

Getting Started with MPLAB[®] Mindi[™] Analog Simulator Tool

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GETTING STARTED WITH MPLAB[®] MINDI™ ANALOG SIMULATOR TOOL

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) 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.

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 will be useful to know before using the MPLAB[®] Mindi[™] Analog Simulator Tool. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Web Site
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the MPLAB[®] Mindi[™] Analog Simulator Tool as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- Introduction
- Running MPLAB^{® Mindi™} Simulator
- Welcome Page Overview and Navigation
- Creating a New Schematic
- Running the Simulation
- Simulation Results

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		·
Italic characters	Referenced books	MPLAB [®] IDE User's Guide
	Emphasized text	is the only 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>File>Save</u>
Bold characters	A dialog button	Click OK
	A tab	Click the Power 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></f1></enter>
Courier New font:	·	
Plain Courier New	Sample source code	#define START
	Filenames	autoexec.bat
	File paths	c:\mcc18\h
	Keywords	_asm, _endasm, static
	Command-line options	-0pa+, -0pa-
	Bit values	0, 1
	Constants	0xFF, `A'
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] file [options]
Curly brackets and pipe character: { }	Choice of mutually exclusive arguments; an OR selection	errorlevel {0 1}
Ellipses	Replaces repeated text	<pre>var_name [, var_name]</pre>
	Represents code supplied by user	void main (void) { }

RECOMMENDED READING

This user's guide describes how to use the MPLAB[®] Mindi[™] Analog Simulator Tool. Other useful documents are listed below.

• None available at this time.

THE MICROCHIP WEB SITE

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- 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

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Users of Microchip products can receive assistance through several channels:

- 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.

Technical support is available through the web site at: http://www.microchip.com/support.

DOCUMENT REVISION HISTORY

Revision A (January 2017)

• Initial Release of this Document.

NOTES:



GETTING STARTED WITH MPLAB[®] MINDI™ ANALOG SIMULATOR TOOL

Getting Started with MPLAB[®] MindiTM Analog Simulator Tool

1.1 INTRODUCTION

The MPLAB[®] Mindi[™] Analog Simulator Tool is a comprehensive tool for circuit analysis. It consists of:

- SIMPLIS (SIMulation of Piecewise LInear Systems): A circuit simulator specifically designed to handle the simulation challenges of switching power systems. Similar to SPICE, SIMPLIS works at the component level, but typically can perform a transient analysis of a switching circuit 10 to 50 times faster. For switching power systems, the Piecewise Linear (PWL) modeling and simulation techniques employed by SIMPLIS result in qualitatively superior convergence behavior as compared to SPICE.
- SIMetrix: A general analog and mixed-signal simulator that includes an enhanced SPICE simulator, schematic editor and waveform viewer in a unified environment. It is easy to use, offers good accuracy and performance, and rapid convergence for a broad range of analog and mixed-signal design applications.

1.2 RUNNING MPLAB[®] MINDI™ SIMULATOR

To start the MPLAB Mindi Simulator, double-click on the desktop shortcut after installation or select <u>Start>All Programs>Mindi 8.00</u>. A splash screen will display the MPLAB Mindi Simulator logo followed by the MPLAB Mindi Simulator desktop.

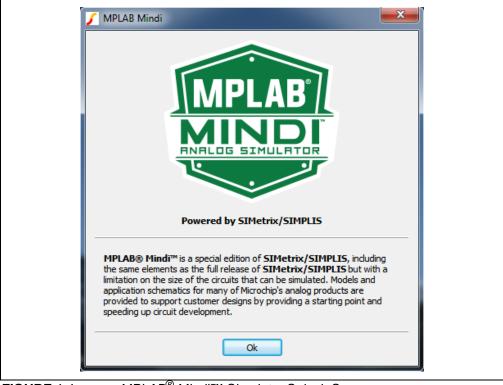


FIGURE 1-1:

MPLAB[®] Mindi™ Simulator Splash Screen.

Getting Started with MPLAB[®] Mindi[™] Analog Simulator Tool

✓ MPLAB Mindi Main Window File View Help		Web View V
File View Add Directory Examples-80	Welcome to MPLAB® Mindi [™] Analog Simulator	Міскоснір
Part Selector Command Shell File View MPLAB Mindi	Create New / Open New SIMetrix Schematic New SIMPLIS Schematic New Symbol Open File Recent Schematics	MPLAB® Mindi™ Support
Powered by SIMetrix/SIMPLIS		Le Toner Smithes

FIGURE 1-2:

MPLAB[®] Mindi™ Simulator Desktop.

NOTICE It is strongly recommended that the user lets MPLAB[®] Mindi[™] periodically check for updates to ensure that the simulator always has the latest models and example schematics. The user can do this by clicking on <u>Help>Check for updates...</u> and set the Automatic Update Schedule to Monthly.

FIGURE 1-3:

MPLAB[®] Mindi[™] Update Settings Window.

1.3 WELCOME PAGE OVERVIEW AND NAVIGATION

After the MPLAB Mindi Simulator start-up, the Welcome Page will be shown. It has quick links for the following actions:

- Create New/Open: Open or create a new schematic for SIMPLIS or SIMetrix from scratch.
- Application Schematics: Browse existing application schematics by category.
- Recent Schematics: Open recent schematics.
- MPLAB[®] Mindi[™] Support: Get help or more application schematics from Microchip Technology Inc.

The existing directory structure, containing application schematics, can also be visualized in the left frame by clicking on the **File View** tab.

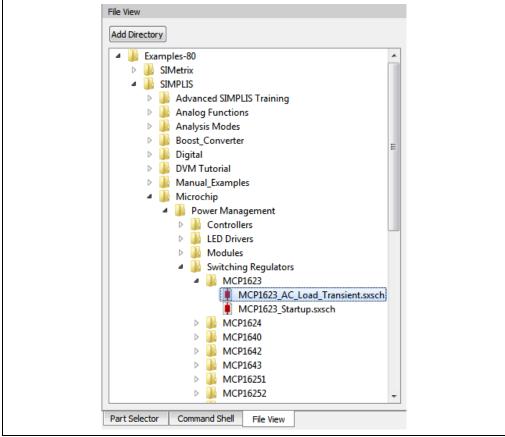


FIGURE 1-4:

Directory Structure in the File View Tab.

The user can also easily navigate through this directory structure using the Welcome Page breadcrumbs by clicking on one directory in the Application Schematics frame.



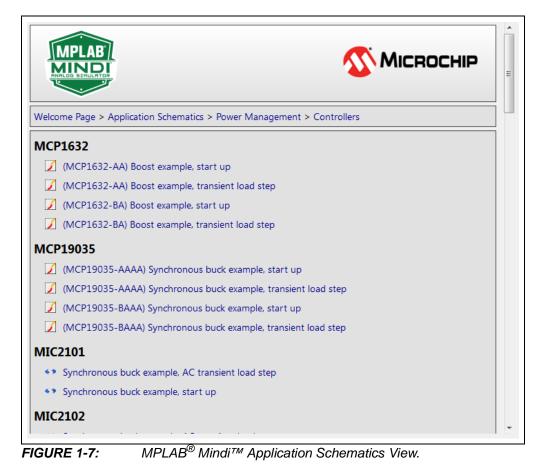
FIGURE 1-5:

The Application Schematics Frame.

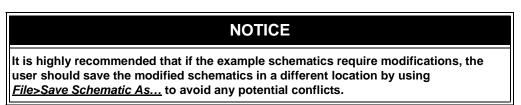
During navigation, the breadcrumb area will indicate the current path in the directory hierarchy.

Welcome Page		
Welcome Page > Ap	plication Schematics > MOSFET and Motor Drivers	
FIGURE 1-6:	Breadcrumb Area View Showing the Current Path.	

Note: The directory-type icon *i* means that the user can go down in the hierarchy. The Mindi *i* icon represents folders that are at the bottom level. In those folders, you can find the application schematic that you want. The faded icons mean empty directories.



The schematic files have two types of icons. SIMetrix files are marked with the \square icon and SIMPLIS schematics are marked with the \square icon.



1.4 CREATING A NEW SCHEMATIC

The user can create a new schematic from <u>*File>New>SIMetrix/SIMPLIS Schematic*</u> or by using the <u>*Create New/Open*</u> quick link from the Welcome Page.

By pressing the <Ctrl + G> key combination, the user can see all the models that are installed.

Microchip Technology Inc. models are available from <u>*Place>From Microchip Library.*</u> Here, the user will find only the models that are compatible with the schematic type (SIMetrix or SIMPLIS).

Repeat Last Place	Alt+R	Ħ	(Q	(Ð,	Ð		Q			'	Þ		L	1	ň		¢	1	÷	~	2	÷	• (Ð	Ę
From Model Library	Ctrl+G	inti	tle	d*																							
From Symbol Library			•	•	•	•	•	•	•	•	•		•	•				•	•	•	•						
From Microchip Library	•		A	mp	olif	iers	;				•	Ì				:	:	:		:		:	:			:	
Select by Specification	×		P	ow	er	Ma	nag	jen	nen	t	۲	(Co	nti	roll	ers		F			м	°P1	632	2-0	Δ	
Search Part																								632			
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			:	:	:	:	:			:	:	:	:			:	:	:	:					903			
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Magnetics	•		:	:	:	:	:	:	:	:	:	:	:	:		:	:	:	:	:	:	:	:	:	:	:	
Passives	+	·																									
Connectors	+	·	•	•	•	•	•	•	•		•	•	•			•	•		•	•	•	•	•	•	•	•	•
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Voltage Sources	•	·																									
Current Sources	+	·	•	•	•	•	•	•	•	•	·	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Controlled Sources	+																										
Bias Annotation	•	·																									
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Digital	•																										
Digital Generic		·										•	•						•			•	•			•	•
Analog Behavioural			:	:	:	:	:	:	:	:	:	:	:	:		:	:	:	:	:	:	:	:	:	:	:	•
Analog Functions																											
Worksheets		•				•							•	•			•	•	•	·	•	•				·	



View of Installed Models.

1.5 RUNNING THE SIMULATION

After opening a Microchip application schematic, the user can run the default analysis by pressing the <F9> key or by clicking on <u>Simulator>Run Schematic</u>.

Mindi Main Wind File Edit View	ow Simulator Place Probe Probe AC/Noise	Hierarchy	Monte Ca
🗋 - 📄 🗙 🗖	Choose Analysis	F8	(Q
File View	Run Schematic	F9	ocument
Add Directory	Abort Show SIMPLIS Status Window	Ctrl+Space	· · ·
SIMetri SIMPLI SIMPLI SIMPLI Adr An	Initial Conditions Setup Multi-step Run Multi-step	•	· · · · · · · · · · · · · · · · · · ·
▷ 🍶 An ▷ 🍶 Boo ▷ 🍶 Dig ▷ 闄 DV	Find Smallest Time Constant Graph Time Constants Debug Simulation		
⊳ 퉬 Ma ⊿ 📑 Mie	Manage Data Groups		· · ·
	Edit Netlist (before preprocess) Edit Netlist (after preprocess)		BATT -
4	Open/Close Command (F11) Window	F11	
	Switch to SIMetrix Mode		

FIGURE 1-9: Running the Default Analysis on a Microchip Schematic.

The default analysis type is highlighted in the application schematic's file name (e.g., MCP1623_AC_Load_Transient) and its parameters can be altered after opening the Choose Analysis window, which is available by pressing the <F8> key or by clicking on <u>Simulator>Choose Analysis</u>. If the user wants to run a user-created schematic, the analysis type and its parameters must be chosen first.

	Choose SIMPLIS Analysis	
-	Periodic Operating Point AC Transient Analysis parameters POP Stop time 2.5m \$ s Start saving data at t = 0 \$ s Ø Default	
	Plot data output Number of plot points 1k Default Save options All Voltages Only Probes Only	
	Advanced In No Forced Output Data Image: Concel Help Image: Concel Help	

FIGURE 1-10: The Choose Analysis Window.

Getting Started with MPLAB[®] Mindi[™] Analog Simulator Tool

The analysis options for SIMPLIS and SIMetrix are different and the models are not compatible from one tool to another. If the user wants to run a SIMPLIS schematic using the SIMetrix tool (or vice versa), the MPLAB Mindi Simulator will issue a warning and will highlight the non-compatible parts.

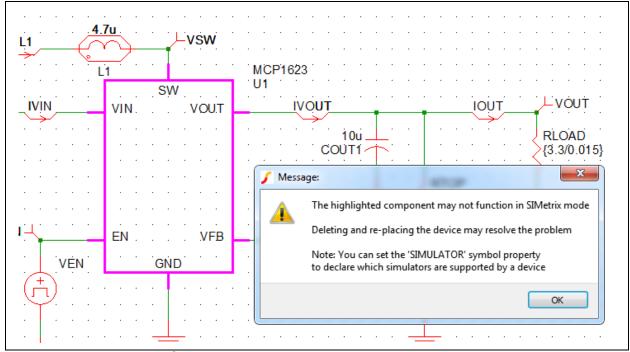


FIGURE 1-11: MPLAB[®] Mindi[™] Simulator Warning Message with Highlighted Non-Compatible Parts.

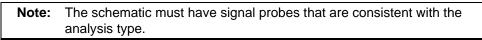
1.6 SIMULATION RESULTS

The user can check the state of the analysis in the Simulation Status window.

Analysis Transient	Da	ata Group simplis_tran2	
Run status Finished	St	tep	
Run Progress			100%
POP Status Pass	4	Convergence	5.826541795e-12%
Time	400u	Topologies	New topology #466
Elapsed Time Current	0 hr 0 min 24 sec	Total	0 hr 0 min 51 sec
CPU time Current	0 hr 0 min 12.74 se	ec Total	0 hr 0 min 35.97 sec
	Elapsed CPU time) min 12.74 sec
Writing pertinent data Leaving SIMPLIS.	Simulati	on time: 4.000000	0000000e-004 sec

FIGURE 1-12: Simulation Status Window.

After the simulation is finished, the results will pop up.



The MPLAB Mindi Simulator can do time domain (waveforms) and frequency domain (Bode plots) analysis.

A time domain simulation shows characteristics, such as response time and overshoot.

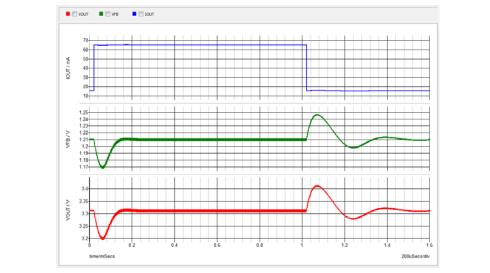
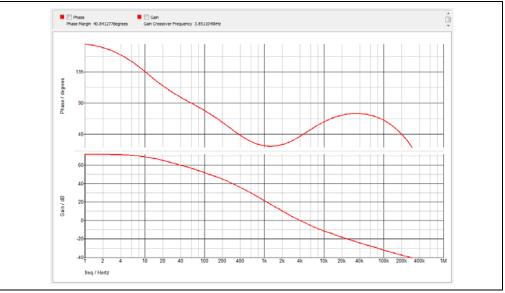


FIGURE 1-13:

Time Domain Simulation.



While time domain analysis shows how a signal changes over time, frequency domain analysis shows how the signal's energy is distributed over a range of frequencies.

FIGURE 1-14: Frequency Domain Simulation

This frequency domain analysis produces the Bode plots. These plots include critical information regarding the circuit's closed-loop stability, such as gain and phase margins.

NOTES:



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