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**Microchip Compact MP3  
Decoder Library  
User's Guide**

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# MICROCHIP COMPACT MP3 DECODER LIBRARY USER'S GUIDE

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## Preface

### NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site ([www.microchip.com](http://www.microchip.com)) to obtain the latest documentation available.

Documents are identified with a “DS” number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is “DSXXXXA”, where “XXXX” is the document number and “A” is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® X IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

### INTRODUCTION

This chapter contains general information that will be useful to know before you use the Microchip Compact MP3 Decoder Library. Items discussed in this Preface include:

- [Document Layout](#)
- [Conventions Used in this Guide](#)
- [Warranty Registration](#)
- [License Agreement](#)
- [Recommended Reading](#)
- [The Microchip Web Site](#)
- [Development Systems Customer Change Notification Service](#)
- [Customer Support](#)
- [Document Revision History](#)

### DOCUMENT LAYOUT

This document describes how to use the Microchip Compact MP3 Decoder Library with the PIC32 family of devices. The document layout is as follows:

- **Chapter 1. “Introduction”** – This chapter provides an overview of the Microchip Compact MP3 Decoder Library.
- **Chapter 2. “Library Resources”** – This chapter describes the resources available for the Microchip Compact MP3 Decoder Library.
- **Chapter 3. “Application Programming Interface (API)”** – This chapter outlines how the API functions provided in the Microchip Compact MP3 Decoder Library can be included in your application software via the Application Programming Interface.

# Microchip Compact MP3 Decoder Library User's Guide

## CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

### DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Italic characters	Referenced books	<i>MPLAB<sup>®</sup> IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	<u><i>File&gt;Save</i></u>
Bold characters	A dialog button	Click <b>OK</b>
	A tab	Click the <b>Power</b> tab
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Plain Courier New	Sample source code	#define START
	Filenames	autoexec.bat
	File paths	c:\mcc18\h
	Keywords	_asm, _endasm, static
	Command-line options	-Opa+, -Opa-
	Bit values	0, 1
	Constants	0xFF, 'A'
<i>Italic Courier New</i>	A variable argument	<i>file.o</i> , where <i>file</i> can be any valid filename
Square brackets [ ]	Optional arguments	mcc18 [options] <i>file</i> [options]
Curly brackets and pipe character: {   }	Choice of mutually exclusive arguments; an OR selection	errorlevel {0 1}
Ellipses...	Replaces repeated text	var_name [, var_name...]
	Represents code supplied by user	void main (void) { ... }
Notes	A Note presents information that we want to re-emphasize, either to help you avoid a common pitfall or to make you aware of operating differences between some device family members. A Note can be in a box, or when used in a table or figure, it is located at the bottom of the table or figure.	<b>Note:</b> This is a standard note box.
		<b>CAUTION</b> <b>This is a caution note.</b> <b>Note 1:</b> This is a note used in a table.

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## RECOMMENDED READING

This user's guide describes how to use the Microchip Compact MP3 Decoder Library. The following are available and recommended as supplemental reference resources.

### **PIC32 Family Reference Manual Sections**

Family Reference Manual sections are available, which explain the operation of the PIC32 device family architecture and peripheral modules. The specifics of each device family are discussed in the individual family's device data sheet.

### **MPLAB<sup>®</sup> XC32 C/C++ Compiler User's Guide (DS51686)**

This document details the use of Microchip's MPLAB XC32 Compiler for PIC32 microcontrollers to develop 32-bit applications.

### **MPLAB<sup>®</sup> X IDE User's Guide (DS52027)**

Consult this document for more information pertaining to the installation and implementation of the MPLAB X IDE software.

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- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 3
- **MPLAB X IDE** – The latest information on Microchip MPLAB X IDE, the Windows® Integrated Development Environment for development systems tools
- **Programmiers** – The latest information on Microchip programmers including the PICkit™ 3 development programmer

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- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

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Technical support is available through the web site at:

<http://www.microchip.com/support>

## DOCUMENT REVISION HISTORY

### Revision A (October 2012)

This is the initial released version of this document.

### Revision B (November 2012)

In this revision, the [Performance and Resource Consumption for Microchip Compact MP3 Decoder Library](#) table was updated ([Table 2-1](#)).





# MICROCHIP COMPACT MP3 DECODER LIBRARY USER'S GUIDE

## Chapter 1. Introduction

Thank you for purchasing the Microchip Compact MP3 Decoder Library, which can be used with Microchip's PIC32 family of devices, and provides the ability to decode MP3 audio.

### 1.1 MP3 OVERVIEW

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

One of the advantages of MP3 audio is that it can be separated into segments. Each segment is independent and may be decoded or played. This feature makes it a very attractive scheme for streaming audio.

MP3 encoding uses psychoacoustic principles. This is a catch-all term for the way sound is perceived psychologically and physiologically by humans. The human ear can nominally hear sounds in the range of 20 Hz to 20,000 Hz, although with age the higher frequencies may be inaudible. One of the principles applied in encoding is to limit the high frequency information, especially at low bit rates. The threshold of sound perception varies with frequency. A low level sound at high frequencies may be inaudible or may add little to the musical experience. In some situations, an otherwise clearly audible sound can be masked by another sound of higher intensity.

The MP3 encoder evaluates the perceptual experience loss to the listener by analyzing various such phenomena and makes a qualitative judgment based on the chosen compression rate (bit rate). Alternatively, you may choose a Variable Bit Rate (VBR) and the encoder makes a decision on the bit rate for every frame based on the amount of information that is contained.

The task of the decoder is to take the compressed data and produce the decompressed audio on a frame-by-frame basis.

### 1.2 MICROCHIP MP3 IMPLEMENTATION

Table 1-1 shows the different audio layers that use the .mp3 file type. The Microchip Compact MP3 Decoder Library implements the MPEG-1, Audio Layer III, which has been approved in the ISO/IEC 11172-3 standard.

TABLE 1-1: MP3 DECODER SUPPORT MATRIX

Encoding Format	Layer I	Layer II	Layer III
MPEG-1 (Fs = 32, 44.1, 48 kHz)	No	No	Yes
MPEG-2 (Fs = 16, 22.05, 24 kHz)	No	No	No
MPEG-2.5 (Fs = 8, 11.025, 12 kHz)	No	No	No

# Microchip Compact MP3 Decoder Library User's Guide

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## 1.3 MICROCHIP COMPACT MP3 DECODER FEATURES

- Implements MPEG-1, Audio Layer III decoder (ISO/IEC 11172-3)
- Simple user interface – initialize decoder and pass MP3 data
- Optimized C callable APIs
- Assembly optimized implementation for overall performance
- Supported sampling rates:
  - 32 kHz
  - 44.1 kHz
  - 48 kHz
- Supported bit rates (kbps):
  - 32
  - 40
  - 48
  - 56
  - 64
  - 80
  - 96
  - 112
  - 128
  - 160
  - 192
  - 224
  - 256
  - 320
  - Variable Bit Rate (VBR)

## Chapter 2. Library Resources

This chapter provides information on the available resources for the Microchip Compact MP3 Decoder Library.

Topics covered include:

- [Resources](#)
- [Resource Usage](#)

### 2.1 RESOURCES

Several resources related to the Microchip Compact MP3 Decoder Library are available from Microchip:

- Hex file for the specific hardware resource
- Library binary archive (SW320002-1)
- Library source (SW320002-2)

The Microchip Compact MP3 Decoder Library can be used as a software resource with your hardware, or with many of Microchip's PIC32 family device hardware resources.

Due to many hardware resources, and to conserve space, the related installation and demonstration procedures are not listed in this document.

To locate the related installation instructions and demonstration files and procedures for your hardware, refer to the main Microchip web page for your specific board.

**Note:** If you are accessing the information for the specific hardware resource from microchipDIRECT, click the **More Info** link to access the main web page for the board.

### 2.2 RESOURCE USAGE

**TABLE 2-1: PERFORMANCE AND RESOURCE CONSUMPTION FOR MICROCHIP COMPACT MP3 DECODER LIBRARY**

Peak MIPS	Code Size (Kbytes)	Data Size (Kbytes)	
27.1	45.58	~29 Total	
		Decoder State (Heap)	10.76
		I/O Buffers	12
		Stack	5.4

**Note:** Tested with CD quality 44.1 kHz, 128 kbps encoded data.

# Microchip Compact MP3 Decoder Library User's Guide

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## Chapter 3. Application Programming Interface (API)

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This chapter describes the Application Programming Interface (API) to the Microchip Compact MP3 Decoder Library. The prototype declaration of the API functions, the state buffer used, and the buffer sizes for the audio are located in the header file, `MP3Decoder.h`.

### 3.1 PIC32 MP3 DECODER API FUNCTIONS

This section lists and describes the following three API functions that are available in the Microchip Compact MP3 Decoder Library:

- [MP3GetStateSize](#)
- [MP3Initialize](#)
- [MP3Decode](#)

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#### **MP3GetStateSize**

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##### **Description**

This function gets the size of the MP3 state buffer. Based on the return value, the application allocates the required memory for the MP3 Decoder state. If dynamic memory allocation (`malloc`) is not used, this function need not be called and the MP3 Decoder state buffer shall be statically defined at compile time with the size of the MP3 Decoder state structure.

##### **Prototype**

```
unsigned short int MP3GetStateSize(void);
```

##### **Arguments**

None.

##### **Return Values**

Size of MP3 Decoder state structure size.

---

## MP3Initialize

---

### Description

This function initializes the MP3 Decoder state with the default values.

### Prototype

```
BOOL MP3Initialize ( void *state );
```

### Arguments

\*state            Pointer to the allocated state memory

### Return Values

TRUE/FALSE

# Application Programming Interface (API)

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## MP3Decode

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### Description

This function decodes a frame of MP3 data.

### Prototype

```
BOOL MP3Decode (void *state, unsigned char *inBuff, unsigned short
int inSize, unsigned short int *used, MP3_FORMAT *format, unsigned
char *outBuff, unsigned short int *outSize);
```

In the following example, MP3\_FORMAT is the following structure:

```
typedef struct
{
    unsigned short int bitRate;
    unsigned short int sampleRate;
    unsigned char bitsPerSample;
    unsigned char channels;
}
```

### Arguments

<code>*state</code>	Pointer to the allocated state memory
<code>*inBuff</code>	Pointer to input buffer that contains the encoded bit stream
<code>inSize</code>	Number of valid bytes in the input buffer
<code>*used</code>	Pointer to the number of bytes consumed in the current frame
<code>*format</code>	Pointer to the channel information structure
<code>*outBuffer</code>	Pointer to output buffer that contains decoded PCM samples
<code>*outsize</code>	Pointer to the number of valid bytes in the output buffer

### Return Values

TRUE/FALSE

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## Appendix A. License Agreement

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