



# **Mixed-Signal Explorer**

## **User's Guide**

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# Preface

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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 “DSXXXXXXXXA”, where “XXXXXXXX” 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® 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 is useful to know before using the Mixed-Signal Explorer. Items discussed in this chapter include:

- [Document Layout](#)
- [Conventions Used in this Guide](#)
- [Recommended Reading](#)
- [The Microchip Website](#)
- [Product Change Notification Service](#)
- [Customer Support](#)
- [Document Revision History](#)
- [Index](#)

This document describes how to use the Mixed-Signal Explorer. The manual layout is as follows:

- **Chapter 1. “Product Overview”** – Important information about the Mixed-Signal Explorer.
- **Chapter 2. “Installation and Operation”** – Includes instructions on how to install and start the Mixed-Signal Explorer components.

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### CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

#### DOCUMENTATION CONVENTIONS

Description	Represents	Examples
<b>Arial font:</b>		
Italic characters	Referenced books	<i>MPLAB® 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
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
<b>Courier New font:</b>		
Plain Courier New	Sample source code	<code>#define START</code>
	Filenames	<code>autoexec.bat</code>
	File paths	<code>c:\mcc18\h</code>
	Keywords	<code>_asm, _endasm, static</code>
	Command-line options	<code>-Opa+, -Opa-</code>
	Bit values	<code>0, 1</code>
	Constants	<code>0xFF, 'A'</code>

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Italic Courier New	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) { ... }

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### RECOMMENDED READING

This user's guide describes how to use the Mixed Signal Explorer. Other useful documents are listed below. The following Microchip document is available and recommended as a supplemental reference resource:

- Mixed-Signal-Explorer-GUI-User-Guide.pdf
- Mixed-Signal-Explorer-CLI-User-Guide.pdf
- Mixed-Signal-Explorer-Release-Notes.pdf

### THE MICROCHIP WEBSITE

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- **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
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- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document, under **Worldwide Sales and Service**.

Technical support is available at: [microchip.com/support](http://microchip.com/support).

### DOCUMENT REVISION HISTORY

#### Revision E (September 2025)

- Update for adding support for DAC families with I2C interface: MCP47CXBXX, MCP47CXDX1/2.
- Update for adding support for DigiPOT family: MCP4XU83.

#### Revision D (May 2025)

- Update for adding support for DAC families with SPI interface.

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### **Revision C (March 2025)**

- Update for Firmware Update.

### **Revision B (February 2025)**

- Update for Delta-Sigma support.

### **Revision A (November 2024)**

- Initial Release of this document.

# Chapter 1 PRODUCT OVERVIEW

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The Mixed-Signal Explorer is a software package containing a set of tools meant to showcase the capabilities of the Mixed-Signal Evaluation Boards from Microchip. The following evaluation board (s) are currently supported by this software:

- ADM00873 Rev 2
- EV76B70A
- EV17X13A

The following ADC devices are currently supported by this software:

- **SAR ADC** devices:
  - **MCP33111-05**: 500 ksps 12-Bit Single-ended Input SAR ADC
  - **MCP33111-10**: 1 Msps 12-Bit Single-ended Input SAR ADC
  - **MCP33121-05**: 500 ksps 14-Bit Single-ended Input SAR ADC
  - **MCP33121-10**: 1 Msps 14-Bit Single-ended Input SAR ADC
  - **MCP33131-05**: 500 ksps 16-Bit Single-ended Input SAR ADC
  - **MCP33131-10**: 1 Msps 16-Bit Single-ended Input SAR ADC
  - **MCP33141-05**: 500 ksps 12-Bit Single-ended Input SAR ADC
  - **MCP33141-10**: 1 Msps 12-Bit Single-ended Input SAR ADC
  - **MCP33151-05**: 500 ksps 14-Bit Single-ended Input SAR ADC
  - **MCP33151-10**: 1 Msps 14-Bit Single-ended Input SAR ADC
  - **MCP33111D-05**: 500 ksps 12-Bit Differential Input SAR ADC
  - **MCP33111D-10**: 1 Msps 12-Bit Differential Input SAR ADC
  - **MCP33121D-05**: 500 ksps 14-Bit Differential Input SAR ADC
  - **MCP33121D-10**: 1 Msps 14-Bit Differential Input SAR ADC
  - **MCP33131D-05**: 500 ksps 16-Bit Differential Input SAR ADC
  - **MCP33131D-10**: 1 Msps 16-Bit Differential Input SAR ADC
  - **MCP33141D-05**: 500 ksps 12-Bit Differential Input SAR ADC
  - **MCP33141D-10**: 1 Msps 12-Bit Differential Input SAR ADC
  - **MCP33151D-05**: 500 ksps 14-Bit Differential Input SAR ADC
  - **MCP33151D-10**: 1 Msps 14-Bit Differential Input SAR ADC
- **Delta-Sigma** devices:
  - **MCP3564R**: Eight-Channel, 153.6 ksps, Low Noise 24-Bit Delta-Sigma ADC with Internal Voltage Reference
  - **MCP3562R**: Four-Channel, 153.6 ksps, Low Noise 24-Bit Delta-Sigma ADC with Internal Voltage Reference
  - **MCP3561R**: Two-Channel, 153.6 ksps, Low Noise 24-Bit Delta-Sigma ADC with Internal Voltage Reference
- **DAC** devices:
  - **MCP48CXBXX**: 8/10/12-Bit Digital-to-Analog Converters, 1 LSb INL, Single/Dual Voltage Outputs with SPI Interface
  - **MCP48CXDX1/2**: 8/10/12-Bit Digital-to-Analog Converters, 1 LSb INL, Single/Dual Voltage Outputs with SPI Interface
  - **MCP47CXBXX**: 8/10/12-Bit Digital-to-Analog Converters, 1 LSb INL, Single/Dual Voltage Outputs with I2C Interface
  - **MCP47CXDX1/2**: 8/10/12-Bit Digital-to-Analog Converters, 1 LSb INL, Single/Dual Voltage Outputs with I2C Interface
- **DigiPOT** devices:
  - **MCP4XU83**: 10-Bit Single/Dual-Channel Digital Potentiometers with Selectable SPI/I2C Serial Interface



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Another MCHP Evaluation Board (EV64F02A - PIC32MZ MXS Data Capture Board) is designated to facilitate communication between the ADC Evaluation Board and the software tools. Required Firmware version: >= 25.09.002

The software tools have features like signal processing (Spectral Analysis, Linearity Analysis) , Bit Analysis and Signal Injection. The visual plots give insight into the result of the analyses along with the displayed/downloadable metrics.

The software package contains two main components: Mixed-Signal Explorer GUI and Mixed-Signal Explorer CLI and two dependencies: the MCHP DAL Backend and the MCHP USB Bridge Service.

The following software packages are supported with this release:

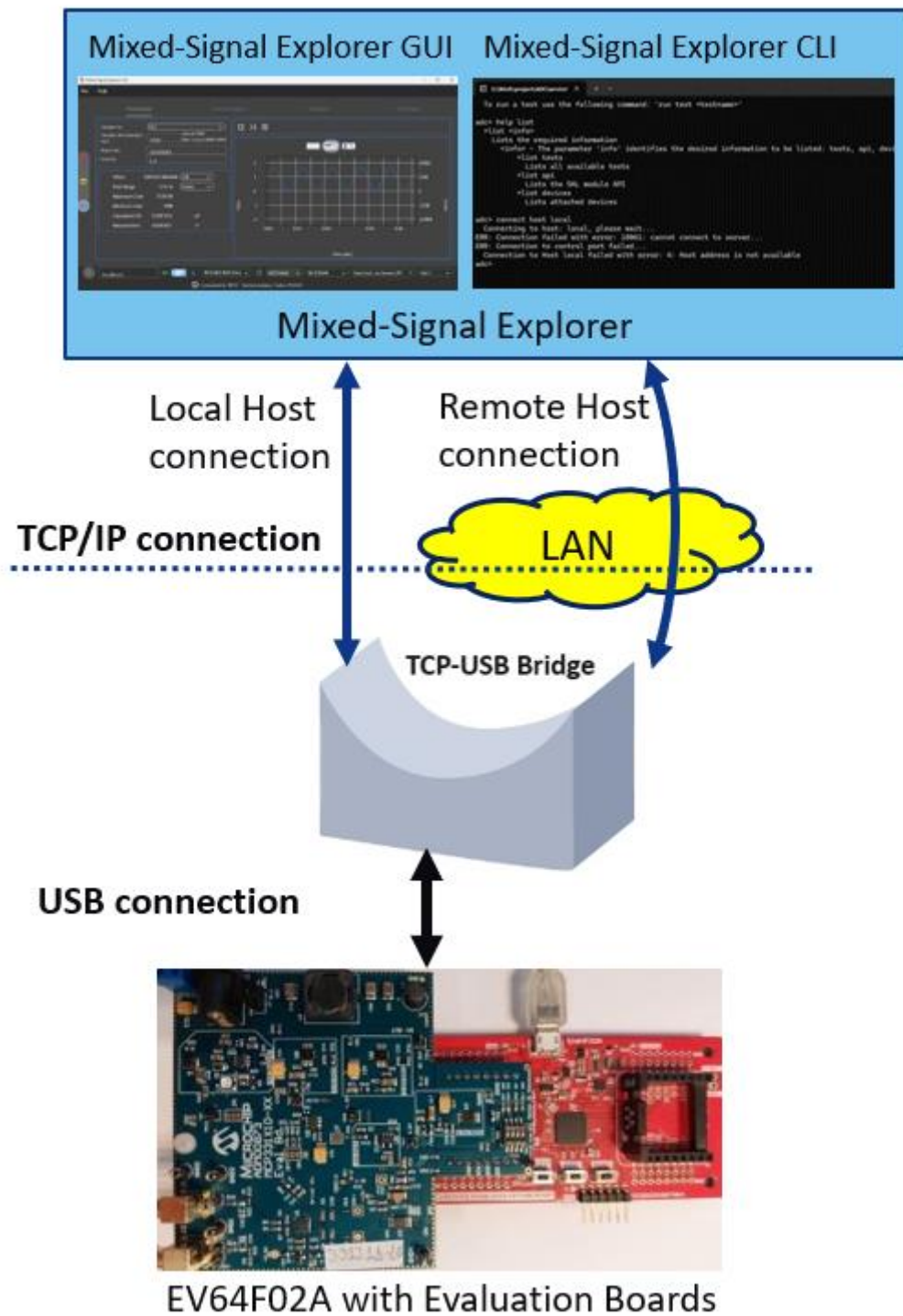
- MCHP USB Bridge Service Installer version: >= 1.0.9

Here is a high-level structure of the package content:

- <INSTALLDIR>\Mixed\_Signal\_Explorer\ - containing the GUI, CLI and Backend
- <INSTALLDIR>\usbBridgeService\ - MCHP USB Bridge Service

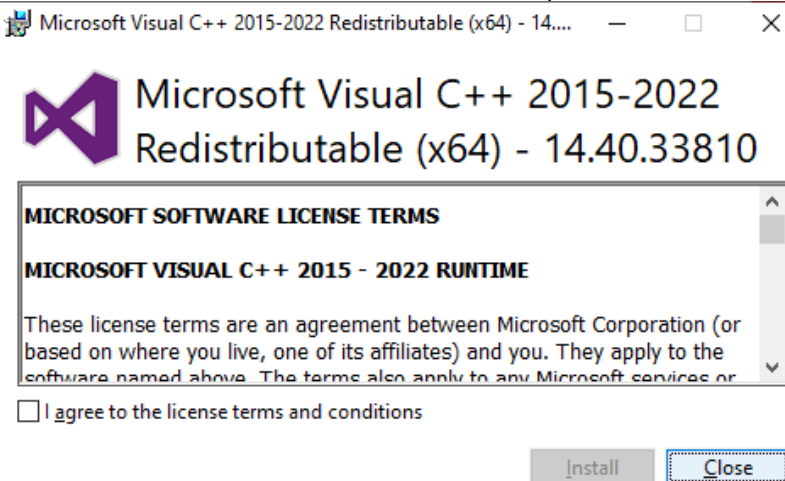
Here is a high-level structure of the Mixed-Signal Explorer folder content:

- <INSTALLDIR>\Mixed\_Signal\_Explorer\bin\ - Mixed-Signal Explorer binaries
- <INSTALLDIR>\Mixed\_Signal\_Explorer\devices\ - Mixed-Signal Explorer SVD (System View Description) files for the supported devices
- <INSTALLDIR>\Mixed\_Signal\_Explorer\doc\ - Mixed-Signal Explorer documentation



High level system overview

## Chapter 2 INSTALLATION AND OPERATION

Supported Operating System:	Windows 10 (64-bit) and Windows 11
Admin Privileges Required:	Yes
Other Requirements*:	<p>MCHP USB Bridge Service installed on the same PC or installed on another PC with connectivity between the two PCs.</p> <p>Backend library for:</p> <ul style="list-style-type: none"> <li>Communicating with the MCHP USB Bridge Service</li> <li>Performing the data processing</li> </ul> <p>Flutter</p> <p>.NET</p> <p>Microsoft Visual C++ Redistributable, which can be installed using the last step of the installer. If you have a newer redistributable version you can skip installing this (<b>press Close</b>), however make sure that newer version installation is not corrupted.</p> 

- All dependencies are automatically installed by the installer.

The package installer also includes the MCHP USB Bridge service. If you want to use the service and GUI/CLI on the same PC, it is necessary to check the respective checkbox (this will start the sub-installer for the MCHP USB Bridge Service).

Additionally, if you want to use the service locally (not on a lab PC connected to the devices), you need to start the MCHP USB Bridge Service from services.msc (type services.msc in the Start menu, then in services.msc search for MCHP USB Bridge Service, right-click the entry, and start it).

The installer will also install Microsoft Visual C++ Redistributable. If the PC already has it, you can press Close at this step. If an upgrade is required, a reboot will be necessary, which will interrupt the installer. This is fine since the installation of the redistributable is the last step in this installer.

To start the software components, use the Windows Search Bar to type the following:

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- o To start the CLI application: MSECLI
- o To start the GUI application: MSEGUI
- o To open the documentation folder: MSEDOCS

**To operate the system successfully, make sure the service has been installed then update the PIC32MZ firmware from GUI (as per document Mixed-Signal-Explorer-GUI-User-Guide.pdf) or as in the following method:**

Start the service from services.msc and then do the following steps:

1. Connect the PIC32MZ Mixed Signal Data Capture Board (EV64F02A) with the ADC Evaluation board to the PC hosting the service via a USB cable.
2. Navigate in browser to <http://localhost:12110/> (or the IP address of the host if different from local PC, and the port).
3. Click button '**Attempt DFU Reboot**' if the MCU is not in bootloader Mode. If the device is not detected in this web page and it is not in bootloader mode put the device in bootloader mode manually (Keep BOOT button pressed and click RESET button. The RUN and STATUS LEDs will blink alternately. Release the BOOT button.).

**MCHP USB Bridge Bootloader Utility**

Connected boards

ID	Name	Type	S/N	FW Version	Actions
1	PIC32MZ Generic USB Bridge	26	9CC3B221F1084BFFFFFFFFFFFFFFFF	24.10.002	<div>Attempt DFU Reboot</div>

Rescan USB devices

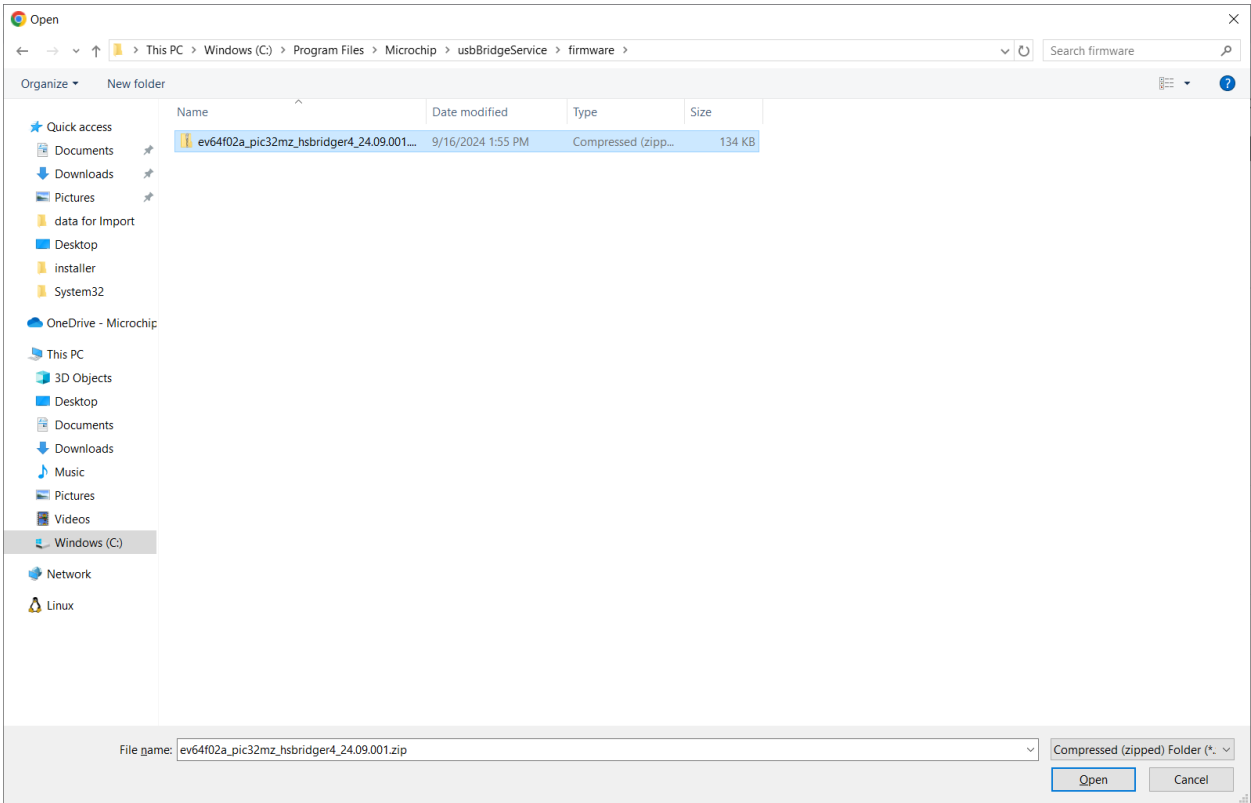
Detected bootloaders

ID	Name	Type	S/N	Loader Version	Actions
N O N E					

Rescan USB devices

4. In the bootloader section, click the '**Browse for firmware**' button and upload the supported firmware from USB Bridge Service installation Folder.

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## MCHP USB Bridge Bootloader Utility

Connected boards

ID	Name	Type	S/N	FW Version	Actions
NONE					

Rescan USB devices

Detected bootloaders

ID	Name	Type	S/N	Loader Version	Actions
1	PIC32MZ MXS Capture Board Loader	26	9CC3B221F10848FFFFFFFFFFFFFFFF	3.4	Erase Browse for firmware Program Boot App

Rescan USB devices

5. Press **Program** button.

The selected firmware will be programmed into the MCU device.

### INDEX

Alphabetical order	Meaning
ADC	Analog-to-Digital Converter
CLI	Command Line Interface
DAC	Digital-to-Analog Converter
DAL	Device Access Layer
DNL	Differential Nonlinearity
EVB	Evaluation Board
FFT	Fast Fourier Transform
FW	Firmware
GUI	Graphical User Interface
HW	Hardware
INL	Integral Nonlinearity
INSTALLDIR	Installation Directory
IP	Internet Protocol
MCHP	Microchip
MCU	Microcontroller Unit
SW	Software
Rev	Revision
PC	Personal Computer
TCP	Transmission Control Protocol
USB	Universal Serial Bus