. From the over 35 source code examples to the 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 72 MHz with 512K Flash, 32K RAM, 4 ch. DMA
- Expansion connector enables addition of Microchip's PIC32 expansion boards or create your own

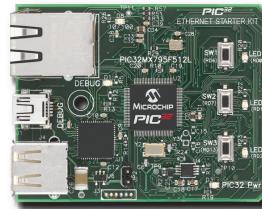
PIC32 USB Starter Kit II (DM320003-2)

The PIC32 USB Starter Kit II provides the easiest and lowest cost method to experience the USB and CAN functionality of the PIC32 microcontrollers. Users can develop CAN applications using PIC32 expansion board. The board contains everything needed 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 ch. DMA + 4 ch. 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 addition of Microchip's PIC32 expansion boards or create your own

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, your project will be running in no time. 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 ch. DMA + 8 ch. DMA dedicated to Ethernet, CAN and USB
- Expansion connector enables addition of Microchip's PIC32 expansion boards or create your own

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. The kit is extremely portable as well and is still 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

PIC32 Audio Solutions

Audio Development Board for PIC32 (DM320011)



The audio Development Board for PIC32 MCUs features and 80 MIPS PIC32 MCU, a 24-bit Wolfson audio codec, a two-inch color LCD Display, a USB interface, and an onboard 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 PIC32MX795F128B MCU with 80 MIPS 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 (MCU). 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: 40 MHz, 128 KB of program memory and 32 KB of RAM
- PIC32 I²S 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

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, thus reducing system BOM cost for many applications. The board is designed to attach to a PIC32 starter

kit (DM320001, DM320003-2, DM320004) or an Explorer16 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 9/12/24-bit TFT interface
- SD/MMC Card 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 allows evaluating Microchip Technology's 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 Megabit 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 development of cost effective multitouch 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 device MTCH6301
- WQVGA 4.3" display
- USB port for Device or Host functionality
- Expansion header
 - Access to PIC32 I/Os and peripherals

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 onboard FCC certified WiFi module, a 24-bit stereo audio code, a three-axis accelerometer, a joystick and a MicroSD memory card slot. Simply connect any DM320001, DM320003-2, DM320004, DM330012 and 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, 8 position joystick with fire button, 3-Axis orientation/acceleration
- FCC certified Wi-Fi, 10/100 Ethernet via PIC32 Ethernet Starter Kit

Display Boards

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

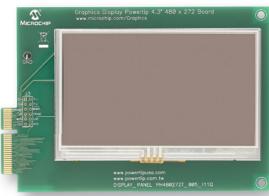


The Graphics Display Truly 3.2" 240 × 320 Board is a demonstration board for evaluating Microchip's graphic display solution and graphics library for 16- and 32-bit microcontrollers.

Key Features:

- 3.2 QVGA (240 × 320) 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)

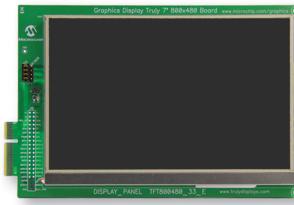


The Graphics Display Truly 5.7" 640 × 480 Board is a demonstration board for evaluating Microchip's graphic display solution and graphics library for 16- and 32-bit microcontrollers.

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

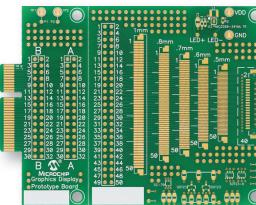


The Graphics Display Truly 7" 800 × 480 Board is a demonstration board for evaluating Microchip's graphic display solution and graphics library for 16- and 32-bit microcontrollers.

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 Key Board
- 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 onboard MRF24WBOMA Wi-Fi module which is FCC/IC/ETSI certified along with a PIC32 microcontroller.

Key Features:

- Wi-Fi solution compatible with IEEE 802.11 b/g/n Access Points
- Supports Infrastructure and Ad hoc networks
- MRF24WBOMA module is FCC, IC, Wi-Fi certified and ETSI compliant
- Powered by 2 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)

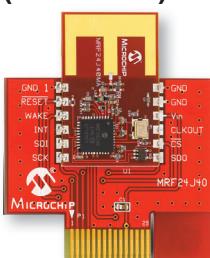


with Microchip's Multimedia Expansion Board and a PIC32 starter kit to provide developers with a turn-key platform to get started with apps such as texting, email and GPS.

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 multislots 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 Development Environment 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 Transceiver Module. The daughter board can plug into multiple Microchip Technology Demonstration and development boards such as 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 (DM240001) development board.

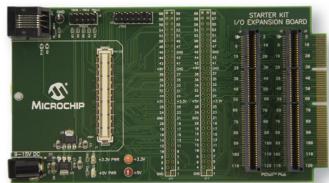
Key Features:

- IEEE 802.3 Compliant
- 10BASE-T Ethernet
- RJ-45 Female Ethernet Connector
- Plug in compatible with the Explorer 16 Development Board (DM240001)

Expansion and Development Boards

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

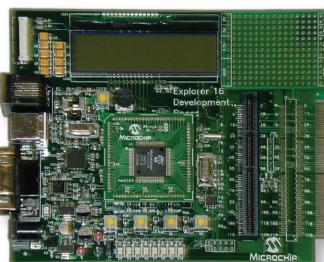
PIC32 I/O Expansion Board (DM320002)



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.

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

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 Microcontroller and the dsPIC33 Digital Signal Controller (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 display
- Interfaces to MPLAB ICD 2, 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 bread board prototyping area
- PICtail Plus connector for expansion boards
- Full documentation CD includes user's guide, schematics and layout

Plug-In Modules

Processor Plug-In Modules are small circuit boards to 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 used for prototyping, demonstration or development, quickly and easily.

PIC32 General Purpose (PIM) (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, 4 channels of hardware DMA, and instruction trace is installed on the plug-in module.

PIC32 USB Plug-In Module (PIM) (MA320002)

This Plug-in Module enables USB development using a PIC32 on the Explorer 16 development board, it requires 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, 4 channels of hardware DMA and instruction trace is installed on the plug-in module.

PIC32 USB/CAN Plug-In Module (PIM) (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 x CAN 2.0b modules, 8 channels of dedicated DMA, and 8 general channels of dedicated DMA comes on this PIM.

PIC32MX1/MX2 Plug-In-Module (PIM) (MA320011)



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

Microchip TCP/IP Stack

Application Note: AN833, Ready-to-Use Solution



Summary

There is nothing new about implementing TCP/IP (Transmission Control Protocol/Internet Protocol) on Microchip microcontrollers. Interested developers can easily find many commercial and non-commercial implementations of TCP/IP for Microchip products.

This application note details Microchip's own freely available implementation of the TCP/IP Stack. The Microchip TCP/IP Stack is a suite of programs that provides services to standard TCP/IP-based applications (HTTP Server, Mail Client, etc.), or can be used in a custom TCP/IP-based application.

The Microchip TCP/IP Stack is implemented in a modular fashion, with all of its services creating highly abstracted layers. Potential users do not need to know all the intricacies of the TCP/IP specifications to use it. In fact, those who are only interested in the accompanying HTTP Server application do not need any specific knowledge of TCP/IP.

IrDA Standard Stack

Application Note: AN1071, Ready-to-Use Solution



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)



HTTP Server Using BSD Socket API for PIC32MX Devices

Application Note: AN1107, Ready-to-Use Solution

FREE Proven Software Source Code

Summary

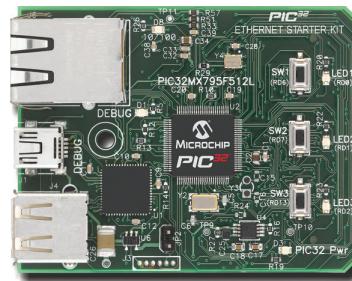
An embedded HTTP (Hyper Text Transfer Protocol) server, or web server is an excellent addition to any network-enabled device. HTTP server capability allows an embedded device to be monitored and controlled remotely using any standard, off-the-shelf Internet browser. Owing to the ubiquitous deployment of Internet browsers, a web-enabled device can be accessed from almost any computer, desktop or mobile. This Microchip HTTP server application note and the included FAT16 module, supplemented by the TCP/IP Application Note AN1108, *Microchip TCP/IP Stack with BSD Socket AP*, provide an HTTP server module that can be integrated with almost any application on a PIC32 microcontroller.

Capabilities of this Application Solution

- Provides portability across the 32-bit family of PIC microcontrollers
- HTTP Server APIs compatible with PIC18/PIC24 Microchip HTTP Server APIs

- Supports multiple HTTP connections
- Automatic interaction with the FAT16 file system
- Supports the HTTP methods: GET, HEAD, POST and PUT
- Supports “continue” response that may be requested by the client
- Supports a modified Common Gateway Interface (CGI) to invoke predefined functions from within the remote browser
- Supports dynamic web page content generation
- Supports HTTP web page authentication

PIC32 Ethernet Starter Kit (DM320004)



TCP/IP Stack with BSD Socket API for PIC32MX Devices

Application Note: AN1108, Ready-to-Use Solution

FREE Proven Software Source Code

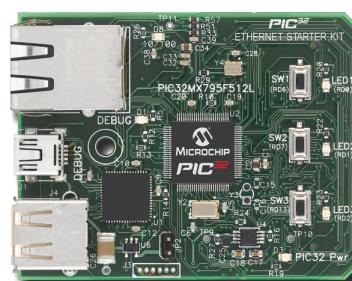
Summary

This application note describes the Microchip TCP/IP stack with BSD (Berkeley Socket Distribution) Socket API and provides the socket library for Internet TCP/IP communications. Many popular operating systems and many commercial TCP/IP stacks support BSD socket API. With a common programming interface, applications can now be ported easily across completely different platforms. For example, network applications written for a PC environment can also be compiled in an embedded environment, provided the embedded platform supplies the BSD library API. The demo applications included with this application note provide example client and server applications that use stream socket.

Capabilities of this Application Solution

- Creating client/server applications in an embedded environment
- TCP/IP stack components and design
- Socket functions included in the API
- Application can be a server or a client, or both
- Full duplex communication
- Stream and datagram socket support
- IP address resolution done in background
- Can be used with or without a kernel/RTOS

PIC32 Ethernet Starter Kit (DM320004)



SNMP Agent Using BSD Socket API for PIC32MX Devices

Application Note: AN1109, Ready-to-Use Solution

Proven Software Source Code

Summary

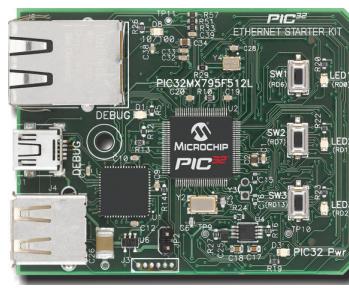
This Microchip SNMP agent application note and the included FAT16 module, supplemented by the TCP/IP application note AN1108, Microchip TCP/IP Stack with BSD Socket API, provide an SNMP agent that can be integrated with almost any application on a Microchip 32-bit microcontroller products. The TCP/IP application note and the FAT16 module are required to compile and run the SNMP agent module. The software in the installation files includes a sample application that demonstrates all of the features offered by this SNMP agent module.

Capabilities of this Application Solution

- Provides portability across the 32-bit family of PIC microcontrollers
- SNMP agent APIs (Application Program Interfaces) are compatible with PIC18/24 SNMP agent APIs
- Functions independently of RTOS or application
- Supports MPLAB XC32 Compiler

- Supports SNMP version 1 over UDP
- Supports Get, Get-Next, Set and Trap PDUs
- Automatically handles access to constant OIDs
- Supports up to 255 dynamic OIDs and unlimited constant OIDs
- Supports sequence variables with 7-bit index
- Supports enterprise-specific trap with one variable information
- Uses an MIB that can be stored using FAT16
- Includes a PC-based MIB compiler
- Does not contain built-in TCP/UDP/IP statistics counters (user application must define and manage the required MIB)

PIC32 Ethernet Starter Kit (DM320004)



FTP Server Using BSD Socket API for PIC32MX Devices

Application Note: AN1111, Ready-to-Use Solution



Summary

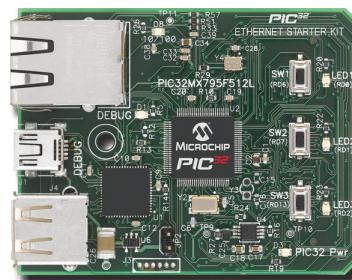
An embedded FTP (File Transfer Protocol) server is an excellent addition to any network-enabled device. FTP server capability facilitates the uploading of files to, and downloading of files from, an embedded device. Almost all computers have, at the very least, a command line FTP client that will allow a user to connect to an embedded FTP server. This Microchip FTP server application note and the included FAT16 module, supplemented by the TCP/IP application note AN1108, Microchip TCP/IP Stack with BSD Socket API, provide an FTP Server module that can be integrated with almost any application on a Microchip 32-bit microcontroller product.

Capabilities of this Application Solution

- Provides portability across all 32-bit PIC microcontrollers
- FTP Server APIs are compatible with PIC18 and PIC24 Microchip FTP Server APIs

- FTP connection is authenticated by your application
- Automatic interaction with the FAT16 file system
- Upload files to the server using the PUT command
- Download file to the client using the GET command
- Supports the FTP NOOP command
- Supports the PORT command, allowing you to change the data port
- FTP Server APIs compatible with older Microchip FTP Server APIs

PIC32 Ethernet Starter Kit (DM320004)



Serial Bootloader for PIC32 MCUs

Ref Application Note: AN851, Ready-to-Use Solution



Summary

The serial bootloader for PIC32 MCUs is used to program the user application to the Program Flash Memory (PFM) using the UART serial port. The software comes with a PC application that reads the user provided HEX file and writes the program flash contents to the PIC32. This PC application works in conjunction with the bootloader (BL) firmware installed on the PIC32 MCU.

Capabilities of this Application Solution

- RS-232 based
- Auto baud detection
- Checksum validation of application code
- Bootloader located in protected Flash
- Graphical user interface provided
- Application code is located exclusively in program Flash
- Simple development system

Graphics Display Solution

Application Note: AN1136, Ready-to-Use Solution

Proven Software Source Code

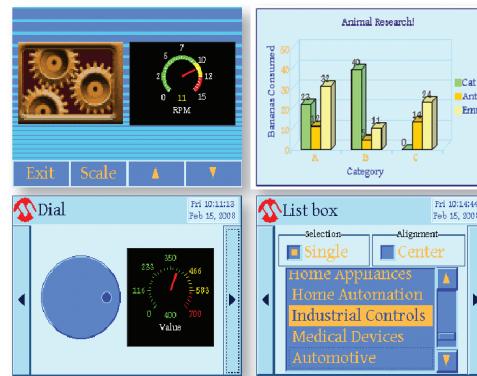
Summary

This application note describes How to Use Widgets in the Microchip Graphics Library and also acts as a guide to the use of Microchip's graphics display solution which consists of the Explorer 16, a Graphics PICtail Plus (AC164127) daughter card, and a free Graphics Library. The graphics display solution allows a designer to quickly implement a graphical user interface on a display. The library also includes the software needed to quickly implant a touch screen display, turning the display into a modern user interface.

Capabilities of this Application Solution

- 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

Graphics Screen Display



Graphics PICtail Plus Daughter Board with 3.2" Display Kit (AC164127-3)



Using a Keyboard with the Microchip Graphics Library

Application Note: AN1227, Ready-to-Use Solution

Proven Software Source Code

Summary

Graphics displays are widely used in many applications and the number of products with displays is steadily growing. A primary reason is that a Graphical User Interface (GUI) can greatly simplify the use of a device. The GUI can interface a display with a variety of input devices, such as keyboards, touch screens or mice. Keyboards range from devices with several side buttons to those enabling text entry. Low cost and the ability to quickly enter data result in frequent use of keyboards.

Graphics PICtail Plus Daughter Board with 3.2" Display Kit (AC164127-3)



Data Encryption Routines for PIC24 and PIC32 MCUs and dsPIC DSCs

Application Note: AN1044, Ready-to-Use Solution

FREE Proven Software Source Code

Summary

Currently, there are three data encryption standards approved for use in the Federal Information Processing Standards (FIPS). This application note discusses the implementation of two of these for PIC24, dsPIC30/33 and PIC32 devices: Triple Data Encryption Standard (TDES) and Advanced Encryption Standard (AES). Source code for this application note (Part Number SW300052) is available from Microchip for a nominal fee.

Capabilities of this Application Solution

- Optimized for speed, code size and RAM usage
- Library functions tested for adherence to applicable standards
- Application note describes APIs
- Several examples of use are provided for each library function
- All Microchip 16-bit families supported

Cryptographic Algorithm	Applicable Specification	Cryptographic Function*	Code Size (bytes)	Data Rate (Kbytes/sec)
T-DES	FIPS 46-3	Basic Encryption and Decryption	7500	19.8 (16 MIPS) 37.2 (30 MIPS)
AES (128-bit)	FIPS 197	Basic Encryption	3018	74.1 (16 MIPS) 138.9 (30 MIPS)

*AES and T-DES data rate represents the average of the data rates for performing basic encryption and decryption functions for a single block of data.

File I/O Functions Using Memory Disk Drive File System Library

Application Note: AN1045, Ready-to-Use Solution

FREE Proven Software Source Code

Summary

Application note AN1045 covers the implementation of a memory disk drive file system on Microchip's 16-bit families. This memory disk drive file system allows a designer to easily implement a removable Flash-based media card of up to 2 GB into their application. Applications that require data logging or retrieval of large blocks of data such as fonts or bit maps are often taking advantage of removable Flash-based memory cards. The memory disk drive file system library is modular and provided in "C" source to easily integrate into any application.

- Most popular files system with SD cards, CF cards and USB thumb drives
- Provides directory manipulation support
- Provides file/directory search support
- Easy-to use standard I/O style functions
- Available free for use on Microchip microcontrollers
- Portable across PIC18 and PIC24 MCUs and dsPIC DSC devices
- Supports up to 2 GB

PICtail Plus Daughter Board for SD and MMC Cards (AC164122)



Capabilities of this Application Solution

- Developed based on ISO/IEV9293 specification
- Known as FAT16 File System used on early DOS operating systems by Microsoft® Corporation

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

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)



PIC32 High Quality Audio Applications

Application Note: AN1044, 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 I2S 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

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.

Using PIC32 MCUs to Develop Low Cost Controllerless Graphics Solutions

Application Note: AN1387, Ready-to-Use Solution

Proven Software Source Code

Summary

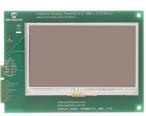
Many vendors today offer graphics solutions involving an internal or external graphics controller as part of the system, which may result in higher costs and complex design. In most cases for a simple embedded Graphical User Interface (GUI), these graphics controllers are not necessary, but a suitable 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 x 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 240 x 320 Board (AC164127-4)	WQVGA 4.3" Graphics Display Powertip 480 x 272 Board (AC164127-6)	VGA 5.7" Graphics Display Truly 640 x 480 Board (AC164127-8)	Prototype Boards Connect Your Glass (AC164139)

Video Playback and Streaming Solutions Using the PIC32 MCU

Application Note: AN1415, Ready-to-Use Solution

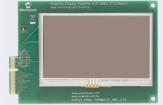
Proven Software Source Code

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 micro-SD card using the Solomon SSD1926 LCD Graphics Controller on the MED and PIC32
- Streaming uncompressed AVI video over ethernet and the MEB using PIC32
- Streaming uncompressed AVI video over ethernet on WVGA using PIC32

Graphics Development Board	Display Boards Supported				
					
PIC32 Starter Kit (DM320001 or DM320003) + Solomon GFX Board (AC164127-5)	Yes	Yes	No	No	Yes
	Yes	Yes	Yes	Yes	Yes

Create Widgets in Microchip Graphics Library

Application Note: AN1246, Ready-to-Use Solution

Proven Software Source Code

Summary

Creating new Widgets from scratch is necessary to save code and to simplify the usage of the Widgets in certain

applications. The different functions and files in the Graphics Library, that require modification to implement customized widgets, have been discussed in this application note. This application note also outlines the process of integrating new widgets into the Graphics Library in order to utilize the already implemented routines for processing messages and rendering Widgets.

MPLAB ICD In-Circuit Debugger (DV164035)

Summary



MPLAB ICD In-Circuit Debugger System is Microchip's most cost effective high-speed hardware debugger/programmer for Microchip Flash Digital Signal Controller (DSC) and microcontroller (MCU) devices. It debugs and programs PIC MCUs and dsPIC DSCs with the powerful, yet easy-to-use graphical user interface of 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.

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

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 with the latest version of MPLAB X IDE, free of charge.

MPLAB REAL ICE In-Circuit Emulator (DV244005)

Summary



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 microcontrollers and dsPIC DSCs with the easy-to-use

but powerful graphical user interface of the MPLAB X Integrated Development Environment (IDE), included with each kit.

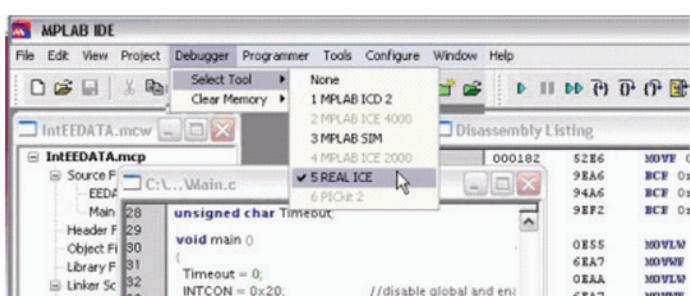
The MPLAB REAL ICE In-Circuit Emulator probe is connected to the design engineer's PC using a high-speed USB 2.0 interface and is connected to the target with either a connector compatible with the popular MPLAB ICD system (RJ11) or with the high-speed, noise tolerant, low voltage differential signal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

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 ($3\frac{3}{8}'' \times 4\frac{5}{8}'' \times \frac{3}{4}''$)

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 PIICKit In-Circuit Debugger allows debugging and programming of Flash PIC MCUs and dsPIC DSCs at an affordable price point using the powerful MPLAB X Integrated Development Environment (IDE) graphical user interface. The PIICKit 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)

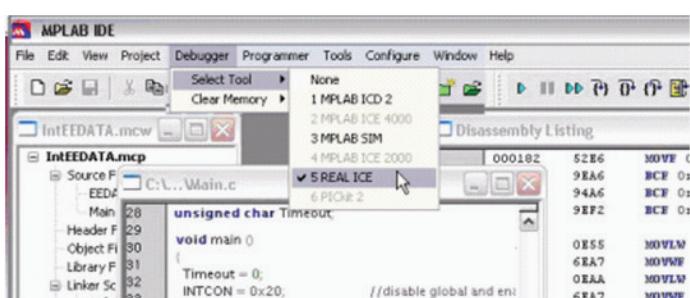
Summary



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)
- SQTPSM 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



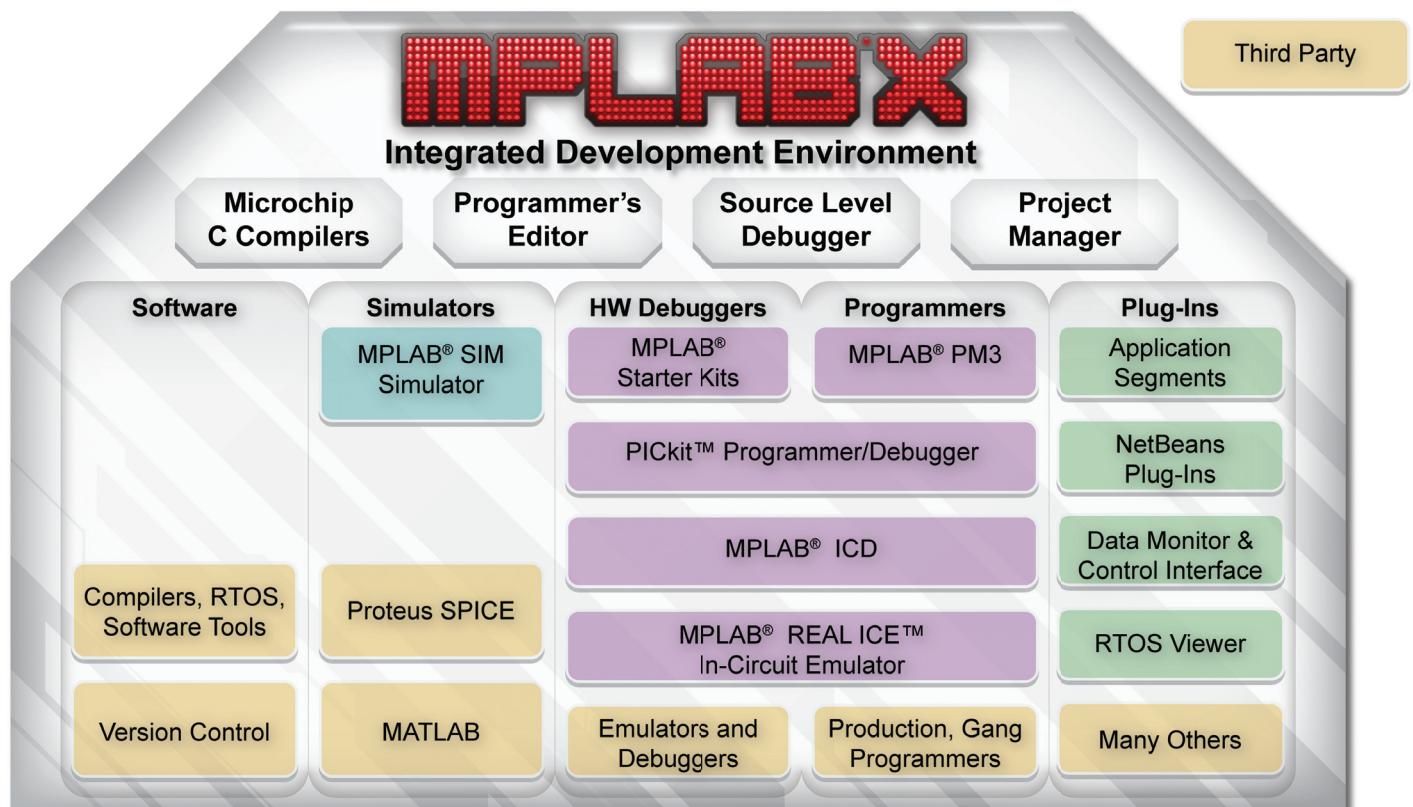
MPLAB X IDE

Summary

MPLAB X IDE is a software program that runs on a PC (Windows, Mac OS, Linux) to develop applications for Microchip microcontrollers and digital signal controllers. MPLAB X Integrated Development Environment 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 enables to add many frequently requested features very quickly and easily while also providing a much more extensible architecture to come up with even 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, a user can configure their own Code Format Style
- Seamless interface for MPLAB X IDE tools
- Easy migration between tools from software simulators to hardware debugging and programming tools



MPLAB XC32 Compiler (SW006023-2)

Summary

The MPLAB XC32 is a full-featured, highly-optimized ANSI C compiler for the PIC32 Microcontroller family. This compiler integrates into Microchips 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 & 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 compiler libraries for 16-bit products

FREE Graphics Display Designer X

Summary

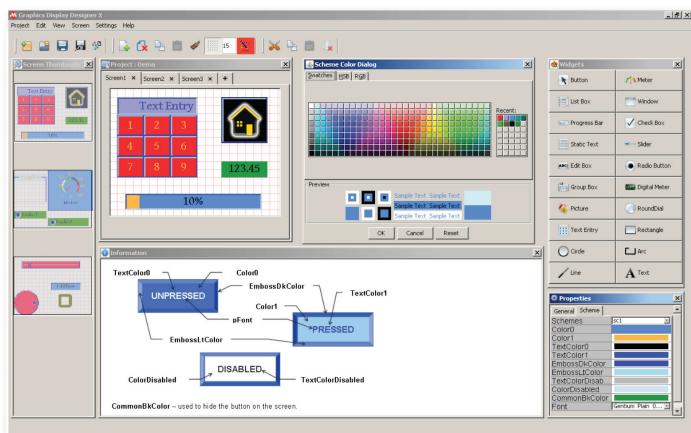
The Microchip's New Graphics Display Designer X (GDD X) is an enhanced visual design tool that provides customers with a quick and easy way of creating graphical user interface (GUI) screens for graphical interface applications on Microchip MCUs. It can be used with Microchip Graphics Library as a standalone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

What's New?

- WYSIWYG design
- Multiplatform
 - 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

- Resize, align and move widgets, create color schemes, add fonts and images to your App
- Generates source code ready for PIC24, dsPIC and PIC32 devices
- 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



Third Party Software Tools, RTOS and Libraries

PIC32 Third Part Software Options

Vendor	RTOS	GUI	TCP/IP	USB	Example Projects	Application Note	MPLAB® X IDE RTOS Viewer
 AVIX-RT	✓	-	-	-	✓	✓	✓
 CMX SYSTEMS	✓	-	-	-	-	-	✓
expresslogic	✓	-	✓	✓	-	✓	✓
Micrium Empowering Embedded Systems	✓	-	-	-	✓	✓	✓
 freeRTOS	✓	✓	-	-	✓	✓	✓
 PUMPKIN™ REAL-TIME SOFTWARE	✓	-	-	-	-	-	-
 RoweBots	✓	-	✓	✓	✓	✓	-
 SEGGER	✓	✓	-	-	✓	-	✓
 easyGUI	-	✓	-	-	-	-	-
 RAMEX	-	✓	-	-	-	-	-

PIC32 C++ and Eclipse Options from Third Parties

Vendor	IDE	Compilers	Debug Hardware
 ASHLING THE DEVELOPMENT SYSTEMS COMPANY	Customized Eclipse	GNU C/C++/ Microchip C	Ashling JTAG
 Green Hills SOFTWARE INC.	Multi IDE	Green Hills C/C++	Green Hills JTAG
 LAUTERBACH	Trace32 IDE	GNU C/C++ Microchip C	Lauterbach JTAG
 Macraigor Systems Complete JTAG Debug Support	Standard Eclipse	GNU C/C++ Microchip C	Macraigor JTAG (3 models)

Support

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

- **Support** link provides a way to get questions answered fast: <http://support.microchip.com>
- **Sample** link offers evaluation samples of any Microchip device: <http://sample.microchip.com>
- **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

Training

If additional training interests you, then Microchip can help. We continue to expand our technical training options, offering a growing list of courses and in-depth curriculum locally, as well as significant online resources – whenever you want to use them.

- Technical Training Centers: www.microchip.com/training
- MASTERs Conferences: www.microchip.com/masters
- Worldwide Seminars: www.microchip.com/seminars
- eLearning: www.microchip.com/webseminars
- Resources from our Distribution and Third Party Partners www.microchip.com/training

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Tel: 49-89-627-144-0
Italy - Milan
Tel: 39-0331-742611
Netherlands - Drunen
Tel: 31-416-690399
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Tel: 44-118-921-5869

ASIA/PACIFIC

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Tel: 86-10-8569-7000
China - Chengdu
Tel: 86-28-8665-5511
China - Chongqing
Tel: 86-23-8980-9588
China - Hangzhou
Tel: 86-571-2819-3187
China - Hong Kong SAR
Tel: 852-2943-5100
China - Nanjing
Tel: 86-25-8473-2460
China - Qingdao
Tel: 86-532-8502-7355
China - Shanghai
Tel: 86-21-5407-5533
China - Shenyang
Tel: 86-24-2334-2829
China - Shenzhen
Tel: 86-755-8864-2200
China - Wuhan
Tel: 86-27-5980-5300
China - Xiamen
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