

MPLAB[®] Code Configurator v3.xx User's Guide

MPLAB[®] Code Configurator (MCC) User's Guide

Preface



Important: 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. Refer to our website (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 "DSXXXXXXA", where "XXXXXXXX" is the document number and "A" is the revision level of the document.

Introduction

This document describes how to install, configure and use the MPLAB[®] Code Configurator (MCC) software tool during or before starting the development process of an embedded software application designed with PIC[®] microcontrollers.

Recommended Reading

This user's guide refers to MCC operation only. Other applicable documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources:

- Release Notes for the MPLAB Code Configurator
- MPLAB X IDE User's Guide

Table of Contents

Pre	face		1
1.	Introd	uction	4
2.	Instal	ation	5
	2.1.	Installing MPLAB [®] Code Configurator from the Microchip Plugins Update Center	5
	2.2.	Installing MPLAB [®] Code Configurator from the Microchip Website	
	2.3.	Updating MPLAB [®] Code Configurator	
	2.4.	Older MPLAB [®] Code Configurator Versions	7
3.	MCC	Plugin Options	8
	3.1.	File Handling	8
	3.2.	MCC Line Endings	8
	3.3.	Editor Behavior	9
	3.4.	Installing an MPLAB [®] Code Configurator Library	
	3.5.	Installing an MPLAB [®] Code Configurator Core	9
4.	Gene	rating MCC Code	10
	4.1.	Setting Up MPLAB [®] X IDE and Launching MCC	10
	4.2.	Generating Code	11
5.	мсс	Content Manager	14
6.	мсс	Classic	15
	6.1.	Resource Management Area	
	6.2.	Versions Area	
	6.3.	Pin Manager Package View Area	23
	6.4.	Pin Manager Grid View Area	24
	6.5.	The Composer Area	27
	6.6.	Generated Sources and Header Files	30
	6.7.	MCC Device Migration	32
7.	мсс	Melody	33
8.	мсс	Harmony	34
9.	Revis	ion History	35
The	Micro	chip Website	36
Pro	duct C	hange Notification Service	36
		Support	
		Devices Code Protection Feature	
геб	jai inoti	Ce	36
Tra	demarl	(S	37
Qua	ality Ma	anagement System	38

1. Introduction

The MPLAB[®] Code Configurator (MCC) generates driver code using a Graphical User Interface (GUI). The generated drivers control the peripherals on PIC[®] microcontrollers. The GUI provides an easy means for setting up the configuration of the peripherals. MCC is a plugin for the MPLAB[®] X IDE and MPLAB[®] Xpress.

Additionally, the MCC is used to configure and generate libraries, allowing code generation and configuration for software libraries and external components.

The generated drivers or libraries can be used in any Microchip PIC or AVR[®] device application program. MCC requires creating or opening an already existing project in the MPLAB X IDE or MPLAB Xpress before launching the MCC plugin. This is necessary as the MCC needs to know the device used in the project, to have access to device-specific information like registers, bits, configurations, and to set up the MCC GUI.

The MCC generates source and header files based on selections made in the GUI. The generated files are added to the active project of MPLAB X IDE or MPLAB Xpress.

2. Installation

The MPLAB Code Configurator can be installed in two ways: via the Microchip Plugins Update Center or from the Microchip website. The following chapters describe these procedures and also the MCC update process.

2.1 Installing MPLAB[®] Code Configurator from the Microchip Plugins Update Center

By default, MCC is not installed together with the MPLAB[®] X IDE and must be downloaded separately and installed. One way to do so is via the Microchip Plugins Update Center:

- 1. In the MPLAB X IDE, go to **Tools -> Plugins**.
- 2. Go to the **Available Plugins** tab.
- 3. Select MPLAB Code Configurator and click the Install button. See figure below.
- 4. The Plugin installer opens. Click **Next** and check the Terms and Agreements. After this step, the Plugin installer begins downloading the MCC plugin.
- 5. When the MCC plugin download is complete, MPLAB X IDE will ask to be restarted. Upon restart, the plugin is installed.
- 6. MCC can now be opened on a new or already existing MPLAB X IDE project. See Section 4.1 "Setting Up MPLAB X IDE and Launching MCC."

Figure 2-1. Installing MPLAB[®] Code Configurator

Install	Name	Category	Source		MPLAB® Code Configurator
	Power Monitor	MPLAB Plugin	መ መ		
	RTOS Viewer (FreeRTOS)	MPLAB Plugin			🙀 Community Contributed Plugin
	ECAN Bit Rate Calculator	MPLAB Plugin			
	PCLint	MPLAB Plugin	66		Version: 3.45.1
	DMCI	MPLAB Plugin			Author: Microchip Technology Inc
	Halt Notifier (Trial)	MPLAB Plugin	କଳି		Date: 11/29/17
	Remote USB Debugging (Trial Vers	. MPLAB Plugin	66	=	Source: Microchip Plugins
	Plugin Update Services	MPLAB Plugin	66	-	Homepage: http://www.microchip.com/mcc
	Doxygen Integrator	MPLAB Plugin	-		
V	MPLAB® Code Configurator	MPLAB Plugin	ก็กิ		Plugin Description
	MPLABX KeeLoq Plugin	MPLAB Plugin	6		The MDI AD & Code Conference (MCC) assesses a secolar and the reducted C and
	App Launcher	MPLAB Plugin	6		The MPLAB® Code Configurator (MCC) generates seamless easy to understand C code that's inserted into your project. It enables, configures and utilizes a rich set of
	MemoryStarterkit	MPLAB Plugin	66		peripherals across a select list of devices. It's integrated into MPLAB X (IDE) to provide
	Code Profiling (Trial Version)	MPLAB Plugin	44 44 44 44 44 44 44 44 44 44 44 44 44		a very powerful and extremely easy to use development platform.
	dsPICWorks	MPLAB Plugin	କିଳି		
	Digital Compensator Design Tool Pl	. MPLAB Plugin	พิพิ		
	MPLAB® Harmony Configurator	MPLAB Plugin	66		System requirements
	dsPIC Filter Designer	MPLAB Plugin	÷ ÷		MPLAB X: v4.00
	Simple Serial Port Terminal	MPLAB Plugin	କିଳି		
	SEGGER JLink Probe	MPLAB Plugin	- ##		
	motorBench™ Development Suite	MPLAB Pluain	66	-	

2.2 Installing MPLAB[®] Code Configurator from the Microchip Website

The MCC plugin can also be downloaded from the Microchip website by typing the address www.microchip.com/mcc in a web browser, selecting the **Current Download** tab, and downloading the Current Version .zip file. See Figure 2-2.

Figure 2-2. Downloading MCC from the Microchip Website

Features Current Download Archive Download Documentation								
Current Version								
Title	Version	Date Published	Release Notes	D/L				
MPLAB® Code Configurator	3.45.1	12/1/2017	7	a				

Once downloaded, extract the archive which contains the MCC plugin to a preferred location. To install the downloaded plugin, complete the following instructions:

- 1. Open MPLAB X IDE.
- 2. Go to Tools -> Plugins.
- 3. Select the **Downloaded** tab, and click on the **Add Plugins...** button.
- 4. Navigate to the folder where the downloaded .zip file was extracted and select the MCC plugin. It may have a .nbm file extension.
- 5. Click on the **Install** button. MPLAB X IDE will ask to be restarted. Upon restart, the plugin is installed. See figure below.
- 6. MCC can now be opened on a new or already existing MPLAB X IDE project. See Section 4.1 "Setting Up MPLAB X IDE and Launching MCC."

Figure 2-3. Installing MCC from Downloaded File

Plugins	×
Updates Available Plugins (33) Downloaded (1) Installed (66) Settings	
Add Plugins	Search:
Install Name	MPLAB® Code Configurator Remove
MPLAB © Code Configurator	Installed version: 3.45.1 Available version: 33 Author: Microchip Technology Inc Date: 11/1/16 Source: com-microchip-mcc.nbm Homepage: <u>http://www.microchip.com/mcc</u> Plugin Description The MPLAB@ Code Configurator (MCC) generates seamless easy to understand C code that's inserted into your project. It enables, configures and utilizes a rich set of peripherals across a select list of devices. It's integrated into MPLAB X (IDE) to provide a very powerful and extremely easy to use development platform. System requirements MPLAB X: v3.26 MPLAB X: v3.26
	• XC16: v1.26 • XC32: v1.42
Install 1 plugin selected	
	Close Help

2.3 Updating MPLAB[®] Code Configurator

When an MCC version newer than the one installed is available, the MPLAB X IDE will display a notification in the bottom right corner of the IDE window. By clicking on it, the plugin update wizard is launched. In the wizard, click on the **Install** button, and the software will download and install the new MCC plugin version. See figure below.

Figure 2-4. Updating MPLAB[®] Code Configurator

	1 update found. Click here to make years		to date.)	
😰 Plugin Installer					x
Welcome to the Plu The installer will downli	ugin Installer oad, verify and then inst	all the selected pl	ugins.		
The following plugins	will be updated:				
MPLAB® C	ode Configurator [3.3	6 -> 3.45.1]			
		< Back	Next >	Cancel	Help

2.4 Older MPLAB[®] Code Configurator Versions

Older MCC versions are available at the same www.microchip.com/mcc address, under the Archive Download tab.

3. MCC Plugin Options

Several aspects of the operation of the MCC can be managed by using the "Options" panel (see figure below), which can be invoked by clicking **Tools** \rightarrow **Options** \rightarrow **Plugins** \rightarrow **MPLAB Code Configurator** in the menu bar of the MPLAB X IDE.

Figure 3-1. The MCC Option Panel

Ĩ											
	MPLAB® Code Configurator	r 3.x									
	File Handling	Remove unused files from the project									
		Delete unused files from the disk									
	Generated Line Endings	DOS (CRLF) 👻									
	Editor Behavior	Always ask before removing a module									
		Always ask before removing a pin									
		Demons Gene									
	Install Core	Remove Core Open Core Folder									
	Install Library	Remove Library Open Library Folder									

The MCC Options panel offers the following controls:

- File Handling
- Generated Line Endings
- Editor Behavior

3.1 File Handling

- 1. **Remove unused files from the project:** Enabling this option tells the MCC to remove .c and .h files from modules which were removed from the MCC configuration between the subsequent generation procedures. This option ensures that the files included in the project (and thus in the compilation) are only those which are strictly necessary. However, this will not delete the files from the disk.
- 2. **Delete unused files from the disk:** This option gets enabled only when selecting "Remove unused files from the project," which performs the additional task of deleting unused files from the disk. Once a file is deleted, it cannot be recovered.

3.2 MCC Line Endings

Specify the type of line endings to use in the files generated by MCC. The default is DOS (<CR><LF>). Unix line endings (<LF>) may be specified.

3.3 Editor Behavior

- 1. **Always ask before removing a module:** Enabling this control enables the "Are you sure?" dialog box which appears while disabling or removing an enabled module.
- 2. Always ask before removing a pin: Enabling this control enables the "Are you sure?" dialog box which appears while deallocating or removing a pin from a peripheral.

3.4 Installing an MPLAB[®] Code Configurator Library

The MPLAB Code Configurator provides a peripheral or software library installation feature. This feature can be used to add MCC-compatible libraries. There are several libraries for various applications the user can choose from on the http://www.microchip.com/mcc webpage. An MCC Library file may have a .jar or a .mc3lib file extension. Once this file is downloaded, open the MPLAB X IDE, and in the above menu go to **Tools** \rightarrow **Options** \rightarrow **Plugins** \rightarrow **MPLAB Code Configurator 3.x**, click on the **Install Library** button and select the .jar file via the **Open File** dialog box. The Versions window will now list the newly added library as installed.

If there are multiple versions of a library, the newly installed one will not be the loaded one. To load a particular version of a library, right-click on it and select "Mark for Load," which will then highlight the user's choice. If the user has multiple libraries with multiple versions in each, one from each can be highlighted before loading them. See Section 3.3. "Versions Area" for more details about switching library versions.

Removing a library is done using the **Remove Library** button. The File selection dialogue window will open the **Library** folder. Select the library to remove and click on the **Remove** button on the File selection dialogue. The library can be verified if it is no longer present on the computer by going to the Versions operating area - the removed library version is not present on the computer anymore. It may be present as available for download.

If a library currently in use is attempted to be removed (green tick in the Versions area), MCC will not allow this to happen. To remove that library version, switch to another version, go back to the Options window and press the **Remove Library** button again for the library version to delete.

3.5 Installing an MPLAB[®] Code Configurator Core

The MPLAB Code Configurator provides a core switching feature. This feature works simultaneously on various projects with different core versions without uninstalling or reinstalling the plugin. To install a new core, download first the new core from the Microchip MCC webpage (http://www.microchip.com/mcc). This file may have a .mc3core file extension. Once this file is downloaded, open the MPLAB X IDE and in the above menu go to **Tools** \rightarrow **Options** \rightarrow **Plugins** \rightarrow **MPLAB Code Configurator 3.x**, click on the **Install Core** button and select the .mc3core file via the **Open File** dialog box. The Versions window will now list the fresh core installation.

To switch to another core version, either double click on it, or right-click on it and select "Switch Core Version." The Versions window will now refresh the core selection with the user's choice. The core installations can always be checked by opening the **Core** folder, from **Tools** \rightarrow **Options** \rightarrow **Plugins** \rightarrow **MPLAB Code Configurator 3.x** path. Refer to Section 3.4. "Versions Area" for more details about core switching.

Removing a core version is done from the **Remove Core** button. The Folder selection dialogue window will open the "Core" folder. Select the core version to remove and click on the **Remove** button on the Folder selection dialogue. The core version can be verified it is no longer present on the computer anymore by going to the Versions operating area - the core version removed is not present on the computer anymore. It may be present as available for download.

If a core version currently in use is attempted to be removed (green tick in the Versions area), MCC will not allow this to happen. To remove that core version, switch to another core version, go back to the Options window and press the **Remove Core** button again for the core version to delete.

4. Generating MCC Code

Now that MCC has been installed and its main operating areas are learned, it is time to set up MCC according to the user's needs and begin configuring the project. The following subsections cover basic MCC operation and the code generation process.

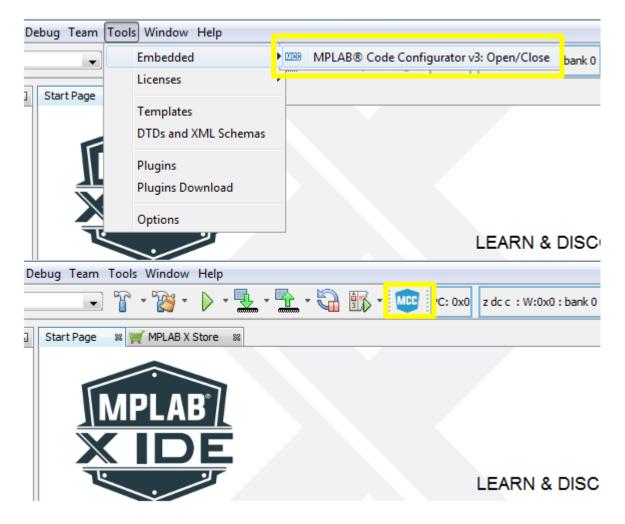
4.1 Setting Up MPLAB[®] X IDE and Launching MCC

To generate drivers using the MCC in MPLAB X IDE, follow these steps:

- 1. Create a new MPLAB X IDE project or open an existing project (see figure below).
- 2. If multiple projects are open in MPLAB X IDE, set one as the main (active) project by selecting "Set as Main Project" in the MPLAB X IDE. For the active project, the MCC automatically includes the generated driver files.
- 3. Open the MCC plugin tool. In the menu bar of the MPLAB X IDE, go to **Tools** → **Embedded** → **MPLAB Code Configurator 3.x: Open/Close**. Or click on the MCC icon in the MPLAB X IDE toolbar.

Note: For MAC users, the "Embedded" selection will be under the Preferences menu. This launches the MCC GUI.

Figure 4-1. Opening the MCC in MPLAB[®] X IDE



When opening MCC for the first time on an MPLAB X project, the configuration saving dialog will be displayed asking for a name and saving path for the MCC configuration file attached to the project. The MCC configuration is also saved to the disk when the **Generate** button is pressed or if the MPLAB X IDE **Save** button is clicked. An existing

MCC configuration file can be loaded by double-clicking on the desired .mc3 file in the **Important Files** section of the MPLAB X IDE project.

4.2 Generating Code

When the MCC **Generate** button is pressed in the Project Resources window, the listed actions are performed by MCC. Details of the code generation are shown in the MCC **Output** tab. See 6.4.2. The MPLAB[®] Code Configurator - Output Tab.

- 1. The MCC configuration file is saved.
- 2. MCC generates code for the peripheral or library module if the module's configuration has changed since the last time MCC generated code for that module.

Note: All modules can be forced to be generated by MCC by right-clicking in the Project Resources section from the 6.1. Resource Management Area and selecting "Force Update," before clicking on the **Generate** button.

If MCC attempts to regenerate a file on the disk that has been modified outside of MCC, the **Merge [MCC]** window is displayed. Use the **Merge [MCC]** window to select whether to keep the modified file (default action) or replace the modified content with the content generated by MCC.

The Merge [MCC] window is discussed in Section 4.3.2 "The Merge [MCC] Window."

4.2.1 Saving and Loading the MCC Configuration

Saving and loading the MCC configuration is integrated into the MPLAB X IDE Save and Load functions. The MCC configuration is saved whenever the **Generate** button is pressed. The MCC configuration can also be saved by clicking on the MPLAB X IDE Save tool or selecting **Save** from the File menu.

The MCC configuration file is included in the MPLAB X IDE project under the **Important Files** folder. The configuration file uses the extension .mc3. Double-clicking on the MCC configuration file will cause that MCC configuration to be loaded.

4.2.2 The Merge [MCC] Window

If any of the files generated by the MCC have been edited outside of MCC and saved to the disk, then the **Merge [MCC]** window appears in the Composer Area. Use the **Merge [MCC]** window to select whether to keep the edits or replace them with the newly generated MCC code.

Note: The user's edits will never be overwritten by the MCC-generated code, except explicit action in the **Merge** [MCC] window.

When changes have been made to both a generated file and the corresponding MCC UI within the Composer Area, the **Merge [MCC]** window shown in Figure 4-2 will be displayed. The **Merge [MCC]** window allows resolving the conflicts between the newly generated file and the edits made to the file.

When the newly generated MCC content has been accepted, MCC makes the changes to the file. To the MPLAB X IDE, these changes are the same as if they were typed in the new content. The normal MPLAB X IDE edit undo can be used in the MCC Merge operation.

Figure 4-2. Merge [MCC] Window - File List

Start Page 🛛 💥 MPLAB X Store 🛛 🗱 🕮 MPLAB @ Code Configura	tor 🛚	Mer	ge [MCC]	
MCC Modified Filename				
C:\Users\c15220\MPLABXProjects\00-v3.15-RC12\MCC-example.X\mcc_				
C:\Users\c15220\MPLABXProjects\00-v3.15-RC12\MCC-example.X\mcc_	-		-	
C:\Users\c15220\MPLABXProjects\00-v3.15-RC12\MCC-example.X\mcc_	genera	ted_fi	les\pin_m	anager.c
				K
Graphical Textual				
MCC Updated Code : Generated		1/2		Merge Result eusart.c
void EUSART Initialize(void)	55	⊫⊘	55	void EUSART Initialize (voig)
	56		56	
// Set the EUSART module to the option	57		57	// Set the EUSART mod List of files to
	58		58	be merged
<pre>// ABDOVF no_overflow; SCKP Non-Invert</pre>	59		59	// ABDOVF no_overflot
BAUDICON = 0x08;	60		60	BAUDICON = 0x08;
	61		61	
// SPEN enabled; RX9 8-bit; CREN enables			62	// SPEN enabled; RX9 8-bit; CREN disab
RC1STA = 0x90;	63		63	<pre>RC1STA = 0x00; // disable SPEN 0x80;</pre>
// TX9 8-bit; TX9D 0; SENDB sync breal	64 65		64 65	// TX9 8-bit; TX9D 0; SENDB sync break = *
TX1STA = 0x24;	66		66	TX1STA = 0x04;
	67		67	
// Baud Rate = 9600; SP1BRGL 12;	68		68	// Baud Rate = 9600; SP1BRGL 12;
SPBRGL = 0x0C;	69		69	SPBRGL = 0x0C;
	70		70	
// Baud Rate = 9600; SP1BRGH 0;	71		71	// Baud Rate = 9600; SP1BRGH 0;
SPBRGH = 0x00;	72		72	SPBRGH = 0x00;
	73		73	
}	74		74	}
	75		75	۰ III ۲

A list of all the files that need to be merged is shown at the top of the **Merge [MCC]** window. Each file in the list must be selected, in turn, to ensure that all of the newly generated code is incorporated into the project.

At the top of the **Merge [MCC]** window, in the center margin, there is an arrow, as shown in Figure 4-3. Clicking on the arrow will replace all the edits in the current file with the MCC updated code that the MCC has just generated. The numbers above the arrow indicate the current difference and the total number of differences.

Figure 4-3. Merge [MCC] Window - Replacing All Edits with MCC Generated Code

Start Page 🛛 🛒 MPLAB X Store 😒 🕮 MPLAB® Code Configurato	or 📽	Merge	[MCC]	
MCC Modified Filename				
C:\Users\c15220\MPLABXProjects\00-v3.15-RC12\MCC-example.X\mcc_g	generat	ed_files\	eusari	
C:\Users\c15220\MPLABXProjects\00-v3.15-RC12\MCC-example.X\mcc_g		-		
C:\Users\c15220\MPLABXProjects\00-v3.15-RC12\MCC-example.X\mcc_g	generat	ed_files	pin_m	edits with the MCC
Graphical Textual				generated code
MCC Updated Code : Generated	1	1/2	1	Merge Result : eusart.c
void EUSART_Initialize (void)	1		5	void EUSART_Initialize(void)
{	56	-	56	{
// Set the EUSART module to the option	57	1.3	57	// Set the EUSART module to the option
	58		58	

The individual lines of **MCC Updated Code** can be selected to replace the edited code. As shown in Figure 4-4, clicking on the arrows in the right margin of the left window will copy the **MCC Updated Code** to the generated driver file. Once the changes are accepted, the Merge mechanism will remove the highlighted file and highlight the next file

MPLAB[®] Code Configurator v3.xx User... Generating MCC Code

on the list. A warning will be generated if the Merge mechanism is closed before all the changes are accepted to ensure all updates are completed.

Figure 4-4. Merge [MCC] Window - Replacing Single Changes with MCC Generated Code

Start Page 🛛 🛒 MPLAB X Store 🖇 💯 MPLAB® Code Configu	irator 🛛	Mer	ge [MCC]	
MCC Modified Filename				
C:\Users\c15220\MPLABXProjects\00-v3.15-RC12\MCC-example.X\mo				
C:\Users\c15220\MPLABXProjects\00-v3.15-RC12\MCC-example.X\m C:\Users\c15220\MPLABXProjects\00-v3.15-RC12\MCC-example.X\m		_		
; USERS (C15220 VMPLADAPTOJECIS (00-V5.15-RC12 VMCC-EXample. X Vm	.c_genera	ited_iii	ies (pin_in	anager.c
Graphical Textual				
1 C/CdCa				
MCC Updated Code : Generated		1/2		Merge Result : eusart.c
void EUSART_Initialize(void)	55	₽⊘	55	void EUSART Initialize(void)
[56		56	Replace single
<pre>// Set the EUSART module to the optior</pre>			57	// Set Coption
	58		58	change with MCC
<pre>// ABDOVF no_overflow; SCKP Non-Invert PNUPACON = 0:000</pre>			59	BAUDIC generated code
BAUD1CON = 0x08;	60 62		61	BAODIC
// SPEN enabled; RX9 8-bit; CREN er bl	- 62	<u> </u>		// SPEN enabled; RX9 8-bit; CREN disak
RC1STA = 0x90;	63	1	63	RC1STA = 0x00; // disable SPEN 0x80;
	- I		64	
// TX9 8-bit; TX9D 0; SENDB sync_br a	-> 55	•	65	// TX9 8-bit; TX9D 0; SENDB sync_break
TX1STA = 0x24;	66		66	TX1STA = 0x04;
	67		67	
<pre>// Baud Rate = 9600; SP1BRGL 12; SPDPCL = 0000;</pre>	68 69		68 69	// Baud Rate = 9600; SP1BRGL 12;
SPBRGL = 0x0C;	69 70		70	SPBRGL = 0x0C;
<pre>// Baud Rate = 9600; SP1BRGH 0;</pre>	70		71	// Baud Rate = 9600; SP1BRGH 0;
SPBRGH = 0x00;	72		72	SPBRGH = 0x00;
	73		73	
	74		74	}
۲ (III) ا	75		75	۰ ااا

Notes:

- 1. Remember to merge the code for every file shown in the file list of the Merge [MCC] window.
- 2. Be sure to save all the changed files from the Merge process.

5. MCC Content Manager

The MCC Content Manager (CMT) allows users to select specific versions of the component modules and libraries to be used for their MCC projects. Refer to the MCC Content Manager Reference for more information.

The MCC Melody Content Manager, supports content management and versioning at a component level.

- This means that component modules of a project can be updated on its own, separate from the other modules. For example, if you have a working project, except for a bug on the ADC driver. Now, rather than needing to update all the other drivers in your system, like the UART and Timers, you will be able to update just the ADC.
- This component level content versioning granularity will be especially useful in the latter stages of your project development, as you near production. At this stage, when almost everything is working perfectly, one may want to change one modules one needs to, due to either bugs or needed features.

Figure 5-1. Opening the MCC Content Manager Reference, MCC User Guide

X MPLAB X IDE v5.50 - MCC-Content-N	· · ·				
ile Edit View Navigate Source Refact	or Production M	CC User Guide ndow Help			
1 🔁 💾 🤚 🏓 🧭 🖻	fault	🗸 🕆 • 🗃 • 🕨 • 💆 •	<u>r - 🖓 </u>	• 🔟 💆	😳 🛒 📖 PC: 0x0 n ov z dc c : W:0x0 : bank 0
Proje Files Classes Servi	. Res	Start Page 🗙 Kit Window 🗙	Builder × Conte	ent Manager	× •••
Project Resources Generate		Q Type to Search Globally			MCC Content Manager Reference
 Configuration Bits Interrupt Manager 		Component Device Supported Content Only	Version	Status	Description
 (2) ♥ Main (2) ♥ Pins (2) ♥ Pins 		Libraries Drivers		÷	
 Hardware Peripherals 		Hardware Peripherals		÷	
🛞 🔀 😂 TMR0 Initializer	<u> </u>	> System > Devices		 ☆	
Device Resources V Libraries	Content Manager	MCC Melody Core	2.0.19-dev 🗡	Update	Communicates with the MCC core, providing views and other functionality for MCC Melody
 Data Encryption Routines Data Visualizer LIN TCPIP-Lite Drivers System 					

6. MCC Classic

MCC Classic is the original plugin and user interface for the MPLAB[®] Code Configurator. It consists of six main operating areas, as shown in Figure 3-1.

- 1. **Resource Management Area:** Contains the Project Resources and all the available/device resources. See 6.1. Resource Management Area section for more details.
- Versions Area: Shows the complete list of MCC Cores, Peripheral Libraries, and Software Libraries which can be used with the selected device. Some of these are installed together with MCC. Others are available for download. Depending on the selected device, some core and library versions are interchangeable. See 6.2. Versions Area section for more details.
- 3. **Pin Manager Package View Area:** Graphic interface for pin selection and configuration. Bidirectional operation with the Pin Manager Grid View. See 6.3. Pin Manager Package View Area section for more details.
- 4. **Pin Manager Grid View Area:** Contains three inner tabs: Notifications (errors, warnings and general information regarding the current selections), Pin Manager Grid View (a table version of the Pin Module Package View) and Output (MCC Log & MPLAB X IDE Log). See 6.4. Pin Manager Grid View Area chapter for more details.
- 5. **Composer Area:** This is the main area in which a peripheral or library driver can be configured. It displays the possible configurations of the peripheral/library. See 6.5. The Composer Area chapter for more details.

Projects Files Classes Resource Management [MCC] 8	Start Page 🛛 🕷 🦷	MPLAB X Store	8 Available R	esource	s %	Pin Mod	ule 🛚	Syste	em Modu	ile :	8 Inte	errupt	4od	•	Ve	2 F	Pin Manager: Package View 🕺 💼
Tree View Flat View	System Module																
Project Resources Generate Import Export Interrupt Module Image: Content of the second se	© Easy Setup																
Available Resources Show Available Resources	Internal Clock Sett Fost										RC5 2 16 RC2 RC4 3 MICROCHIP 13 RC0 RC3 4 PIC16F1619 12 RC1 RC6 5 11 RC2 6 7 8 9 10						
Available Resources													н	RB5 RC7			
Show PIC16F1619 Product Page	▼ WWDT																
vvc - Dashboard swUART - Navigator Versions [MCC] 🗷 🕞	Watchdog Timer Enable WDT disabled											PIN MANAGER PACKAGE AREA					
MPLAB® Code Configurator (Plugin) v3.75	Clock												Т				
	Clock Source Software control, controlled by WDTCS bits * Window Open Time Software WDT window size control (WDTWS bits) *									<()							
 8-bit AVR MCUs (v1.1.1) 	Output Notific	ations Notifi	ications [MCC]	Pin	Manao	jer: Grid	View	38		-							
 AVR-IoT WG Sensor Node (v1.0.0) 	Package: U	QFN20 -	Pin No:	16 1	15 14	1 2	0 19	10 9	8	7	13 1	2 11	4	3 2	2 5	6	3
 MCP19XXX (v1.1) 					Por	t A 🔻		Pc	rt B 🔻		_	-	Port (c 🔻	_		
 PIC10 / PIC12 / PIC16 / PIC18 MCUs (v1.75) 	Module	Function	Direction	0	1 2	3 4	1 5	4 !	6	7	0 1	2	3	4 5	6 6	7	1
 PIC24 / dsPIC33 / PIC32MM MCUs (v1.95) 	OSC	CLKOUT	output			î.										Г	
 PIC32MX MCUs (v1.35) 		GPIO	input	าย า	b în	1. 1	a în	îs î	ı îs	în '	ìn în	i în	îs '	în în	ı îs	î	1
▼ Software	Pin Module 🔻	GPIO	output	โม ใ	b în	1.	a în	îs î	ı îs	în '	ìs îs	ı îs	îu '	ì a 18	ı îs	î	1
 8-bit Bootloader Library (v2.2.37) 	RESET	MCLR	input			â											
47XXX I2C EERAM Board Support Framework	PIN MANAGER GRID VIEW AREA																

Note: All operating areas are dockable. Each can be dragged and dropped into another position, even out of the MPLAB X IDE main window (closing the IDE, however, will close all MCC windows, including those moved outside the IDE).

6.1 Resource Management Area

The Resource Management Area comes with two separate views: the tree view and the flat view. Both provide access to the complete list of software/peripheral components and the selected components for the current project configuration. For more details on each view, refer to 6.1.1. Resource Management Area - Tree View and 6.1.2. Resource Management Area - Flat View sections.

The Project Resources section is common to both views of the Resource Management Area. This section displays the list of on-chip peripherals, external components, and libraries that have been selected for the current MCC project. The information specific to each of the two views regarding this section is available in 6.1.1. Resource Management Area - Tree View and 6.1.2. Resource Management Area - Flat View sections.

Figure 6-1. MCC Operating Areas

MPLAB® Code Configurator v3.xx User... MCC Classic

There system modules are always available in the Project Resources section. These modules cannot be removed. The modules are:

- 1. **Interrupt Module:** Configures the interrupts for the device.
- 2. **Pin Module:** Configures the pins for the device.
- 3. **System Module:** Configures the system clock, Configuration bits, and other device-level functions for the device.

A module in the Project Resources window can be removed from the project by clicking the \bowtie or \bowtie button to the right of the module name in the Project Resources section. The module will be removed from the MPLAB X IDE project. When a module is removed from the Project Resources, all the unsaved configuration information for that module is lost.

At the top of the Project Resources section, there are three buttons:

- **Generate:** Once the project configuration has been completed, clicking this button will trigger the code generation process for that specific configuration.
- Import: An MCC configuration file (.mc3 extension) can be imported into the current project. If the selected configuration has been created for a device other than the one used in the current project, an alert message pops up offering the possibility of an experimental configuration migration. Once a configuration file is selected, MCC loads and configures all modules detailed in the selected configuration file. If there is a match between a module from the configuration and a module already loaded in the current project, the settings for the loaded module are overwritten with the ones from the imported configuration file. This is useful for the partial configurations created manually or provided by the Export functionality detailed below. In the case of importing a configuration created for a different device than the one used in the current project, an alert message pops up offering the possibility of an experimental configuration migration or canceling the import process (See Figure 6-2). During device migration, the import process might fail due to hardware mismatches between the two devices. In this case, a backup configuration file is created and saved in the project folder. (See Section 6 "MCC Device Migration").

Figure 6-2. Importing a Configuration Created for a Different Device

[MCC 23
	Confirmation ?
	Device to be loaded from the config file does not match the current device. Proceed with this configuration migration process is experimental. Please verify the imported configuration. Do you wish to continue?
	Yes No

• Export: Allows the export of partial configurations. Any loaded module in the Project Resources, except System modules, can be selected for a partial configuration by right-clicking on the module and selecting "Mark for config export" (see figure below for more details). All modules marked for export are shown in bold. Clicking the Export button creates an MCC configuration consisting only of the modules marked for export. To remove the selection, use "Unmark from config export" for a specific module or "Unmark all for config export" for all modules/components selected for export.

Figure 6-3. The Context Menu of the Project Resources Area

Project Resources	Generate	Import	Export	
▼ System				
Interrupt Module				
Pin Module				
System Module				
 Peripherals 				
🗐 EUSART [LIN Libr	ary by Micro	chip Techno	ology, Inc.]	
ADC [PIC10 / PIC	12 / PIC16 /	P]		Tec
[™] CCP1		Force Up	odate	
		Refresh /	ADC Windows	
		ADC Hel	р	
		Mark for	config export	
Device Perourcer				

Besides the partial configuration export mechanism, the Context menu of the Project Resources Area (displayed above) includes several other operations on the loaded components or modules, such as:

- Force Update: Regenerates code for all the selected modules/components, even if no modifications were added to their configuration. See Section 4.3 "Generating Code".
- **Refresh [module_name] Windows:** Reopens the configuration window of the selected module if that window has been closed previously. If the Context menu is invoked by right-clicking under the Resources list with no module/component selected, this option will be available as Refresh Module Windows, and its effect will be global. All previously closed MCC windows will be reopened.
- [module_name] Help: Opens the help content for the user interface of the selected module/component, if available.

6.1.1 Resource Management Area - Tree View

This view is further split into the Projects Resources section (detailed at the beginning of 6.1. Resource Management Area chapter) and the Device Resources section. See Figure 6-4.

Both sections in the Tree View can also be navigated and handled by using the following keys:

- · Up and down arrow keys: For moving up and down in the tree, respectively.
- **Right arrow key**: For expanding a node.
- Left arrow key: For collapsing a node.

gement	Area	- Tree Vi	ew	
Projects	Files	Classes	Resource Management [MCC] 🕷	-
Tree View	Flat Vie	ew		
Project	Resou	rces Gene	rate Import Export	
▼ System				ô
Inter	rupt Mod	lule		
Pin N	lodule			0
Syste	em Modu	le		
 Periphe 	erals			\sim
Device	Resour	ces		-
▼ Docum	ients			
PIC10	6F1619 P	roduct Page		
 Periphe 	erals			
🕨 🕨 🕹	NDC			
► ○ A				
► <u>~</u> °				
🕨 🕨 🕨				
► 🖸 C				
▶갑○				
	omparat	or		
► , D ► (=) E				
	xt_Interru	unt		
• • • • • • • • • • • • • • • • • • •		ipt		
▶ 몲 №				
	/lath Acce	elerator		
► 🔲 N	/lemory			
►ЛЛР	WM			
► 🖲 S	MT			
► 🕚 T	ïmer			
▶ 4, z	CD			
▼ Librarie	25			
<u></u>	Bootload	er Generator		
		n Services		
► 🔾 🛛				
► 💷 U				
-	nTouch			
 Mikro-I 				
Interne	t Of Thin	gs		

6.1.1.1 The Project Resources section

This section displays the peripherals, libraries or external components selected for the current project. The selection is done via the Device Resources section. The System Module, Pin Module, and Interrupt Module are selected by default. The configuration for each of the selected modules is done through the Composer Area. The peripheral and libraries are added to the project by selecting them from the Device Resources section. To add a peripheral or library to the Project Resources section, double-click on its name in the Device Resources section. The configuration can then be done via the corresponding GUI in the Composer Area. A module in the Project Resources window can be

removed from the project by clicking the button to the right of the module name in the Project Resources section. The module will be removed from the MPLAB X IDE project. When a module is removed from the Project Resources, all of the unsaved configuration information for that module is lost.

6.1.1.2 The Device Resources section

The Device Resources section (see figure below) lists the data sheet, external components, and libraries available for the device configured in the MPLAB X IDE project, based on the loaded libraries in the Versions area. When

the name of a peripheral or library is double-clicked, it is moved from the Device Resources area to the Project Resources area, simultaneously invoking the Pin Manager with all associated I/O pins.

Note: The Documents section of the Device Resources area provides a link to the data sheet of the selected device on www.microchip.com.

Right-clicking on a module or component in this tree shows the Device Resources context menu through which the help content of the selected module can be invoked. The Device Resources list can be filtered via the top combo box (see figure below). The available filters are:

- · all supported and tested modules
- all supported modules (including untested ones)
- all modules (including unsupported ones)

Figure 6-5. Resource Filtering in Device Resources - Tree View

Device Resources	
► ◯ AT	✓ Show each module that is supported and tested
► 🐣 CCP	Show each module that is at least supported but untested
🕨 🏊 CLC	Show all modules, including unsupported
• • • • • • • • • • • • • • • • • • •	

6.1.2 Resource Management Area - Flat View

This view is further split into the Projects Resources section (detailed at the beginning of 6.1. Resource Management Area chapter) and the available resources section. See figure below.

Projects	Files	Classes	Resour	ce Mana	gement	[MCC] %	E
Tree View	Flat View						
Project	Resourc	Gene	rate In	nport	Export)	
🔿 Interrup	ot Module						2 🖂
🔿 Pin Mo	dule						0 🖂
O System	Module						0 🖂
ADC 🕀							8 🗙
🗠 CCP1							8 🔀
	г						2 🗙
Availab	e Resou	irces Sh	ow Availa	able Reso	ources		
	C1 C1 O D	duct Page					

6.1.2.1 The Project Resources section

This section displays the peripherals, libraries or external components selected for the current project. Selection is done via the Available Resources window, which can be accessed from the Available Resources section (see 6.1.2.2. The Available Resources section). The Project Resources section in the Flat View is similar to the Project Resources in the Tree View (see 6.1.1.1. The Project Resources section). A module in the Project Resources

section in the Flat View can be removed from the project by clicking the Kather button to the right of the module name. The module will be removed from the MPLAB X IDE project. When a module is removed from the Project Resources,

all the unsaved configuration information for that module is lost. Next to the *button*, the *button* offers insight into a specifically selected module. The same module information can be retrieved from the [module_name] Help option in the Project Resources context menu (see Figure 6-3).

6.1.2.2 The Available Resources section

This section contains two buttons:

- Show [device_name] Product Page: Opens the product page from the Microchip website in the default browser.
- **Show Available Resources**: Opens, or brings into focus, the Available Resources window in the Composer Area. See Figure 6-7 below.

Start Page 🛛 🕺 🛒 MPLAB X Store	🛛 🕺 🕺	able Resources 🕺 Pin Module 🕺 System	Module 🕺 Interrupt Module 🔄 🕨 💌
Module	÷	Туре	Library
	•		Available Libraries 👻
记 4-20mA R	8 🗄	Interface	N ✓ All Libraries
🔁 4-20mA T	😗 🗄	Interface	N Clear All Libraries
C Accel3	8 🗄	Sensors	N ✓ 8-bit Bootloader Library
😢 ACcurrent	8 🗄	Mixed-Signal	N ✓ AVR-IoT WG Sensor Node
ADC	2 🗆	Peripheral	F ✓ Foundation Services Library
C ADC	2	Mixed-Signal	N ✓ LIN Library
C ADC2	8 🗄	Mixed-Signal	N ✓ MikroElektronika Click Library
C ADC3	😗 🗄	Mixed-Signal	N ✓ PIC10 / PIC12 / PIC16 / PIC18 MCUs
😢 AirQuality	😗 🗄	Sensors	N ✓ UCS211X
😢 Alcohol	😗 🗄	Sensors	N ✓ mTouch Capacitive Sensing Library
😢 Altitude	😗 🗄	Sensors	MikroElektronika Click Library
😢 Ammeter	😗 🗄	Mixed-Signal	MikroElektronika Click Library
🔿 AT	😗 🗄	Peripheral	PIC10 / PIC12 / PIC16 / PIC18 MCUs
🔃 AudioAmp	😗 🗄	Audio and Voice	MikroElektronika Click Library
AVR-IoT WG Sensor Node	😗 🗄	Examples	AVR-IoT WG Sensor Node
😢 BLE2	0 🗄	Wireless Connectivity	MikroElektronika Click Library
😢 Bluetooth	0 🗄	Wireless Connectivity	MikroElektronika Click Library
🔀 BluetoothAudio	0 🗄	Wireless Connectivity	MikroElektronika Click Library
Bootloader Generator	0 🗄	Bootloader Generator	8-bit Bootloader Library
🕑 CAN SPI	8 🕀	Interface	MikroElektronika Click Library

The Available Resources window in the Composer Area represents a table of all software/peripheral components available for the selected device with search and filter capabilities. Each module in this table is indexed by three attributes: Module name, module type, and the library containing the module. These attributes are mapped on each table column as follows:

• Module: Displays the module icon, module name, link to module help (via the 🕐 button and module selection

(via the ^b button). When a module is selected, it is added to the Project Resources section under the Resources Management area. A module can be searched by its name using the text field in the Module column header. The Available Resources table can be sorted alphabetically by module name when clicking on the arrow in the column header.

- **Type:** Displays the type of functionality provided by each module (i.e., Peripheral, Interface, Mixed-Signal). The table entries can be filtered by module type using the text field in the Type column header. The Available Resources table can be sorted alphabetically by module type when clicking on the arrow in the column header.
- Library: Shows the name of the library containing a certain module. The table entries can be filtered using the Available Libraries drop-down in the Library column header. When using the Available Libraries drop-down, the table contents can be filtered to include modules from one or several libraries. Also, it is possible to show modules from all libraries (using the All Libraries option) or clear the whole table (using the Clear All Libraries option). The Available Resources table can be sorted alphabetically by library name when clicking on the arrow in the column header. Depending on the selected device and the selected filters, the Available Resources window might show several modules with the same name but coming from different libraries. For example, in the case detailed in Figure 6-7, there are two ADC modules shown: One from the peripheral library and the other from the MikroElektronika Clicks library. Generally, modules bearing the same name are mutually exclusive. After a module selection, no other module with the same name can be selected. The module selection button

MPLAB® Code Configurator v3.xx User... MCC Classic

becomes grayed out, and clicking on it will yield a pop-up message saying that the operation cannot be completed (see Figure 6-8).

Figure 6-8. Module Selection Disabled

II. MCC	×
Message	i
Resource "ADC" already used in project. Unload it to use this one.	
	ОК

6.2 Versions Area

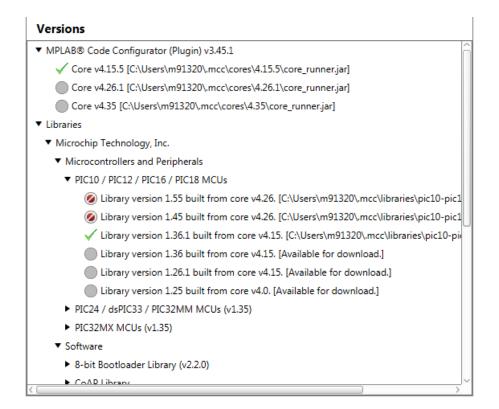
The Versions Area provides information about the versions of each MCC Core, Peripheral Library, Software Library, or other component installed on the local computer. Over time, multiple versions of the libraries may be available. MCC can be configured to use a specific version of a Library for the current MCC project.

Loaded versions are displayed with a green checkmark, compatible but not loaded versions are shown with a grey circle, and available versions which are unsupported by the selected core version are displayed with a circle backslash symbol (see Figure 6-9).

The MCC Core versions can be switched by right-clicking on an available core version and selecting "Switch core version" from the Context menu. Library versions can be loaded by right-clicking on a version of a component/module and selecting "Mark For Load." This action triggers the **Load Selected Library** button to appear at the top of the Versions Area. By clicking the button, all library versions which have been marked are loaded into MCC. Multiple selection are allowed; several components can be loaded at the same time. Only one version for each module/ component is allowed to be loaded at a time.

If the component is already installed on the local computer, the absolute path to the corresponding .jar file is displayed next to the component's name. If the component has not yet been installed, the "Available for download" message is displayed instead. Selecting an uninstalled component for load and then pressing the **Load Selected Libraries** button will download the corresponding .jar file from a Microchip server and will subsequently load it in MCC, provided that the selected version is compatible with the loaded core version.

Figure 6-9. Versions Area



Besides the Versions Area, a core or a library can also be loaded via the MPLABX IDE menu in Tools \rightarrow Options \rightarrow Plugins \rightarrow MPLAB Code Configurator (see Section 3.8 "MCC Options").

Note: All MCC libraries are published via the Microchip website: www.microchip.com/mcc.

6.3 Pin Manager Package View Area

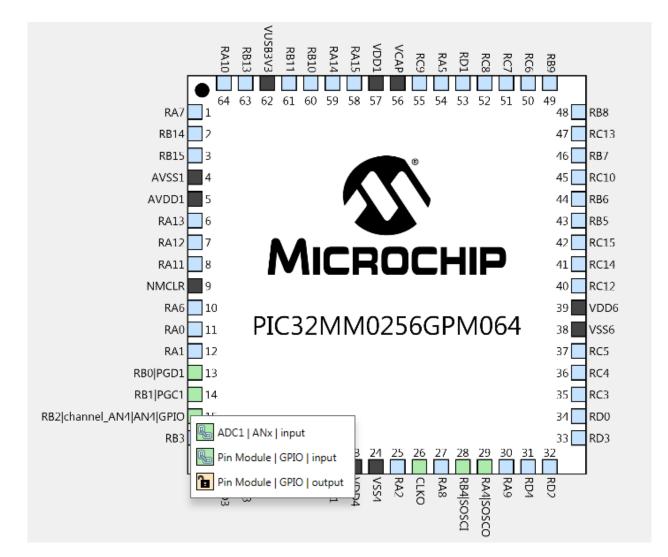
The following color combinations are associated with the pins in Graphical or Table View:

- 1. **Gray colored pin:** The pin is not usable in the selected configuration, and no enabled module that has any functionality on that pin. There are also grayed-out locks on a white background that indicate pins locked out by selected system functions.
- 2. Blue colored pin: Pins that are available to be allocated to a module.
- 3. **Green colored pin (with a lock):** The pin has been allocated and selected for a module. The name displayed against the pin is either the pin name of the module's context or a custom name entered.
- 4. Green colored pin (with chain link): The pin is shared between multiple functions.
- 5. Yellow colored pin: A possible alternate pin for an already allocated pin function.
- 6. Grayed out locks on a white background: Pins locked out by selected system functions.

The graphical Pin Manager can be zoomed in and out to adjust its visibility. This can be done by scrolling the mouse wheel when the mouse is over the Package View. Zooming can also be achieved by the "+" and "-" keys on the keyboard (useful if the mouse is not available).

By right-clicking on a specific pin, all available pin functions are listed for selection. A snapshot of the package view configuration can be saved in PNG format by right-clicking on the package and selecting "Export Image."

Figure 6-10. Package View Area



6.4 Pin Manager Grid View Area

This area contains three inner tabs: Pin Manager Grid View, Output and Notifications.

6.4.1 The Pin Manager Grid View

In the Pin Manager Grid View, the device package can be selected from a drop-down list. The package selection is on the upper left side of the Pin Manager Table View. In the figure below, the drop-down list shows that the QFN64 package has been selected. The selected package will be displayed in the Package View. The pin numbers in the Table View will also show the pin numbers for the selected package.

Figure 6-11. The Grid View Area

otifications [MC	C] Pin Mana	ger: Grid View	88																																							
Package:	QFN64 💌	Pin No:	11	12	25	26	29	54	10	1	27	30	64	8	7	6	59	58	13	14	15	16	28	43	44	46	48	49	60	61	53	2	3	19	20	21	35	36	37	50	51 5	52
						-				Port	A 🔻	,													Po	rt B	•													P	ort C	•
Module	Function	Direction	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0	1	2	3	4	5	6	7	8	9	10	11	13 1	4	15	0	1	2	3	4	5	6	7	8
	ANx	input	î	q,	î.	î			î					â	q,	î			î	î.	î.	î	î							'	à í	6 /)	în '	ì				î		î	è.
ADC1 🔻	VREF+	input	î.																																							
	VREF-	input		î.																																						
ICD 🔻	PGCx	input	ì																	ô																						
ICD V	PGDx	input		î.															â					î.																		
	CLKI	input			ô																																					
	CLKO	output				â																																				
	OSCI	input			î.																																					
OSC 🔻	OSCO	output				î																																				
USC V	REFCLKI	input																																								
	REFCLKO	output																														'	è								T	Т
	SOSCI	input																					â																			
	SOSCO	output					ô																																			
Pin Module 🔻	GPIO	input	î	ę_	ĥ	î	î	î	î	î	î	ô	Ô	î	î	î	î	î	î	ì	Ô	î	î	î	în I	î	î	ì	în I	în (à í	6 /) e	` b	ì	ì	î	ĥ	î	în (Ъ î	è
Pin wodule V	GPIO	output	ì	ĵ,	ĵ.	î	ĵ.	î.	ĵ.	ĵ.	ĵ.	ĵ,	î.	ĵ.	q_	ô	ĵ.	ĵ,	ĵ.	î.	ĵ.	ĵ.	ĵ.	î.	<u>l</u> a	în I	î.	î.	în I	` ם (6	b /	þ	`	Ъ	î.	în I	ĵ.	ĵ.	ìn '	ີຍ ໃ	

The three leftmost columns in the Table View indicate the module's name, functionality name, and direction, respectively.

The Table View allows to:

- Expand/collapse rows and ports (Figure 6-12)
- Hide and show ports and rows (Figure 6-13 and Figure 6-14)
- Show only the pins that are configured (Isolate) (Figure 6-15)

Figure 6-12. Collapsing Ports and Rows

Package:	UQFN40	-	Pin No:	-	35	36	1	2	9	15	16	17	18	19	24	25	26	27	28	29	3	4	5	14	20	21
				A -								Port	t B 🔻										Port	c▼		
Module	Fu	nction	Direction	-	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0	1	2	3	8	9
CLC1 🛏																										
PGCx			input			î.					î.					A										
ICD 🔻	PGDx		input		î.					î.					â											
JTAG 🛏																										
	GPIO		input		q,	î	â	î.	î.	î.	î.	î.	î.	î.	1	î.	î.	î.	1							
Pin Module 🔻	GPIO		output		î.	â	î.	â	î.	î.	î.	î.	<u>l</u>	B	<u>l</u>	î.	î.	î.	2							

Figure 6-13. Hiding Ports and Rows

Mod	ule	Function	Direction
		CLC1OUT	output
CLC1	Isolate S	selected Pins	input
	Show A		input
ICD	Hide Ro	w	input
ico		PGDX	input

Figure 6-14. Restoring Ports and Rows (Show All)

		Include Coloriand Disc	Por	t B 🔻							
0	1	Isolate Selected Pins	7	8	9	10	11	12	13	14	15
î.	î.	Show All	2	î	<u>l</u>	î.	<u>l</u>	î.	î.	î.	î.
2	2	Hide Column	2	2	3-	3-	3-	2	2	2	2

Figure 6-15. Isolating the Selected Pins

otifications	Output	Pin I	/anager: Grid [мс	C] %																												
Package:	TQFP100	+	Pin No:	8	29	66	67	25	24	23	22	21	20	26	27	32	33	34	35	41	42	43	44	6	7	8	9	63	73	74	64	72	7
															Port	в▼											Port	t C 🔻					
Module	Fu	oction	Direction	9	10	14	15	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	12	13	14	15	0	Γ
	CLCIN	3	input			ì	ì	ì	ì	ì		ì	ì	ì	ì	ì	â					ì	ì	ì	ì	ì	ì			ì		î	T
	ICD V PGCx input	input						â				ì	ì																			Ī	
ICD V	PGDx	Isolate	Selected Pins	Γ				â				ì			ì																		Ī
	CLKO	Show	All																												â		Ī
OSC 🔻	SOSCI	Hide R	ow																										â				t
	sosco]	Input	Г																										â			T
	GPIO		input		ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	î.	ì	ì	ì	î.	ì	ì	î.	ì	î	ì	ì	T
Pin Module V	GPIO		output		ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	ì	î	î	ì	ì	t
	DIMDLA	n e	1																											n			I

6.4.2 The MPLAB[®] Code Configurator - Output Tab

This tab displays the MCC operation results (see figure below). The MPLAB X IDE Log is also displayed under the **Output** tab when specifically opened from the **View -> IDE Log** menu.

Figure 6-16. The MPLAB[®] Code Configurator - Output Tab

Output - MPLAB® Co	de Configurator 🖇 Notifications [MCC] Pin Manager: Grid View	
00:31:34.235	INFO: Saved configuration to file C:\Users\m91320\MPLABXProjects\asdff.X\MyConfig.mc3	A
00:31:37.886	INFO: ************************************	
00:31:37.886	INFO: Generation Results	
00:31:37.887	INFO: ************************************	
00:31:37.917	INFO: mcc_generated_files/adcc.c Success.	
00:31:37.917	INFO: mcc_generated_files/adcc.h Success.	
00:31:37.917	INFO: mcc_generated_files\ccpl.c Success. New file.	
00:31:37.918	INFO: mcc_generated_files/ccp1.h Success. New file.	_
00:31:37.918	INFO: mcc_generated_files\mcc.c Success. Auto-merged.	=
00:31:37.918	INFO: mcc_generated_files\mcc.h Success. Auto-merged.	
00:31:37.919	INFO: mcc_generated_files\pin_manager.c Success.	
00:31:37.919	INFO: mcc_generated_files\pin_manager.h Success.	
00:31:40.416	INFO: ************************************	
00:31:40.417	INFO: Generation complete (total time: 2916 milliseconds)	
00:31:40.417	INFO: ************************************	
00:31:40.417	INFO: Generation complete.	
00:31:40.479	INFO: Saved configuration to file C:\Users\m91320\MPLABXProjects\asdff.X\MyConfig.mc3	-

6.4.3 The Notifications Tab

During the configuration process, several messages may be displayed in the **Notifications** tab (Figure 3-15) to help identify issues or simply to make sure a specific setting is configured as intended. These are indexed in the **Notifications** tab by:

- 1. Category: Identifies the notification as an alert or information that the module depends on another module.
- 2. Module Name: Is the name of the module that generated the notification.
- 3. Type: Indicates the severity of the notification.

There are four types of notifications:

- SEVERE: Either the code generation or the compilation process will be faulty with the current configuration.
- WARNING: The code will be generated according to the settings made. It may compile, but it might also fail to function as intended.

- HINT: This provides information to assist in the successful configuration of the module. The module and the MCC can still be used. An action might be required.
- INFO: Information only, no action is required.

These can be filtered out using the Type combo box. If there are any WARNING or SEVERE type messages present in the **Notifications** tab when the **Generate** button is clicked, a message box displays, giving the option of reconfiguration to eliminate the possible errors in the current settings. This action can be skipped, assuming the notifications have been reviewed and taken into consideration.

Figure 6-17. The Notifications Tab

Output - MP	LAB® Code Configurator	Notifications [MCC] 8	Pin Manager: Grid View	N	
Category	Module Name	Туре:	ALL 👻		Description
Â	ADCC	HINT	Display SEVERE and a		Selected Tad (128.0 us) > maximumTad (6.0 us). Please higher the sampling frequency!
>	CCP1	INFO	Display WARNING and		The CCP1 module uses Timer 2
1	CCP1	WARNING	Display HINT and abo Display INFO and abo		In order to use the PWM mode, please configure Timer 2 to use Fosc/4 as clock source.
1	DSM	HINT	Display all levels		Enable CLC1 module

Note: The notification type may change as the MCC configuration changes. For example, WARNING might indicate that a module requires another module to be added to the project to operate correctly. After adding the module, the notification type would change to INFO.

6.5 The Composer Area

When a peripheral, library or other external component is selected from the Project Resources Area, its corresponding configuration GUI is displayed in the Composer Area. The Composer Area (Figure 6-18) is where peripherals and libraries are configured based on the application's requirements.

6.5.1 The Easy Setup Tab

Figure 6-18. The Easy Setup Tab of the PIC16F1947 EUSART Module

Pin Module 🕺 System Module 🕸 Interru	pt Module 🛛 🕅	EUSART1	*			
EUSART1						?
🔯 Easy Setup 📄 Registers						
Hardware Settings						
Mode asynchronous 👻						
Enable EUSART Baud Rate:	9600			*	Error: 0.160 %	
Enable Transmit Transmissio	n Bits: 8-bit			*		
Enable Wake-up Reception B	lits: 8-bit			*		
Auto-Baud Detection Data Polarit	y Non-	Inverted		*		
Enable Address Detect Enable	Receive					
Enable EUSART Interrupts						
 Software Settings 						
Redirect STDIO to USART						
Software Transmit Buffer Size 8 👻						
Software Receive Buffer Size 8 👻]					

The EUSART **Easy Setup** tab in the Composer Area allows configuring various EUSART parameters related to transmission and reception operations.

6.5.2 The Registers Tab

In addition to the **Easy Setup** tab in the module's Composer, MCC also provides a **Registers** tab (Figure 6-19). The **Registers** tab provides direct access to configure the module's registers and settings, providing unrestricted access to the configuration of the module.

Any module configuration done using the **Easy Setup** tab will be reflected in the values displayed in the **Registers** tab. Likewise, changes performed in the **Registers** tab reflecteds in the values in the **Easy Setup** tab.

Figure 6-19. The Register View

▼ EUSART1		
Interrupt Ena	bles	
▶ Register:	BAUDICON Ox8	
▶ Register	RC1STA _{0x80}	
▶ Register	SP1BRGH 0x0	
▶ Register	SP1BRGL OxC	
Register:	TX1REG 0x0	
👻 Register:	TX1STA Ox4	
BRGH	hi_speed 💌	
CSRC	slave 💌	
SENDB	sync_break_complete 💌	
SYNC	asynchronous 💌	
TRMT	TSR_empty 💌	
TX9	8-bit 💌	
TX9D	0x0	
TXEN	disabled 💌	

6.5.3 The Pin Module Tab

For any pin which has been configured in the Pin Manager Table View, additional configuration of that pin can be done using the Pin Module View in the Composer Area. To display the Pin Module View, click on the **Pin Module** tab in the Project Resources Area (see Figure 6-20.)

The following settings are available in this tab (depending on the selected pin).

- Pin Name: The port pin name
- **Module**: The name of the module containing the function of the pin.
- **Function**: Module-specific functionality available on the pin. A pin may have one or more selectable functions. Typically, a pin may be configured to have several functions at the same time if it s also configured as an input (Output column unchecked). Only one function per each pin can be matched with an output direction. Refer to the device data sheet for more details.
- **Custom Name**: A useful pin alias which can be used in the generated code. A set of macros are made available in the Pin Module generated code for each selected pin in MCC.

- Start High: Sets the pin to a high/low logic level at device initialization.
- Analog: Configures the pin as analog or digital.
- Output: Sets the pin direction of the pin.
- WPU: Enables the weak pull-up resistor on the pin.
- WPD: Enables the weak pull-down resistor on the pin.
- **OD**: Enables the open-drain capability on the pin.
- **IOC**: Configures the interrupt-on-change capability of the pin.

Note: Some of the settings detailed above may be missing on some pins or from the device completely. Refer to the pins configuration section in the device data sheet.

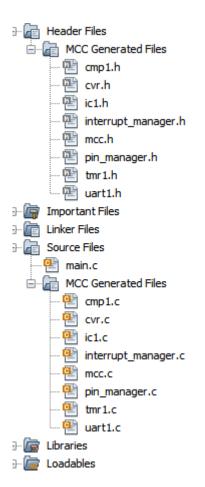
Figure 6-20. The Pin Module Tab

System Module	88 Interrupt Module	≅ EUSART1 ≈	ADC 88					
								?
Registers								
: QFN64								
Module	Function	Custom Name	Start High	Analog	Output	WPU	OD	IOC
ADC	AN0	channel_AN0		\checkmark				
ADC	AN1	channel_AN1		\checkmark				
Pin Module	GPIO	IO_RB2	\checkmark			\checkmark		any 🔻
Pin Module	GPIO	IO_RB4			\checkmark			positive 💌
EUSART1	TX1				\checkmark			
EUSART1	RX1							_
	Registers QFN64 Module ADC ADC Pin Module Pin Module EUSART1	E Registers CVFN64 Module Function ADC AN0 ADC AN1 Pin Module GPIO Pin Module GPIO EUSART1 TX1	Module Function Custom Name ADC AN0 channel_AN0 ADC AN1 channel_AN1 Pin Module GPIO IO_RB2 Pin Module GPIO IO_RB4 EUSART1 TX1	Registers Module Function Custom Name Start High ADC AN0 channel_AN0	Module Function Custom Name Start High Analog ADC AN0 channel_AN0 ✓ ADC AN1 channel_AN1 ✓ Pin Module GPIO IO_RB2 ✓ Pin Module GPIO IO_RB4 EUSART1 TX1	Module Function Custom Name Start High Analog Output ADC AN0 channel_AN0 ✓	Registers Module Function Custom Name Start High Analog Output WPU ADC AN0 channel_AN0 Image: Channel_AN1 Image: Channel_AN1	Module Function Custom Name Start High Analog Output WPU OD ADC AN0 channel_AN0 ✓

6.6 Generated Sources and Header Files

The generated drivers will be included in the active MPLAB X IDE project, as shown in the figure below.





- 1. The mcc.h and mcc.c files include the definitions of Configuration bits and the 'OSCILLATOR_initializer' function. These definitions are based on the settings made for the System module in the Composer. Also included is the 'SYSTEM_initializer' function, which can be called in the application program to call all the other default initializers (the ones marked in the GUI by sprocket symbol).
- 2. The pin_manager.h and pin_manager.c files include the Pin Manager initializer functions based on the configurations made in the Pin Manager GUI.
- 3. The interrupt_manager.h and interrupt_manager.c files are optional files generated only when peripheral interrupts are enabled, and they include interrupt initializer functions.
- 4. The .c and .h are module-specific files and include each module's peripheral\library configuration functions.
- 5. The main.c file is generated even if a main.c already exists in the project. The user can review the code in the generated main.c file and merge the changes to the existing main.c file if required. The main.c file generated by the MCC may include commented-out code lines to enable interrupts. Remove the comments from the appropriate lines if the application requires interrupts to be enabled when it starts. Note: When using a main.c not generated by the MCC, the following lines need to be added to the main.c file #include "mcc generated files/mcc.h";' and 'SYSTEM Initializer()'.

The functions provided in these MCC-generated files can be called from the user application code, as required. The MPLAB X IDE provides auto-completion assistance of all of the MCC-generated content. While editing source code in the project, start typing in an MCC API or MCC variable name, and press **<CTRL+ Space>**. The MPLAB X IDE will show a list of options to complete the entry.

6.7 MCC Device Migration

Using an MCC configuration created for one device on a different device is called MCC device migration.

Note: MCC device migration is not supported in MCC.

It is possible that attempting to use an MCC configuration on a device other than the one for which it was created might appear not to fail. It is entirely the user's responsibility to determine if the MCC code generated as the result of device migration is suitable for use in their application.

Unintended MCC device migration may occur if the selected device in the MPLAB X IDE project is changed after MCC has been configured for that project. Copying an MCC configuration file (*.mc3) to another MPLAB X IDE project may also cause MCC device migration or other unintended operations.

7. MCC Melody

MCC Melody is a new flavor of MCC that provides Libraries, Drivers, Peripheral Libraries (PLIB), and Hardware Initializers (HWI) for the development of embedded software for Microchip PIC[®] and AVR[®] Microcontrollers (MCUs) and dsPIC[®] Digital Signal Controllers (DSCs).

Its key features include:

- 1. A structured relationship manager (MCC Builder) which provides a clear visualization of a component's related dependencies and context in your project.
- 2. An implementation that can enable components available to be configured in the new online development ecosystem, i.e., in MPLAB Xpress IDE.
- 3. A content manager which allows more granular, component-level versioning and selection.

For more information, go to the MCC Melody Technical Reference.

8. MCC Harmony

MPLAB Harmony 3 provides a Chip Support Package (CSP), core hardware abstraction libraries, extensive middleware, and a graphical configuration tool for the development of C language embedded software for Microchip 32-bit microcontrollers and microprocessors. For more information, refer to the Microchip MPLAB Harmony Github Page.

9. Revision History

Doc. Rev.	Date	Comments
E	09/2021	Added section to cover MCC Content Manager and Melody. Reorganized sections. Added metadata to MCC Classic section.
D	03/2019	Updated Chapter 3 content
С	05/2018	Added Chapter 2 Installation; updated text in Chapter 3 Operating Areas; removed previous Figures 1-1, 2-8, 2-13, 2-16, 2-17, 2-18 and 2-19; changed or replaced various figures; added Figures 3-3, 3-4, 3-6, added text in Chapter 3 in Project Resources Area and Versions Area; moved text to Package View Area; added subchapter 3.5.3. The Notification Tab; subchapter 3.6.3 The Pin Module Tab; subchapter 3.7.4 Installing an MPLAB Code Configurator Library; subchapter 3.7.5 Installing an MPLAB Code Configurator Core and different text corrections throughout the document.
В	05/2016	Revised Figure 1-1; Revised Chapter 2; Revised Figure 2-5 Title; Added Figures 2-6 through 2-10; Revised Chapter 3.
A	01/2016	Initial document release

The Microchip Website

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
- **Business of Microchip** Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Product Change Notification Service

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: www.microchip.com/support

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip products:

- · Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable". Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.

Legal Notice

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at www.microchip.com/en-us/support/design-help/client-support-services.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet- Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, NVM Express, NVMe, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQI, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, Symmcom, and Trusted Time are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

[©] 2022, Microchip Technology Incorporated and its subsidiaries. All Rights Reserved.

ISBN: 978-1-5224-9921-3

Quality Management System

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.



Worldwide Sales and Service

MERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
Corporate Office 355 West Chandler Blvd.	Australia - Sydney Tel: 61-2-9868-6733	India - Bangalore Tel: 91-80-3090-4444	Austria - Wels Tel: 43-7242-2244-39
	China - Beijing	India - New Delhi	Fax: 43-7242-2244-39
handler, AZ 85224-6199	Tel: 86-10-8569-7000	Tel: 91-11-4160-8631	
el: 480-792-7200			Denmark - Copenhager
ax: 480-792-7277	China - Chengdu	India - Pune	Tel: 45-4485-5910
echnical Support:	Tel: 86-28-8665-5511	Tel: 91-20-4121-0141	Fax: 45-4485-2829
ww.microchip.com/support	China - Chongqing	Japan - Osaka Tel: 81-6-6152-7160	Finland - Espoo
Veb Address:	Tel: 86-23-8980-9588		Tel: 358-9-4520-820
ww.microchip.com	China - Dongguan	Japan - Tokyo	France - Paris
tlanta	Tel: 86-769-8702-9880	Tel: 81-3-6880- 3770	Tel: 33-1-69-53-63-20
uluth, GA	China - Guangzhou	Korea - Daegu	Fax: 33-1-69-30-90-79
el: 678-957-9614	Tel: 86-20-8755-8029	Tel: 82-53-744-4301	Germany - Garching
ax: 678-957-1455	China - Hangzhou	Korea - Seoul	Tel: 49-8931-9700
ustin, TX	Tel: 86-571-8792-8115	Tel: 82-2-554-7200	Germany - Haan
el: 512-257-3370	China - Hong Kong SAR	Malaysia - Kuala Lumpur	Tel: 49-2129-3766400
oston	Tel: 852-2943-5100	Tel: 60-3-7651-7906	Germany - Heilbronn
/estborough, MA	China - Nanjing	Malaysia - Penang	Tel: 49-7131-72400
el: 774-760-0087	Tel: 86-25-8473-2460	Tel: 60-4-227-8870	Germany - Karlsruhe
ax: 774-760-0088	China - Qingdao	Philippines - Manila	Tel: 49-721-625370
hicago	Tel: 86-532-8502-7355	Tel: 63-2-634-9065	Germany - Munich
asca, IL	China - Shanghai	Singapore	Tel: 49-89-627-144-0
el: 630-285-0071	Tel: 86-21-3326-8000	Tel: 65-6334-8870	Fax: 49-89-627-144-44
ax: 630-285-0075	China - Shenyang	Taiwan - Hsin Chu	Germany - Rosenheim
allas	Tel: 86-24-2334-2829	Tel: 886-3-577-8366	Tel: 49-8031-354-560
ddison, TX	China - Shenzhen	Taiwan - Kaohsiung	Israel - Ra'anana
el: 972-818-7423	Tel: 86-755-8864-2200	Tel: 886-7-213-7830	Tel: 972-9-744-7705
ax: 972-818-2924	China - Suzhou	Taiwan - Taipei	Italy - Milan
etroit	Tel: 86-186-6233-1526	Tel: 886-2-2508-8600	Tel: 39-0331-742611
ovi, MI	China - Wuhan	Thailand - Bangkok	Fax: 39-0331-466781
el: 248-848-4000	Tel: 86-27-5980-5300	Tel: 66-2-694-1351	Italy - Padova
ouston, TX	China - Xian	Vietnam - Ho Chi Minh	Tel: 39-049-7625286
el: 281-894-5983	Tel: 86-29-8833-7252	Tel: 84-28-5448-2100	Netherlands - Drunen
Idianapolis	China - Xiamen		Tel: 31-416-690399
oblesville, IN	Tel: 86-592-2388138		Fax: 31-416-690340
el: 317-773-8323	China - Zhuhai		Norway - Trondheim
ax: 317-773-5453	Tel: 86-756-3210040		Tel: 47-72884388
el: 317-536-2380			Poland - Warsaw
os Angeles			Tel: 48-22-3325737
lission Viejo, CA			Romania - Bucharest
el: 949-462-9523			Tel: 40-21-407-87-50
ax: 949-462-9608			Spain - Madrid
el: 951-273-7800			Tel: 34-91-708-08-90
aleigh, NC			Fax: 34-91-708-08-91
el: 919-844-7510			Sweden - Gothenberg
ew York, NY			Tel: 46-31-704-60-40
el: 631-435-6000			Sweden - Stockholm
an Jose, CA			Tel: 46-8-5090-4654
el: 408-735-9110			UK - Wokingham
el: 408-436-4270			Tel: 44-118-921-5800
anada - Toronto			Fax: 44-118-921-5820
el: 905-695-1980			1 a. ++-110-321-3020
ax: 905-695-2078			