



# **MCP6XXX Amplifier Evaluation Board 1 User's Guide**

---

**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

---

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates.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. 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 ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. 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.

**Trademarks**

The Microchip name and logo, the Microchip logo, Accuron, dsPIC, KEELOQ, KEELOQ logo, microID, MPLAB, PIC, PICmicro, PICSTART, PRO MATE, rfPIC and SmartShunt are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.


AmpLab, FilterLab, Linear Active Thermistor, Migratable Memory, MXDEV, MXLAB, SEEVAL, SmartSensor and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Application Maestro, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, ECAN, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, Mindi, MiWi, MPASM, MPLAB Certified logo, MPLIB, MPLINK, PICkit, PICDEM, PICDEM.net, PICLAB, PICtail, PowerCal, PowerInfo, PowerMate, PowerTool, REAL ICE, rFLAB, Select Mode, Smart Serial, SmartTel, Total Endurance, UNI/O, WiperLock 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.

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

© 2007, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

**QUALITY MANAGEMENT SYSTEM  
CERTIFIED BY DNV  
== ISO/TS 16949:2002 ==**

*Microchip received ISO/TS-16949:2002 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.*



# MCP6XXX AMPLIFIER EVALUATION BOARD 1 USER'S GUIDE

## Table of Contents

<b>Preface</b> .....	<b>1</b>
Introduction.....	1
Document Layout .....	1
Conventions Used in this Guide .....	2
Recommended Reading.....	3
The Microchip Web Site .....	3
Customer Support .....	3
Document Revision History .....	3
<b>Chapter 1. Product Overview</b> .....	<b>5</b>
1.1 Introduction .....	5
1.2 MCP6XXX Amplifier Evaluation Board 1 Kit Contents .....	5
1.3 Microchip's Web-Based Mindi™ Analog Simulator .....	6
1.4 MCP6XXX Amplifier Evaluation Board 1 Description .....	6
<b>Chapter 2. Installation and Operation</b> .....	<b>7</b>
2.1 Introduction .....	7
2.2 Required Tools .....	7
2.3 MCP6XXX Amplifier Evaluation Board 1 Set-up .....	7
2.4 MCP6XXX Amplifier Evaluation Board 1 Operation .....	18
<b>Appendix A. Schematic and Layouts</b> .....	<b>29</b>
A.1 Introduction .....	29
A.2 Board - Schematic .....	30
A.3 Board - Top Silk Layer .....	31
A.4 Board - Top Metal Layer .....	32
A.5 Board - Bottom Metal Layer .....	33
<b>Appendix B. Bill Of Materials (BOM)</b> .....	<b>35</b>
B.1 MCP6XXX Amplifier Evaluation Board 1 BOM .....	35
<b>Worldwide Sales and Service</b> .....	<b>38</b>

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

---

---

NOTES:



# MCP6XXX AMPLIFIER EVALUATION BOARD 1 USER'S GUIDE

## Preface

### NOTICE TO CUSTOMERS

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

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

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

## INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP6XXX Amplifier Evaluation Board 1. 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 MCP6XXX Amplifier Evaluation Board 1. The manual layout is as follows:

- **Chapter 1. "Product Overview"** - Provides all important information about the MCP6XXX Amplifier Evaluation Board 1.
- **Chapter 2. "Installation and Operation"** – Covers the installation and operation of the MCP6XXX Amplifier Evaluation Board 1. It lists the required tools, shows how to set up the board, and demonstrates how to verify the operation.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and board layouts for the MCP6XXX Amplifier Evaluation Board 1.
- **Appendix B. "Bill Of Materials (BOM)"** – Lists the parts used to build the MCP6XXX Amplifier Evaluation Board 1.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

## 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<sup>®</sup> IDE User's Guide</i>
	Emphasized text	...is the <i>only</i> compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	<u><i>File&gt;Save</i></u>
Bold characters	A dialog button	Click <b>OK</b>
	A tab	Click the <b>Power</b> tab
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	#define START
	Filenames	autoexec.bat
	File paths	c:\mcc18\h
	Keywords	_asm, _endasm, static
	Command-line options	-Opa+, -Opa-
	Bit values	0, 1
	Constants	0xFF, 'A'
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) { ... }

## RECOMMENDED READING

This user's guide describes how to use MCP6XXX Amplifier Evaluation Board 1. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

### **MCP6021 Data Sheet “Rail-to-Rail Input/Output, 10 MHz Op Amps“ (DS21685)**

This data sheet provides detailed information regarding the MCP6021 product family.

## THE MICROCHIP WEB SITE

Microchip provides online support via our web site at [www.microchip.com](http://www.microchip.com). This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **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 consultant 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

## CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support
- Development Systems Information Line

Customers should contact their distributor, representative or field application engineer 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://support.microchip.com>.

## DOCUMENT REVISION HISTORY

### **Revision A (July 2007)**

- Initial Release of this Document.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

---

---

NOTES:



## Chapter 1. Product Overview

### 1.1 INTRODUCTION

The MCP6XXX Amplifier Evaluation Board 1 is described by the following:

- Assembly # : 114-00147
- Order # : MCP6XXXEV-AMP1
- Name: MCP6XXX Amplifier Evaluation Board 1

Items discussed in this chapter include:

- **Section 1.2 “MCP6XXX Amplifier Evaluation Board 1 Kit Contents”**
- **Section 1.3 “Microchip’s Web-Based Mindi™ Analog Simulator”**
- **Section 1.4 “MCP6XXX Amplifier Evaluation Board 1 Description”**

### 1.2 MCP6XXX AMPLIFIER EVALUATION BOARD 1 KIT CONTENTS

- MCP6XXX Amplifier Evaluation Board 1 - One partially assembled board
- Important Information “Read First”
- Accessory Bag - Contains loose parts for populating sockets on board
- Analog and Interface Products Demonstration Boards CD-ROM (DS21912)
  - MCP6XXX Amplifier Evaluation Board 1 User’s Guide (DS51667)



**FIGURE 1-1:** MCP6XXX Amplifier Evaluation Board 1 Kit.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

## 1.3 MICROCHIP'S WEB-BASED MINDI™ ANALOG SIMULATOR

The Mindi™ Analog Simulator tool is an innovative software tool that simplifies analog circuit design. The Mindi™ Analog Simulator tool supports the following application circuits: 1) Active Filters, 2) Amplifiers, 3) Battery Chargers, and 4) DC-to-DC Converters. The Mindi™ Amplifier Designer provides full schematic diagrams of the amplifier application circuit with recommended component values and displays the responses in frequency and time domains.

The Mindi™ Analog Simulator tool is a free web-based design tool available on the Microchip web site at <http://www.microchip.com> under “**Online Simulation Tools**” or by going directly to the Mindi™ web site at <http://www.microchip.com/mindi>.

The circuit simulator within the Mindi™ Analog Simulator tool can be downloaded and installed on a personal computer (PC) for more convenient simulations. Modified circuit files can also be downloaded to the PC.

## 1.4 MCP6XXX AMPLIFIER EVALUATION BOARD 1 DESCRIPTION

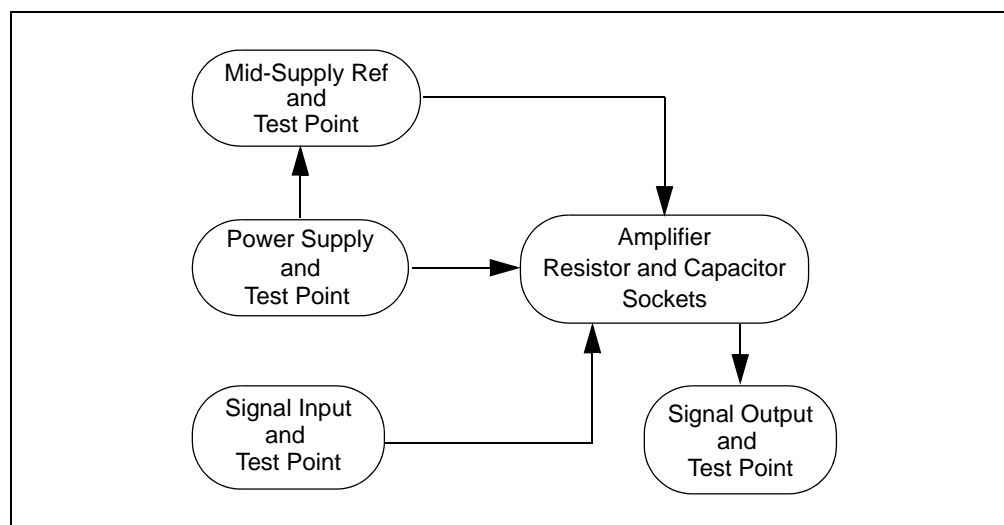
The MCP6XXX Amplifier Evaluation Board 1 is designed to support inverting/non-inverting amplifiers, voltage follower, inverting/non-inverting comparators, inverting/non-inverting differentiators.

However, at this time, the Mindi™ Amplifier Designer does not support the non-inverting comparator or the non-inverting differentiator.

MCP6XXX Amplifier Evaluation Board 1 has the following features:

- All amplifier resistors and capacitors are socketed
- All of the component labels on board keep consistent with those on schematic generated in the Mindi™ Amplifier Designer
- Supports all Microchip single op amps
  - PDIP-8 package (e.g., MCP6021) are socketed
  - SOIC-8 package can be accommodated; see **Section 2.4.3 “Amplifier Modification: Using 8-Pin SOIC Op Amps”**
- Test points for connecting lab equipment
- Single supply configuration

Figure 1-2 shows the block diagram of the MCP6XXX Amplifier Evaluation Board 1. Lab equipment can be attached (via test points) to measure the amplifier response.



**FIGURE 1-2:** MCP6XXX Amplifier Evaluation Board 1 Block Diagram.

## Chapter 2. Installation and Operation

### 2.1 INTRODUCTION

This chapter shows how to set up the MCP6XXX Amplifier Evaluation Board 1 and verify its operation. This chapter includes the following topics:

- Required Tools
- MCP6XXX Amplifier Evaluation Board 1 Set-Up
- MCP6XXX Amplifier Evaluation Board 1 Operation

### 2.2 REQUIRED TOOLS

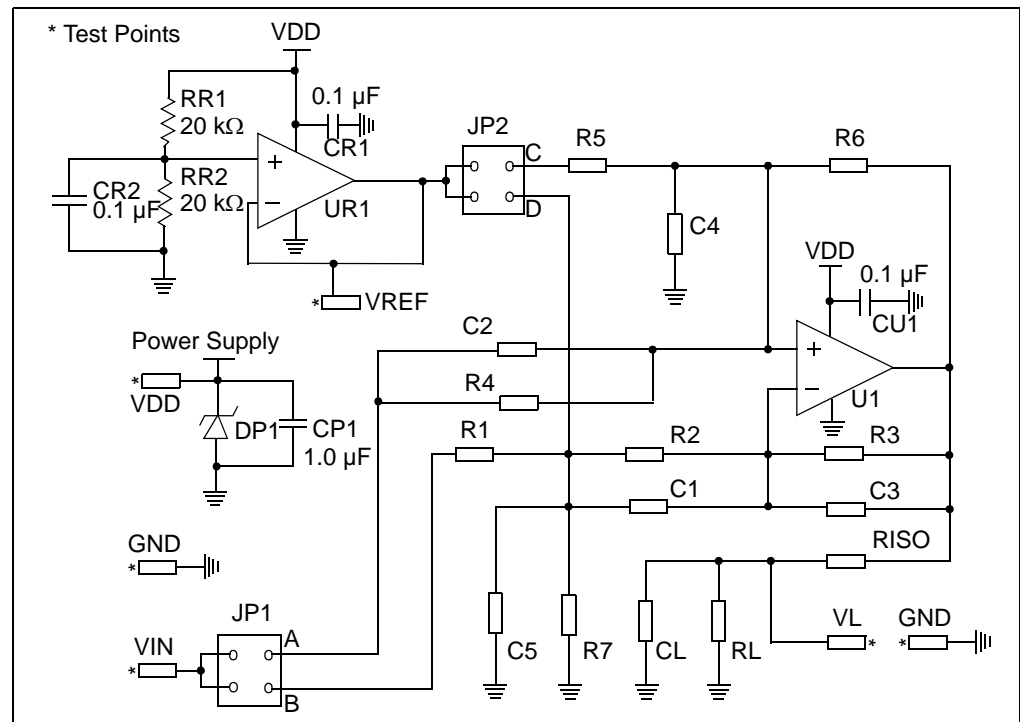
- Lab power supply
- Lab signal source (e.g., function generator)
- Lab measurement equipment (e.g., oscilloscope)

### 2.3 MCP6XXX AMPLIFIER EVALUATION BOARD 1 SET-UP

The MCP6XXX Amplifier Evaluation Board 1 is designed to support inverting/non-inverting amplifiers, voltage follower, inverting/non-inverting comparators, inverting/non-inverting differentiators

At this time, the Mindi™ Amplifier Designer does not support the non-inverting comparator or the non-inverting differentiator.

This section details the conversion of these topologies to the MCP6XXX Amplifier Evaluation Board 1. Figure 2-1 shows the circuit diagram for the board.



**FIGURE 2-1:** MCP6XXX Amplifier Evaluation Board 1 Circuit Diagram.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

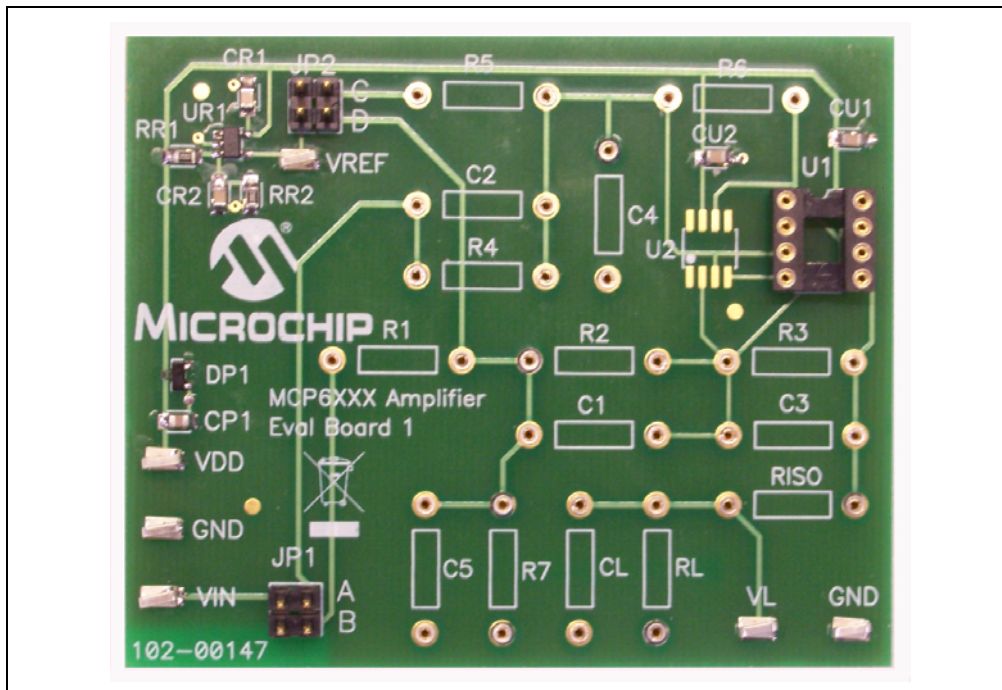
The power supply voltage should be in the allowed range for the installed op amps. Any of Microchip's op amps that operate below 5.5V can be used. Moreover, power supply is protected by a zener diode with nominal voltage 6.2V and bypassed by a 1.0  $\mu$ F capacitor. (See **Figure 2-3: "Power Supply Block."**)

The mid-supply reference consists of a voltage divider and a buffer amplifier. (See **Figure 2-4: "Mid-Supply Reference Block."**)

The resistors and capacitors that are part of an amplifier are placed in pin sockets which are labeled. All of the component labels on board keep consistent with those on schematic generated in the Mindi™ Amplifier Designer. The op amps are bypassed by 0.1  $\mu$ F capacitors and the single op amp U1 can have either a PDIP-8 or SOIC-8 package.

- PDIP-8 packages are inserted into the DIP-8 socket to the right of the U1 label
- SOIC-8 packages can be accommodated; see **Section 2.4.3 "Amplifier Modification: Using 8-Pin SOIC Op Amps"**

The (surface mount) test points for power supply, ground, input signal and output signal allow lab equipment to be connected to the board. The MCP6XXX Amplifier Evaluation Board 1 top view is shown in Figure 2-2.

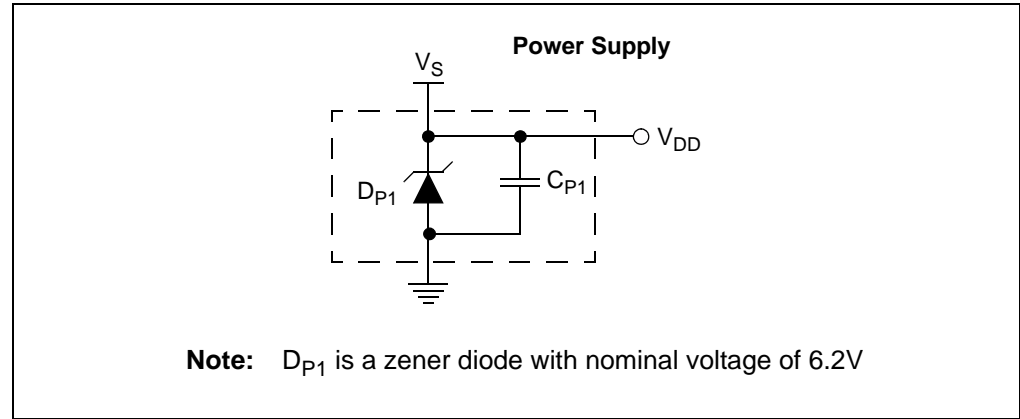


**FIGURE 2-2:** MCP6XXX Amplifier Evaluation Board 1 Top View.

## 2.3.1 Top Level Amplifier Circuit Diagrams

### 2.3.1.1 POWER SUPPLY BLOCK

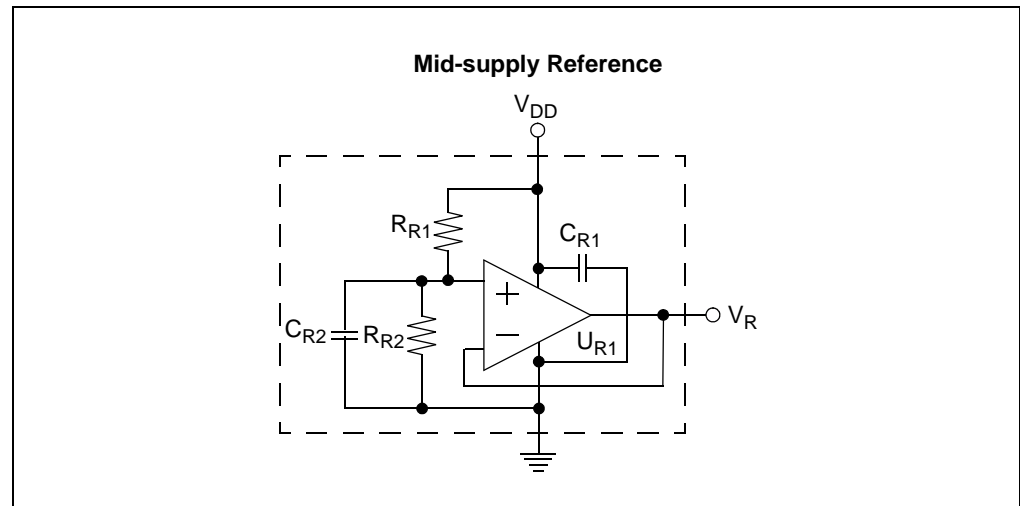
The power supply is protected by a zener diode and bypassed by a capacitor. Figure 2-3 shows the circuit diagram for the power supply.  $C_{P1} = 1.0 \mu\text{F}$ .



**FIGURE 2-3:** Power Supply Block.

### 2.3.1.2 MID-SUPPLY REFERENCE BLOCK

The mid-supply reference consists of a voltage divider and a buffer amplifier. Figure 2-4 shows the circuit diagram for the mid-supply reference.  $C_{R1} = C_{R2} = 0.1 \mu\text{F}$ ,  $R_{R1} = R_{R2} = 20.0 \text{ k}\Omega$ .

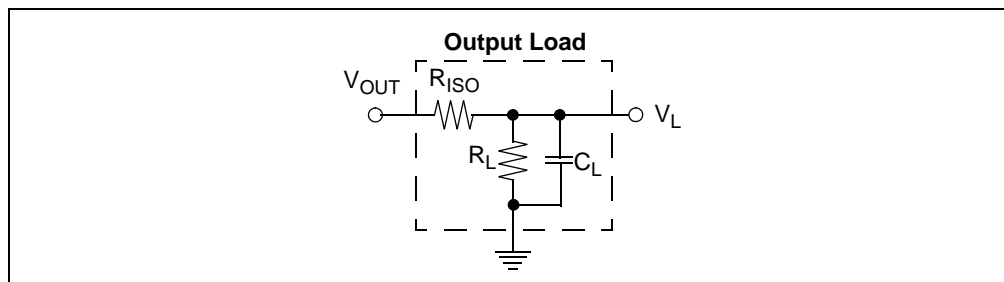


# MCP6XXX Amplifier Evaluation Board 1 User's Guide

---

## 2.3.1.3 OUTPUT LOAD BLOCK

The output load consists of a capacitor and two resistors. Figure 2-5 shows the circuit diagram for the output load.  $R_{ISO}$  is used to stabilize the amplifier when it drives a large capacitive load.  $R_{ISO}$  is a short circuit ( $0\Omega$ ) when  $C_L$  is small.

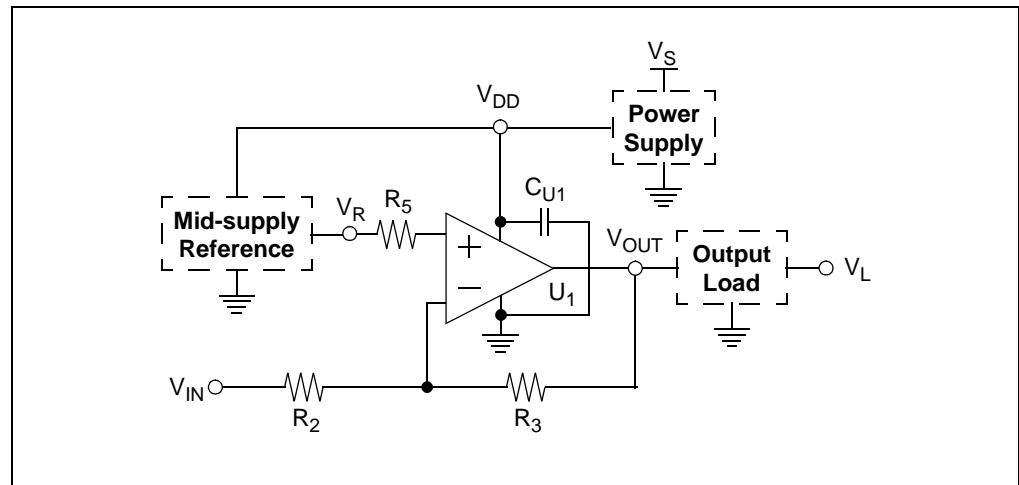


**FIGURE 2-5:** Output Load Block.

# Installation and Operation

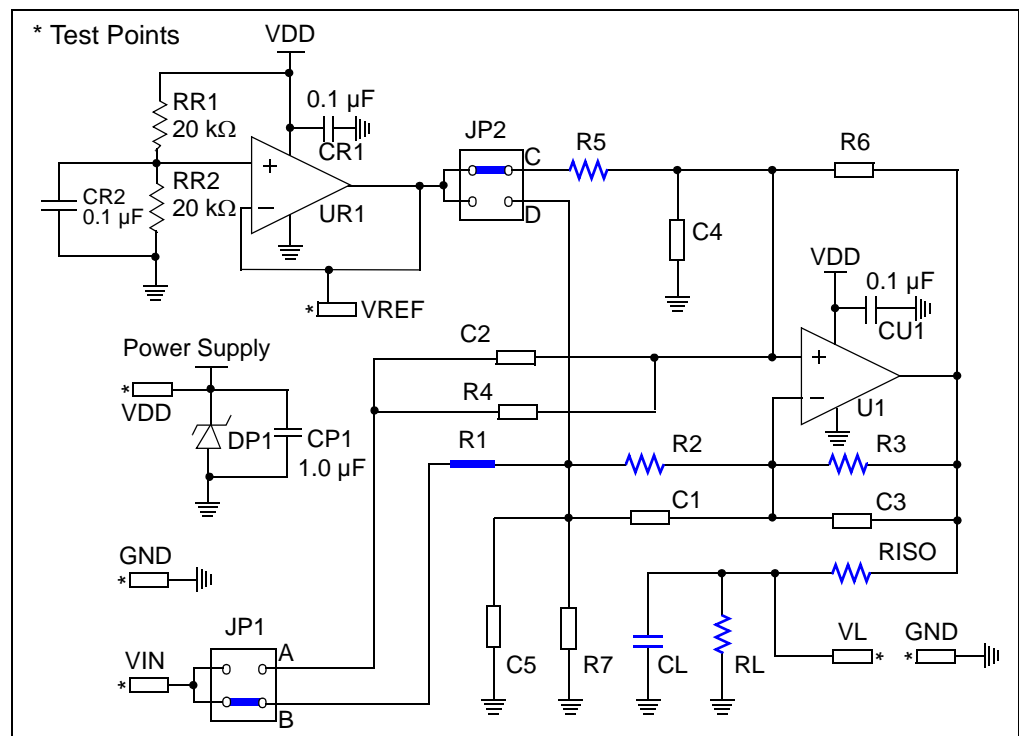
## 2.3.1.4 INVERTING AMPLIFIER

- Amplifies a voltage with an inverting gain. Input and output voltages are shifted by a reference voltage for single supply.
- The Mindi™ Amplifier Designer gives design recommendations for an inverting amplifier circuit; see the circuit diagram shown in Figure 2-6
  - Fill the sockets with the recommended resistors and capacitors
  - Set JP1 and JP2 in the correct positions  
(for the given example, JP1: Position B, JP2: Position C)



**FIGURE 2-6:** Inverting Amplifier Circuit Diagram.

Figure 2-7 shows an example of the inverting amplifier circuit diagram supported by MCP6XXX Amplifier Evaluation Board 1.

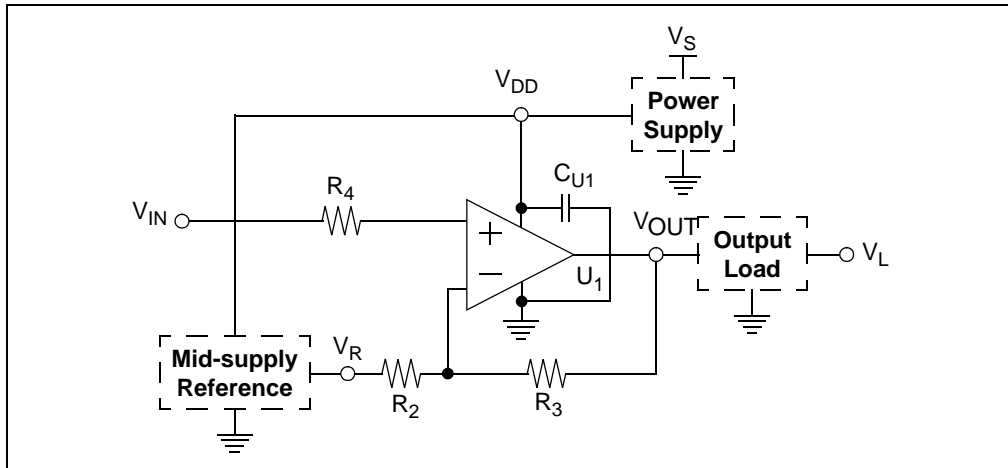


**FIGURE 2-7:** Inverting Amplifier Example Supported by the MCP6XXX Amplifier Evaluation Board 1.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

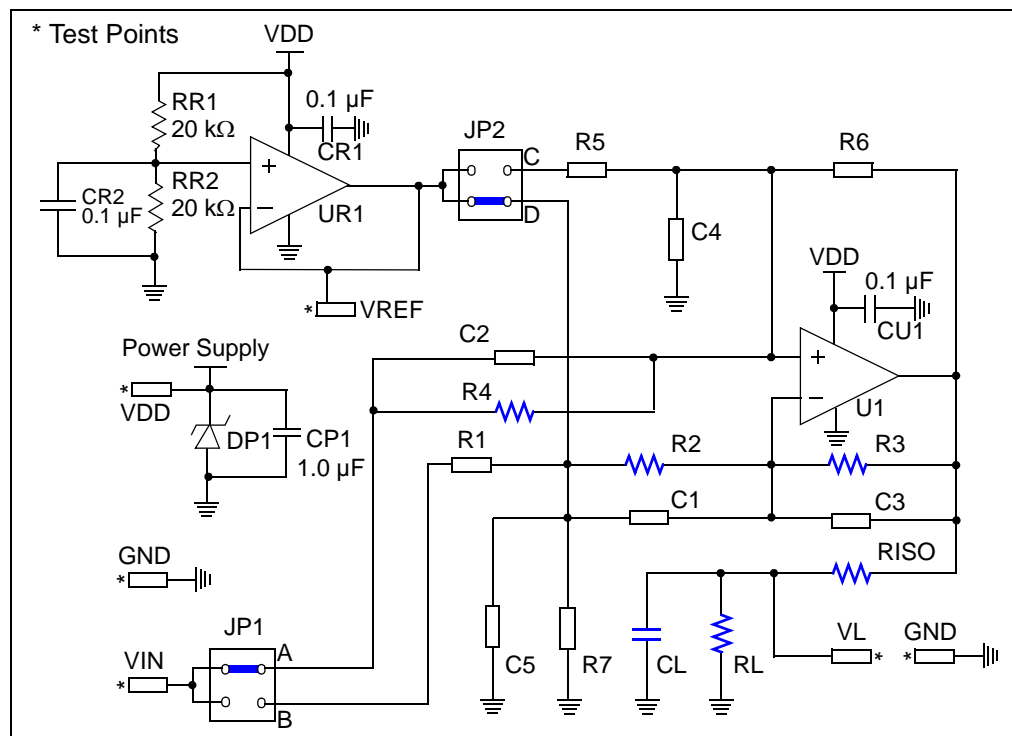
## 2.3.1.5 NON-INVERTING AMPLIFIER

- Amplifies a voltage with a non-inverting gain  $> +1$  V/V. Input and output voltages are shifted by a reference voltage for single supply
- The Mindi™ Amplifier Designer gives design recommendations for the non-inverting amplifier circuit; see the circuit diagram shown in Figure 2-8
  - Fill the sockets with the recommended resistors and capacitors
  - Set JP1 and JP2 in the correct positions (for the given example, JP1: Position A, JP2: Position D)



**FIGURE 2-8:** Non-Inverting Amplifier Circuit Diagram.

Figure 2-9 shows an example of the inverting amplifier circuit diagram supported by MCP6XXX Amplifier Evaluation Board 1.



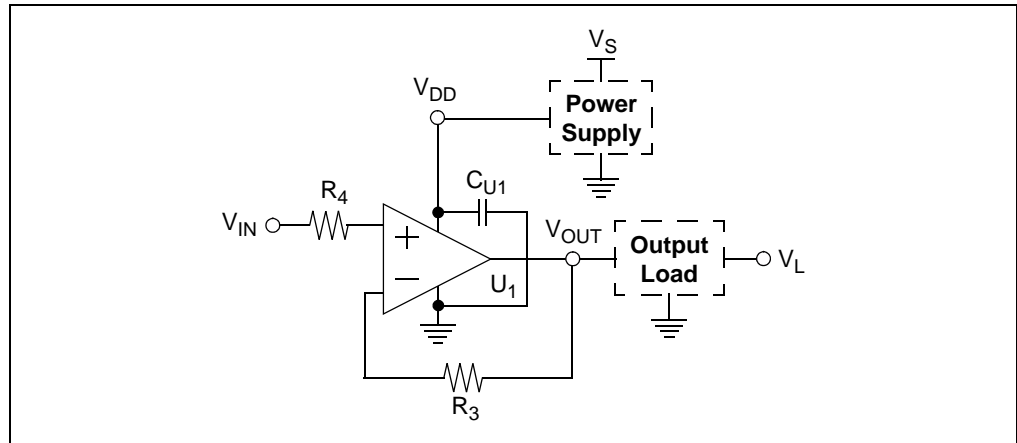
**FIGURE 2-9:** Non-Inverting Amplifier Example Supported by the MCP6XXX Amplifier Evaluation Board 1.



# Installation and Operation

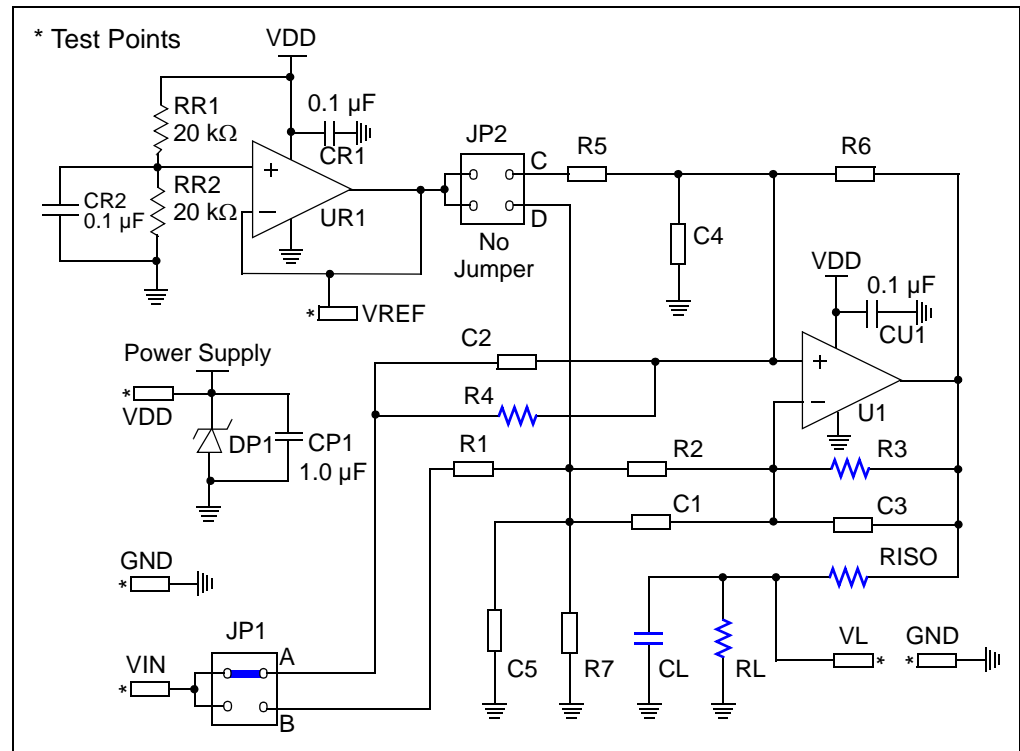
## 2.3.1.6 VOLTAGE FOLLOWER

- Known as a Unity Gain Buffer and as a Voltage Follower. Amplifies a voltage with a gain of 1 V/V
- The Mindi™ Amplifier Designer gives design recommendations for the voltage follower circuit; see the circuit diagram shown in Figure 2-10
  - Fill the sockets with the recommended resistors and capacitors
  - Set JP1 and JP2 in the correct positions  
(for the given example, JP1: Position A, JP2: Position N/A)



**FIGURE 2-10:** Voltage Follower Circuit Diagram.

Figure 2-11 shows an example of the voltage amplifier circuit diagram supported by MCP6XXX Amplifier Evaluation Board 1.



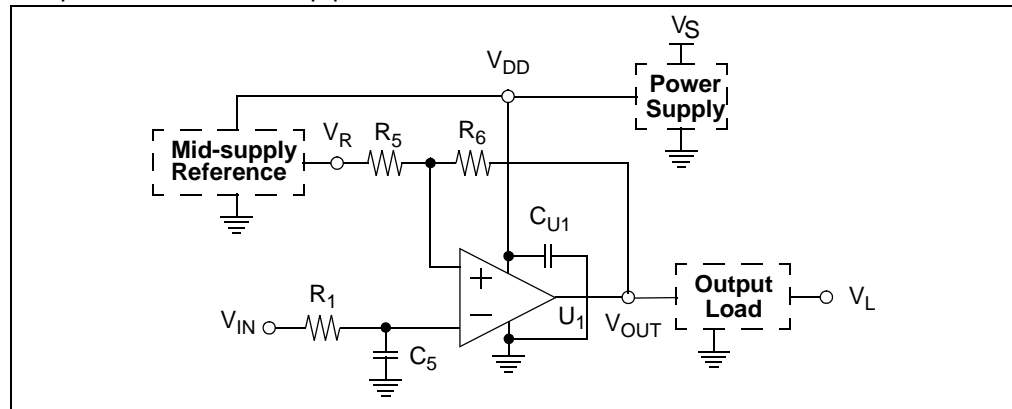
**FIGURE 2-11:** Voltage Amplifier Example Supported by the MCP6XXX Amplifier Evaluation Board 1.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

## 2.3.1.7 INVERTING COMPARATOR

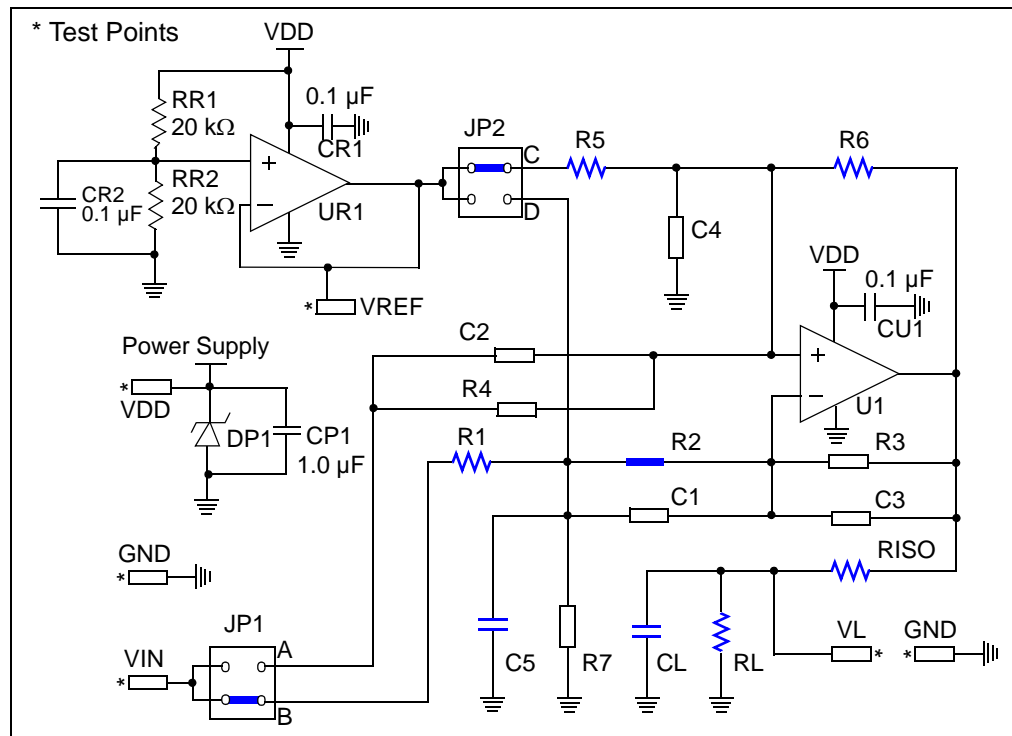
- Compares the input voltage to another (reference) voltage and forces the output to one of two digital states. Input signal is applied to the inverting input. The comparison includes a user selected amount of hysteresis. Input and output voltages are shifted by a reference for single supply
- The Mindi™ Amplifier Designer gives design recommendations for the inverting comparator circuit; see the circuit diagram shown in Figure 2-12
  - Fill the sockets with the recommended resistors and capacitors
  - Set JP1 and JP2 in the correct positions (for the given example, JP1: Position B, JP2: Position C)

**Note:** The MCP6XXX Amplifier Evaluation Board 1 currently only supports the inverting comparator with center trip point = 2.5V.



**FIGURE 2-12:** Inverting Comparator Circuit Diagram.

Figure 2-13 shows an example of the inverting comparator circuit diagram supported by MCP6XXX Amplifier Evaluation Board 1.



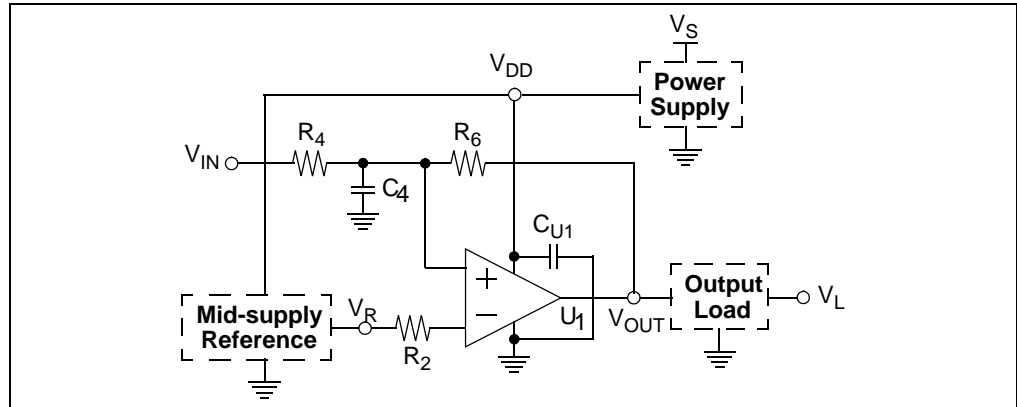
**FIGURE 2-13:** Inverting Comparator Example Supported by the MCP6XXX Amplifier Evaluation Board 1.

# Installation and Operation

## 2.3.1.8 NON-INVERTING COMPARATOR (NOT CURRENTLY SUPPORTED)

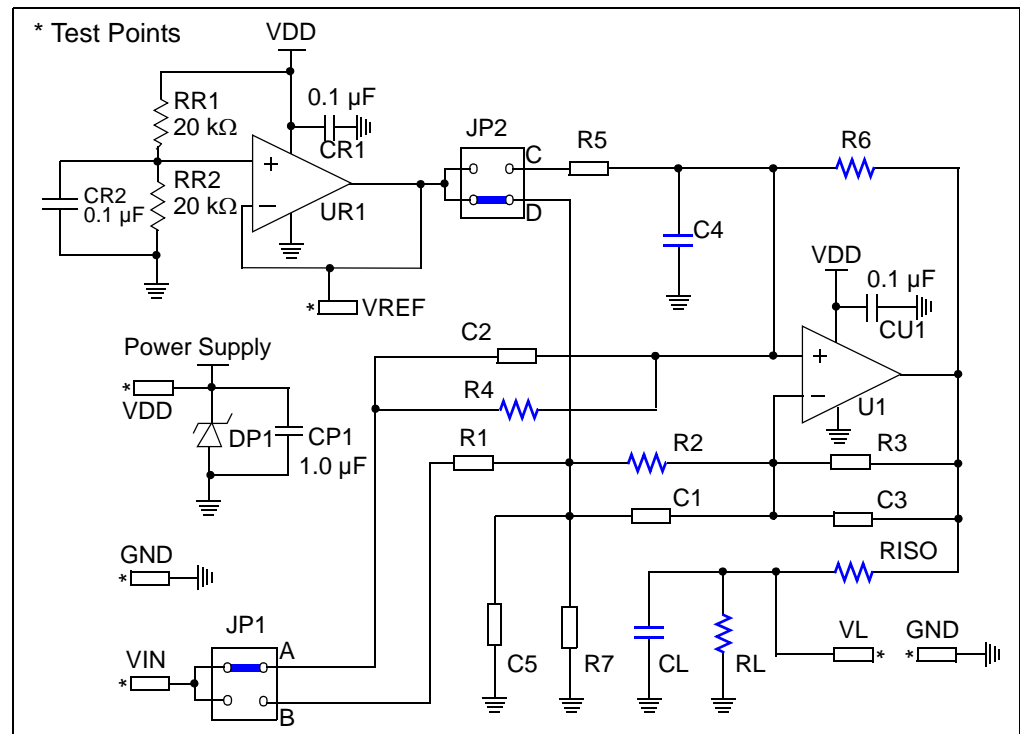
- Compares the input voltage to another (reference) voltage and forces the output to one of two digital states. Input signal is applied to the non-inverting input. The comparison includes a user selected amount of hysteresis. Input and output voltages are shifted by a reference for single supply
- The Mindi™ Amplifier Designer gives design recommendations for the non-inverting comparator circuit; see the circuit diagram shown in Figure 2-14
  - Fill the sockets with the recommended resistors and capacitors
  - Set JP1 and JP2 in the correct positions  
(for the given example, JP1: Position A, JP2: Position D)

**Note:** The MCP6XXX Amplifier Evaluation Board 1 currently only supports the non-inverting comparator with center trip point = 2.5V.



**FIGURE 2-14:** Non-Inverting Comparator Circuit Diagram.

Figure 2-15 shows an example of the non-inverting comparator circuit diagram supported by the MCP6XXX Amplifier Evaluation Board 1.

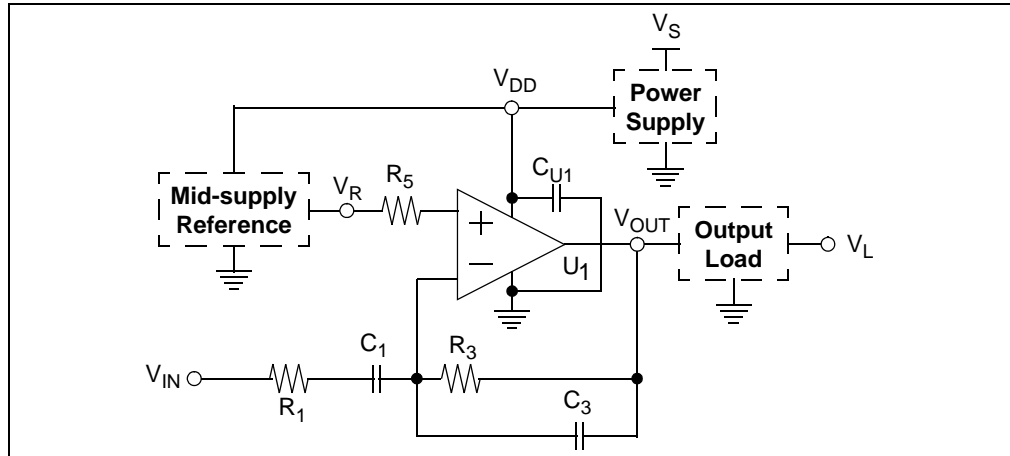


**FIGURE 2-15:** Non-Inverting Comparator Example Supported by the MCP6XXX Amplifier Evaluation Board 1.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

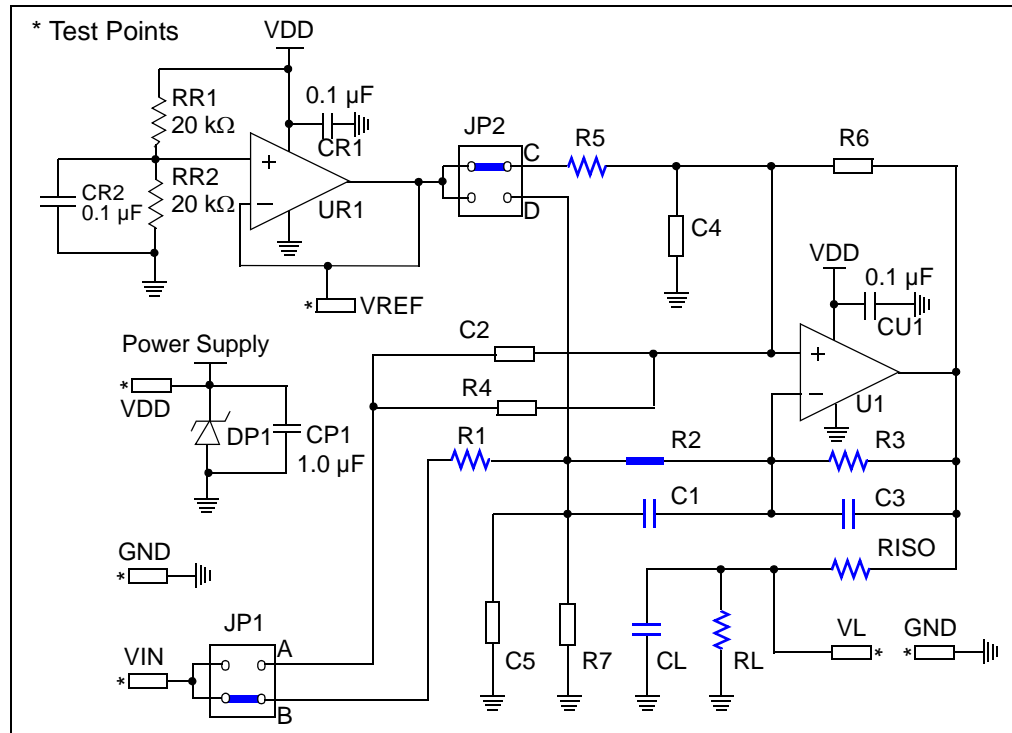
## 2.3.1.9 INVERTING DIFFERENTIATOR (NOT CURRENTLY SUPPORTED)

- Differentiates and inverts a voltage with a differentiating frequency. Additional components ( $R_1$ ,  $C_3$ ) achieve stabilization and noise. Input and output voltages are shifted by a reference for single supply
- The Mindi™ Amplifier Designer gives design recommendations for the inverting differentiator circuit; see the circuit diagram shown in Figure 2-16
  - Fill the sockets with the recommended resistors and capacitors
  - Set JP1 and JP2 in the correct positions  
(for the given example, JP1: Position B, JP2: Position C)



**FIGURE 2-16:** Inverting Differentiator Circuit Diagram.

Figure 2-17 shows an example of the inverting differentiator circuit diagram supported by MCP6XXX Amplifier Evaluation Board 1.



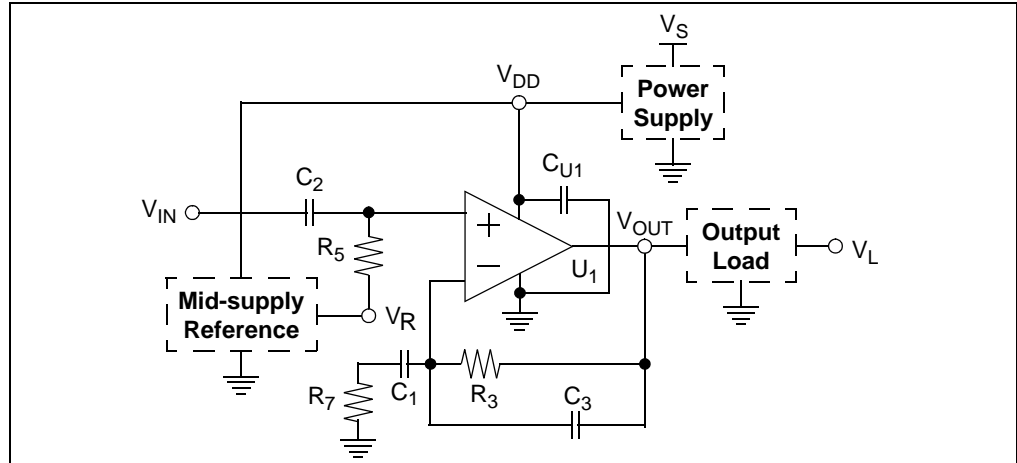
**FIGURE 2-17:** Inverting Differentiator Example Supported by the MCP6XXX Amplifier Evaluation Board 1.

# Installation and Operation

## 2.3.1.10 NON-INVERTING DIFFERENTIATOR (NOT CURRENTLY SUPPORTED)

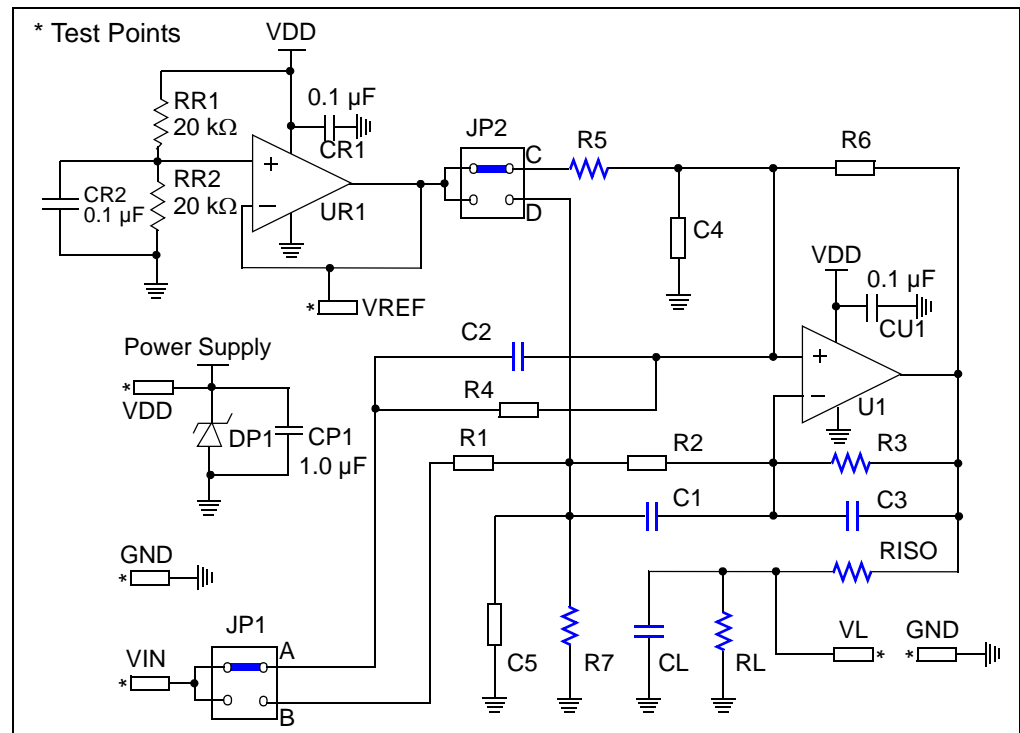
- Differentiates and inverts a voltage with a differentiating frequency. Additional components ( $R_7$ ,  $C_3$ ) achieve stabilization and noise. Input and output voltages are shifted by a reference for single supply
- The Mindi™ Amplifier Designer gives design recommendations for the non-inverting differentiator circuit; see the circuit diagram shown in Figure 2-18
  - Fill the sockets with the recommended resistors and capacitors
  - Set JP1 and JP2 in the correct positions  
(for the given example, JP1: Position A, JP2: Position C)

**Note:** The MCP6XXX Amplifier Evaluation Board 1 currently only supports the non-inverting differentiator with center trip point = 2.5V.



**FIGURE 2-18:** Non-Inverting Differentiator Circuit Diagram.

Figure 2-19 shows an example of the non-inverting differentiator circuit diagram supported by MCP6XXX Amplifier Evaluation Board 1.



**FIGURE 2-19:** Non-Inverting Differentiator Example Supported by the MCP6XXX Amplifier Evaluation Board 1.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

## 2.4 MCP6XXX AMPLIFIER EVALUATION BOARD 1 OPERATION

Items discussed in this section include:

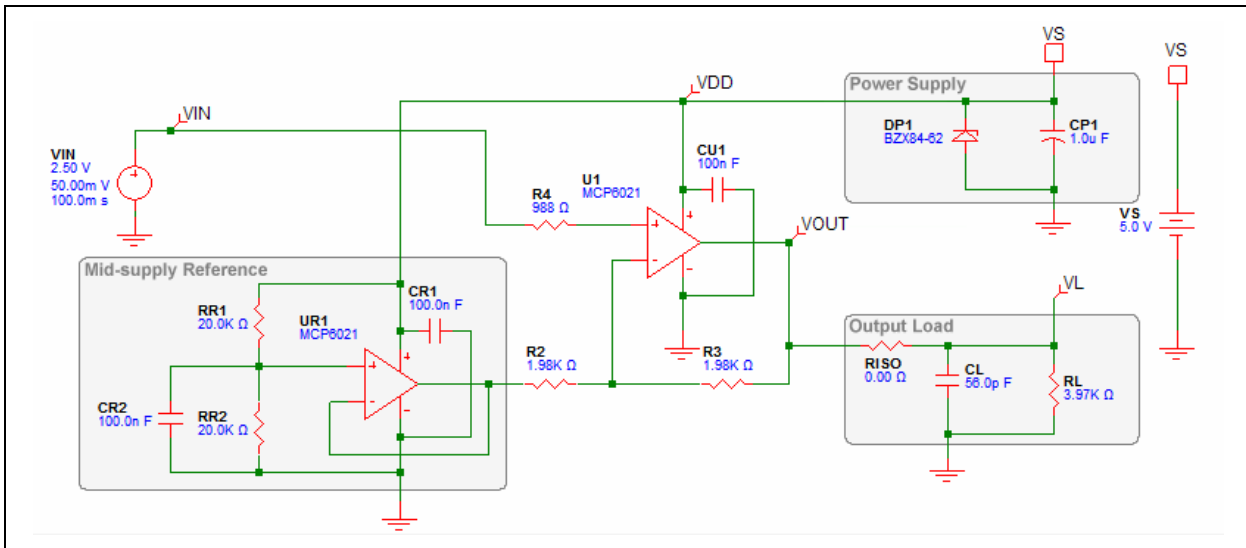
- Building the Amplifier
- Testing the Amplifier
- Amplifier Modification: Using 8-Pin SOIC Op Amps

### 2.4.1 Building the Amplifier

The accessory bag that comes with this kit makes it quick and easy to evaluate the amplifier described below; it was designed in Mindi™ Amplifier Designer.

This amplifier is described as follows:

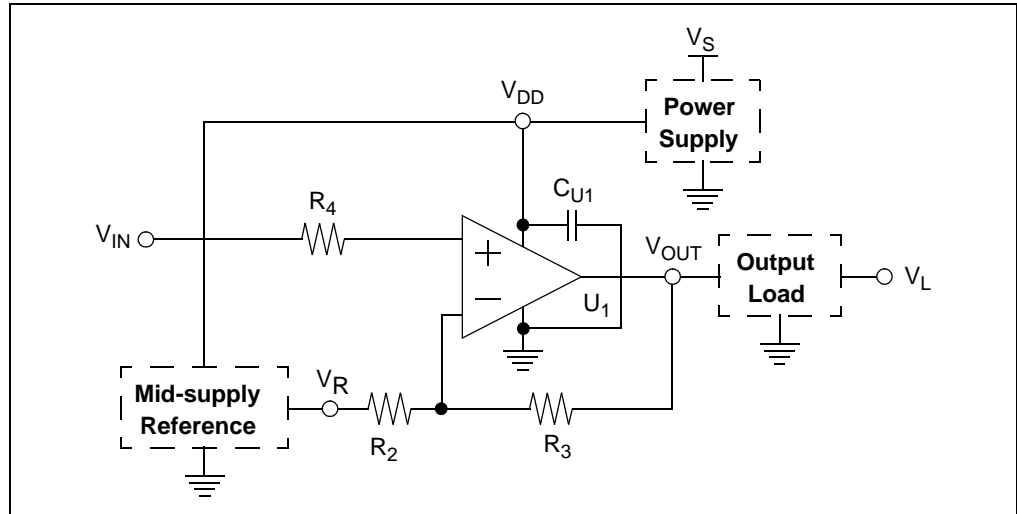
- Non-Inverting Amplifier (Single Supply Configuration)
- Power Supply Voltage is 5.0V
- Desired Closed Loop Gain is 2 V/V
- Load Capacitance is 56 pF



**FIGURE 2-20:** Non-Inverting Amplifier Designed In Mindi™ Amplifier Designer.

# Installation and Operation

Figure 2-21 shows the same circuit redrawn to emphasize the non-inverting amplifier.



**FIGURE 2-21:** Non-Inverting Amplifier Circuit Diagram Supported by the MCP6XXX Amplifier Evaluation Board 1 Kit.

Each of the components in Figure 2-21 that needs to be inserted in a socket on the MCP6XXX Amplifier Evaluation Board 1 is listed in Table 2-1 and Table 2-2.

**TABLE 2-1: AMPLIFIER COMPONENTS LIST**

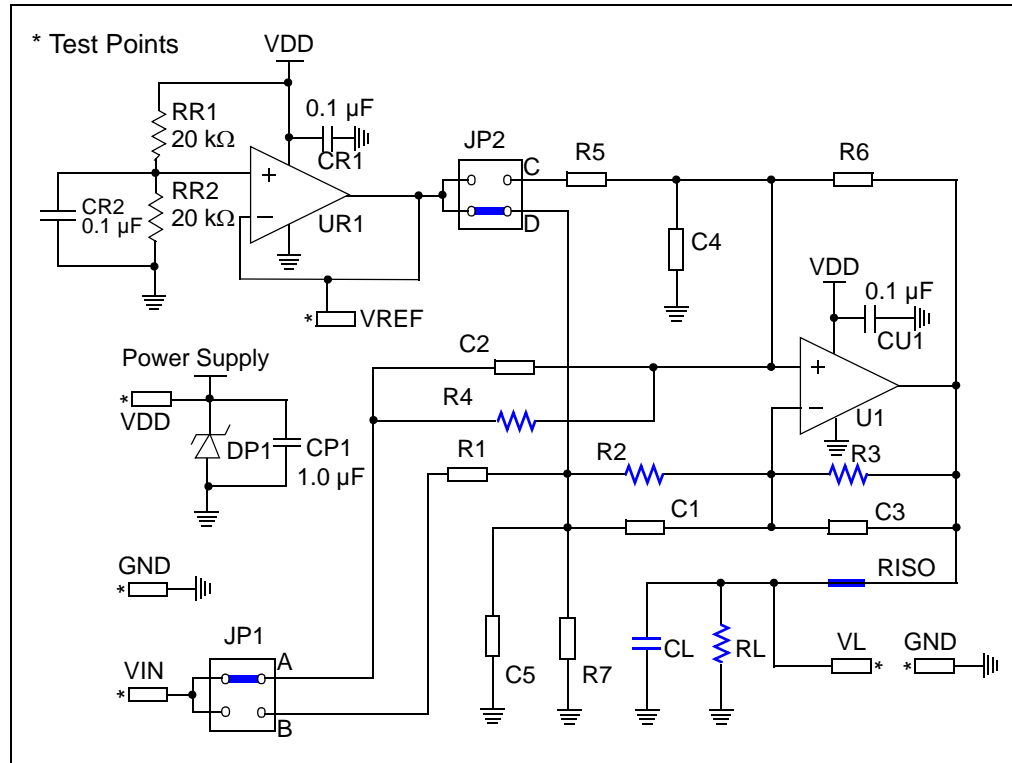
PCB Labels	Component Values
R2	1.98 k $\Omega$
R3	1.98 k $\Omega$
R4	988 $\Omega$
RISO	0 $\Omega$
RL	3.97 k $\Omega$
CL	56 pF
U1	MCP6021, PDIP-8, 10 MHz

**TABLE 2-2: JUMPER POSITIONS**

Jumper	Position
JP1	A
JP2	D

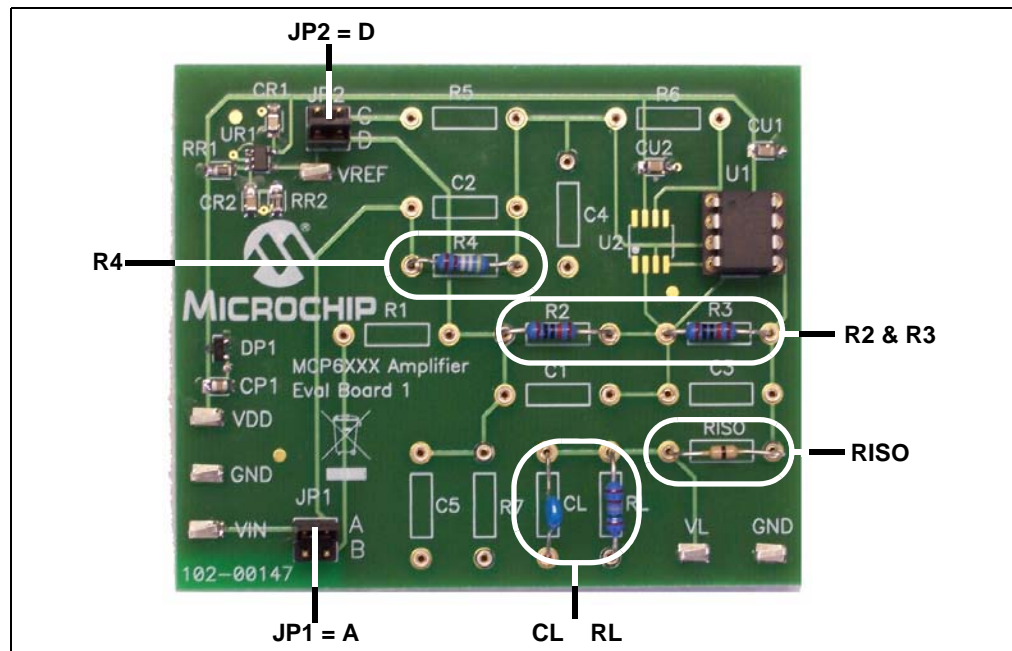
# MCP6XXX Amplifier Evaluation Board 1 User's Guide

Figure 2-22 shows the fully assembled MCP6XXX Amplifier Evaluation Board 1 for the non-inverting amplifier.



**FIGURE 2-22:** Fully Assembled Non-Inverting Amplifier Supported by the MCP6XXX Amplifier Evaluation Board 1.

The fully assembled MCP6XXX Amplifier Evaluation Board 1 top view is shown in Figure 2-23.



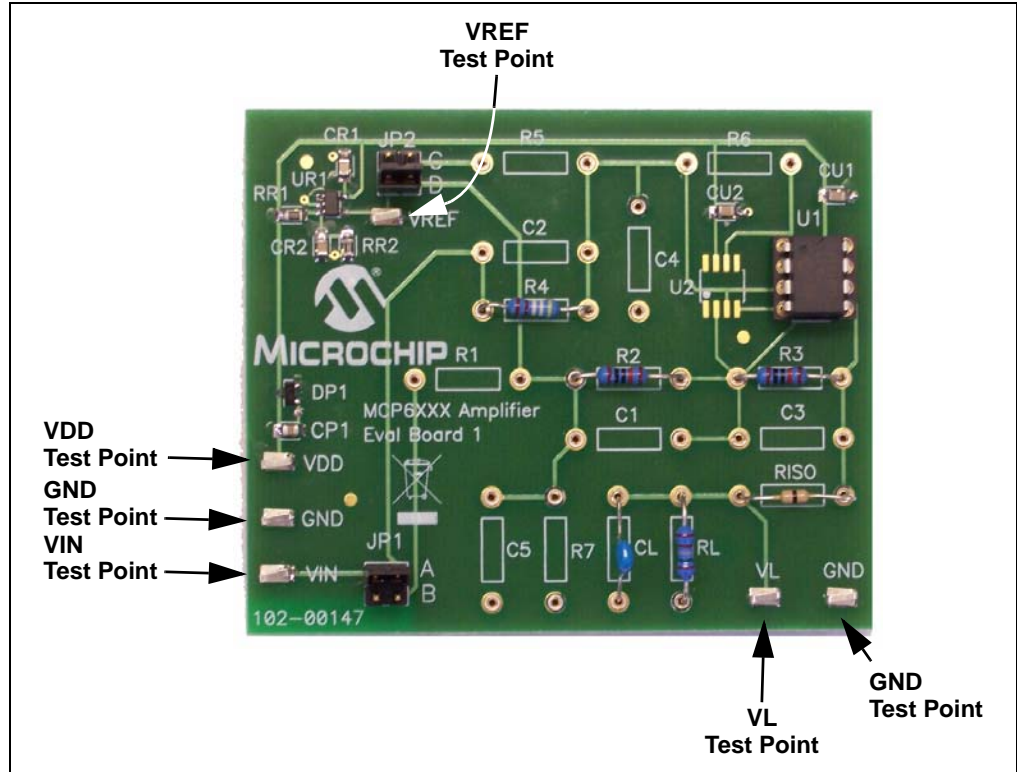
**FIGURE 2-23:** Picture of the Non-Inverting Amplifier Supported by the MCP6XXX Amplifier Evaluation Board 1.



## 2.4.2 Testing the Amplifier

### 2.4.2.1 CHECKING THE TEST POINTS

The (surface mount) test points for power supply, ground, input signal and output signal allow lab equipment to be connected to the board. Figure 2-24 shows the test points to check.



**FIGURE 2-24:** Checking the Test Points.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

## 2.4.2.2 TRANSIENT RESPONSES

This non-inverting amplifier was built, and its responses were measured. A MCP6021 op amp, 1% resistors, and 5% capacitors were used. Notice how close the measured and simulated data are.

### 2.4.2.2.1 Step Response

In Bench Measurement:

- Set  $V_{IN}$  with a step amplitude of 2.0V and a center voltage of 2.5V. (i.e.  $V_{IN}$  starts 1.0V below center and ends 1.0V above center).
- The measured step response is shown in Figure 2-25. It is a signal with a step amplitude of 4.0V and an center voltage of 2.5V. (i.e.  $V_{OUT}$  starts 2.0V below center and ends 2.0V above center).

**Note:** The center voltage of  $V_{IN}$  is set at  $V_{REF} = V_{DD}/2$  (For  $V_{DD} = 5.0V$ ,  $V_{REF} = 2.5V$ )



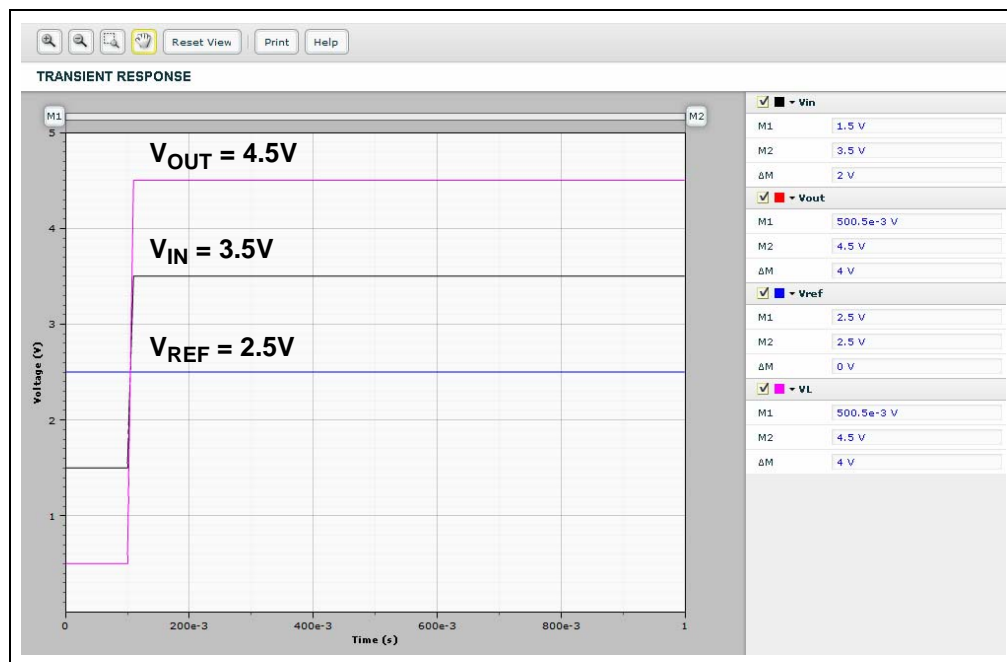
**FIGURE 2-25:** Measured Step Response.

# Installation and Operation

In Mindi™ Amplifier Designer:

- Set  $V_{IN}$  with a step amplitude of 2.0V and a center voltage of 2.5V.  
(i.e. starts 1V below center and ends 1V above center)
- The simulated step response is shown in Figure 2-26. It is a signal with a step amplitude of 4.0V and an center voltage of 2.5V

**Note:** The center voltage of  $V_{IN}$  is set at  $V_{REF} = V_{DD}/2$  (For  $V_{DD} = 5.0V$ ,  $V_{REF} = 2.5V$ )



**FIGURE 2-26:** Simulated Step Response.

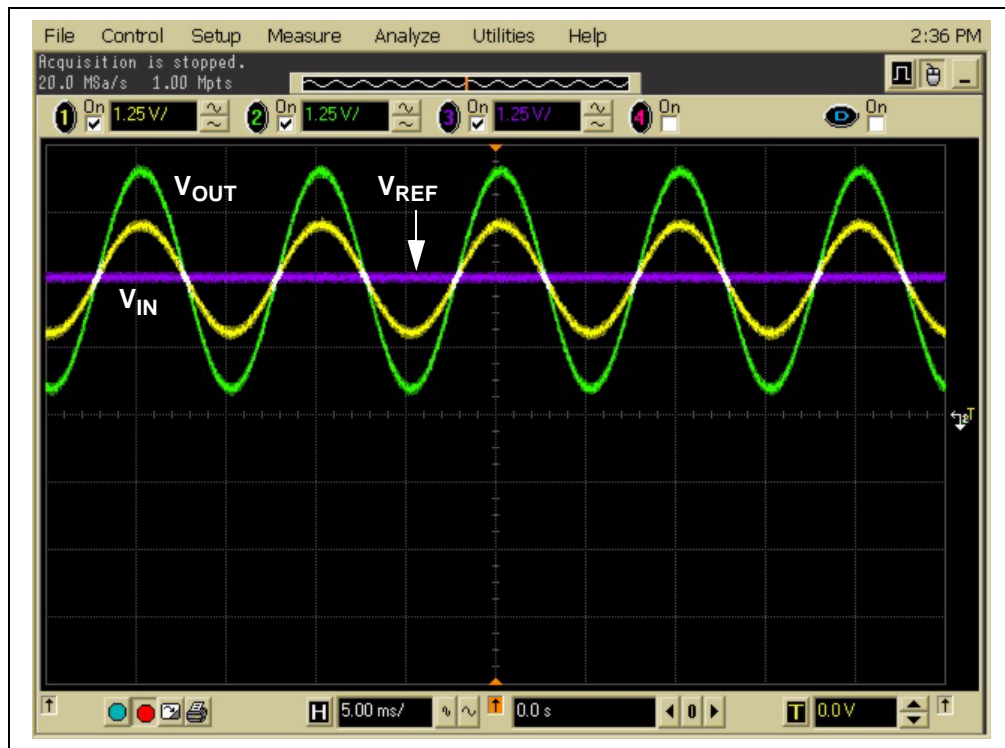
# MCP6XXX Amplifier Evaluation Board 1 User's Guide

## 2.4.2.2.2 Sine Wave Response

In Bench Measurement:

- Set  $V_{IN}$  as a sine wave with a frequency of 100.0 Hz, a peak-to-peak voltage of 2.0V and a center voltage of 2.5V
- The measured sine wave response is shown in Figure 2-27. It is a sine wave signal with a frequency of 100.0 Hz, a peak-to-peak voltage of 4.0V and a center voltage of 2.5V

**Note:** The center voltage of  $V_{IN}$  is set at  $V_{REF} = V_{DD}/2$  (For  $V_{DD} = 5.0V$ ,  $V_{REF} = 2.5V$ )



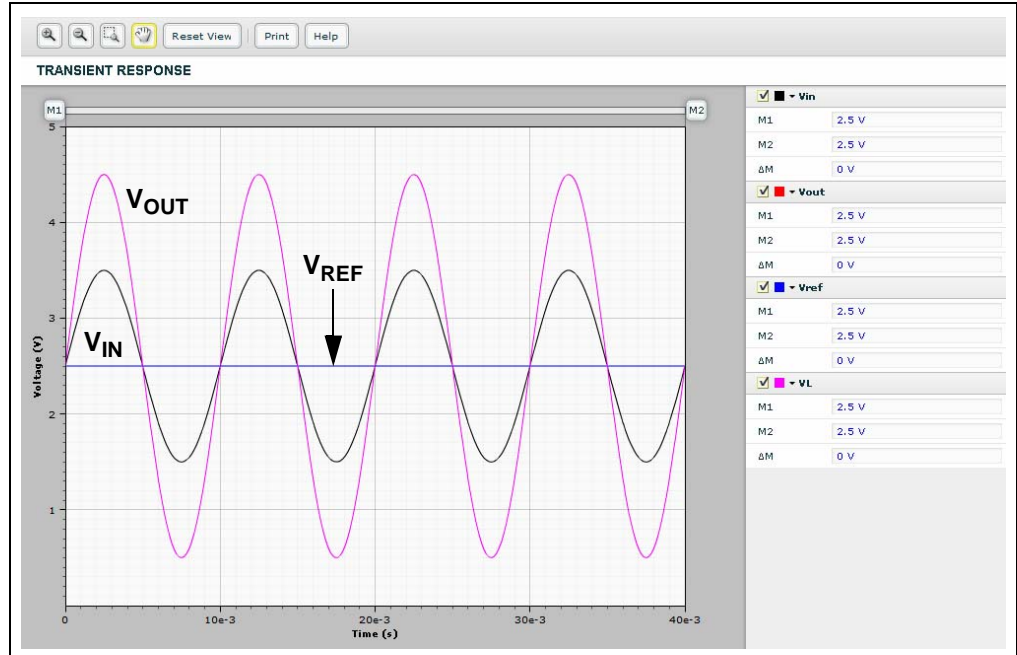
**FIGURE 2-27:** Measured Sine Wave Response.

# Installation and Operation

In Mindi™ Amplifier Designer:

- Set  $V_{IN}$  as a sine wave with a frequency of 100.0 Hz, a peak-to-peak voltage of 2.0V and a center voltage of 2.5V
- The simulated sine wave response is shown in Figure 2-28. It is a sine wave signal with a frequency of 100.0 Hz, a peak-to-peak voltage of 4.0V and a center voltage of 2.5V

**Note:** The center voltage of  $V_{IN}$  is set at  $V_{REF} = V_{DD}/2$  (For  $V_{DD} = 5.0V$ ,  $V_{REF} = 2.5V$ )



**FIGURE 2-28:** Simulated Sine Wave Response.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

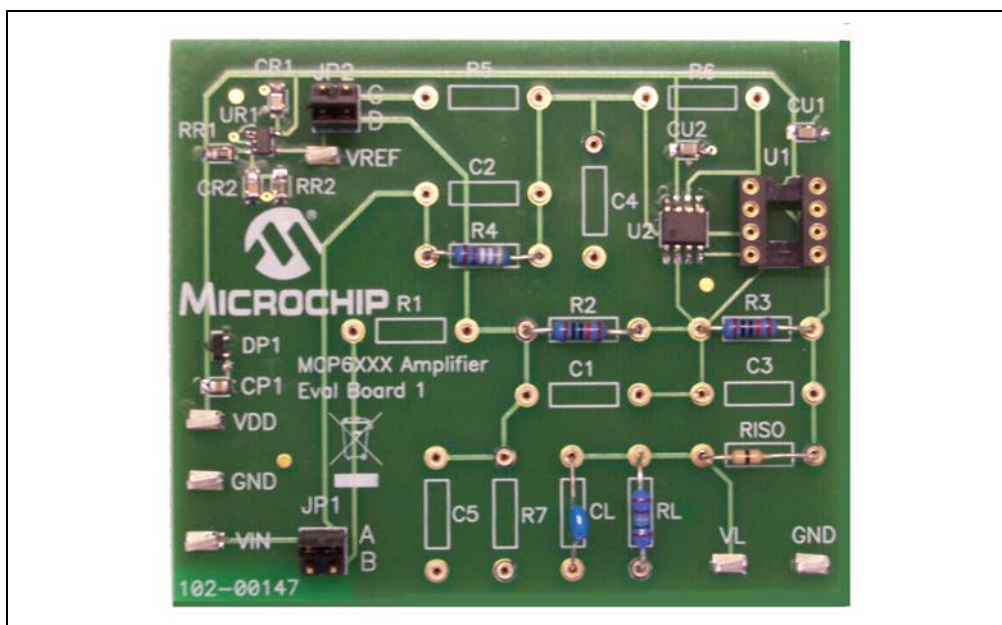
## 2.4.3 Amplifier Modification: Using 8-Pin SOIC Op Amps

There are two options available when using single op amps in SOIC-8 packages (150 mil wide):

- Soldering onto the MCP6XXX Amplifier Evaluation Board 1, or
- Soldering it onto a separate board which is connected to the DIP-8 socket

**Note:** The DIP-8 socket must be empty; only one op amp can be used at a time.

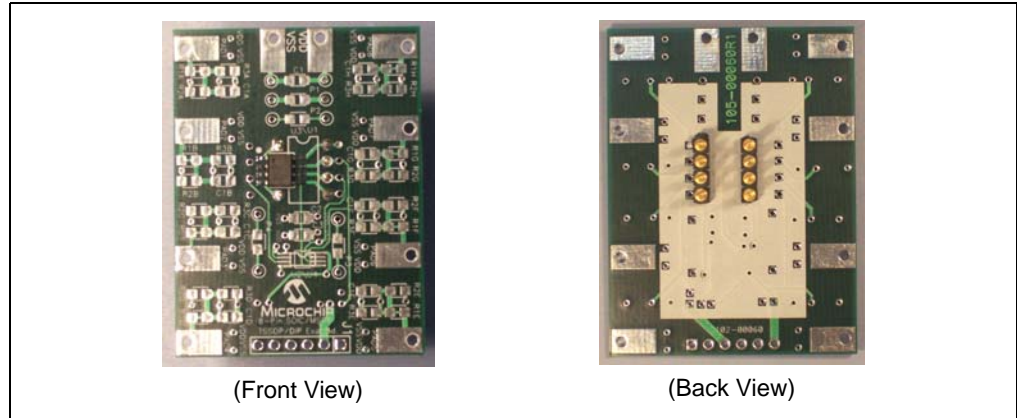
Figure 2-29 shows a SOIC-8 op amp soldered onto the MCP6XXX Amplifier Evaluation Board 1.



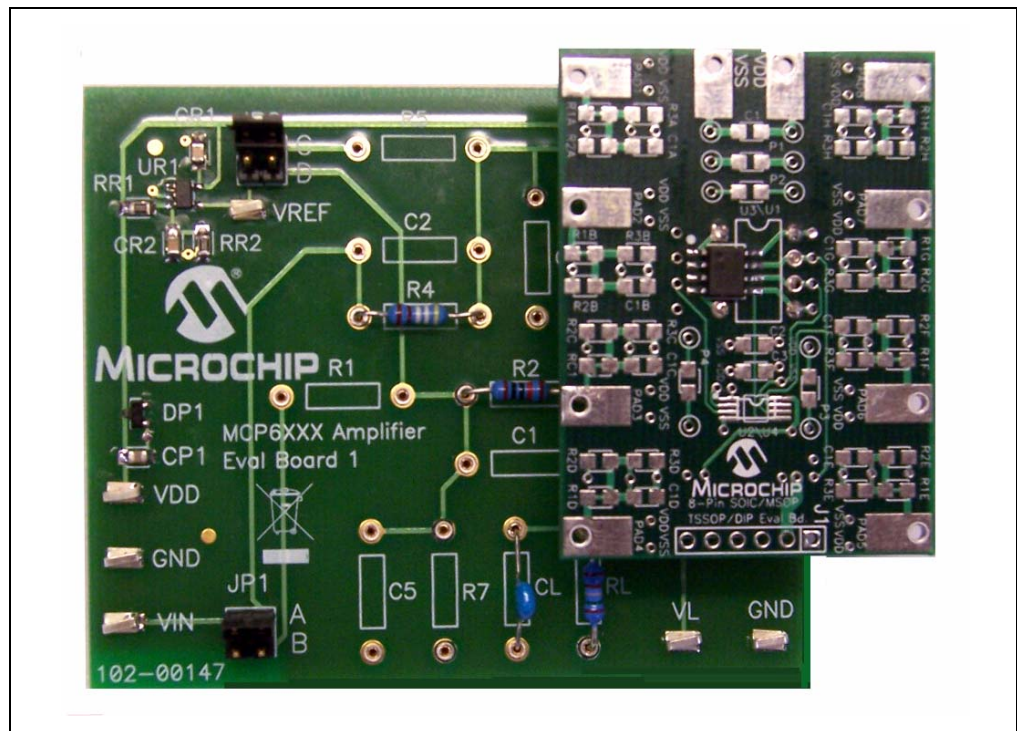
**FIGURE 2-29:** Op Amp in SOIC-8 package soldered onto the MCP6XXX Amplifier Evaluation Board 1.

Figure 2-30 shows a SOIC-8 op amp and a DIP-8 socket, soldered onto the 8-Pin SOIC/MSOP/TSSOP/DIP Evaluation Board available from Microchip Technology Inc (order # SOIC8EV). The two interconnect strips on the bottom are Samtec part # BBS-14-T-B or equivalent and are soldered into the through holes for the DIP-8 socket. Figure 2-31 shows the SOIC8EV board plugged into the MCP6XXX Amplifier Evaluation Board 1.

**Note:** Insert the interconnect strips into the DIP-8 socket on the MCP6XXX Amplifier Evaluation Board 1. Place the SOIC8EV board on the top of the interconnect strips with the same pin orientation. Now solder the strips to the top board; this procedure ensures correct alignment of the strips. Clip the pins flush with the top surface of the SOIC8EV board, then solder the SOIC-8 op amp on the top.



**FIGURE 2-30:** Op Amp in SOIC-8 Package Soldered onto a Separate Board.



**FIGURE 2-31:** Connecting Adaptor Board onto the MCP6XXX Amplifier Evaluation Board 1.

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

---

NOTES:





# MCP6XXX AMPLIFIER EVALUATION BOARD 1 USER'S GUIDE

---

---

## Appendix A. Schematic and Layouts

---

---

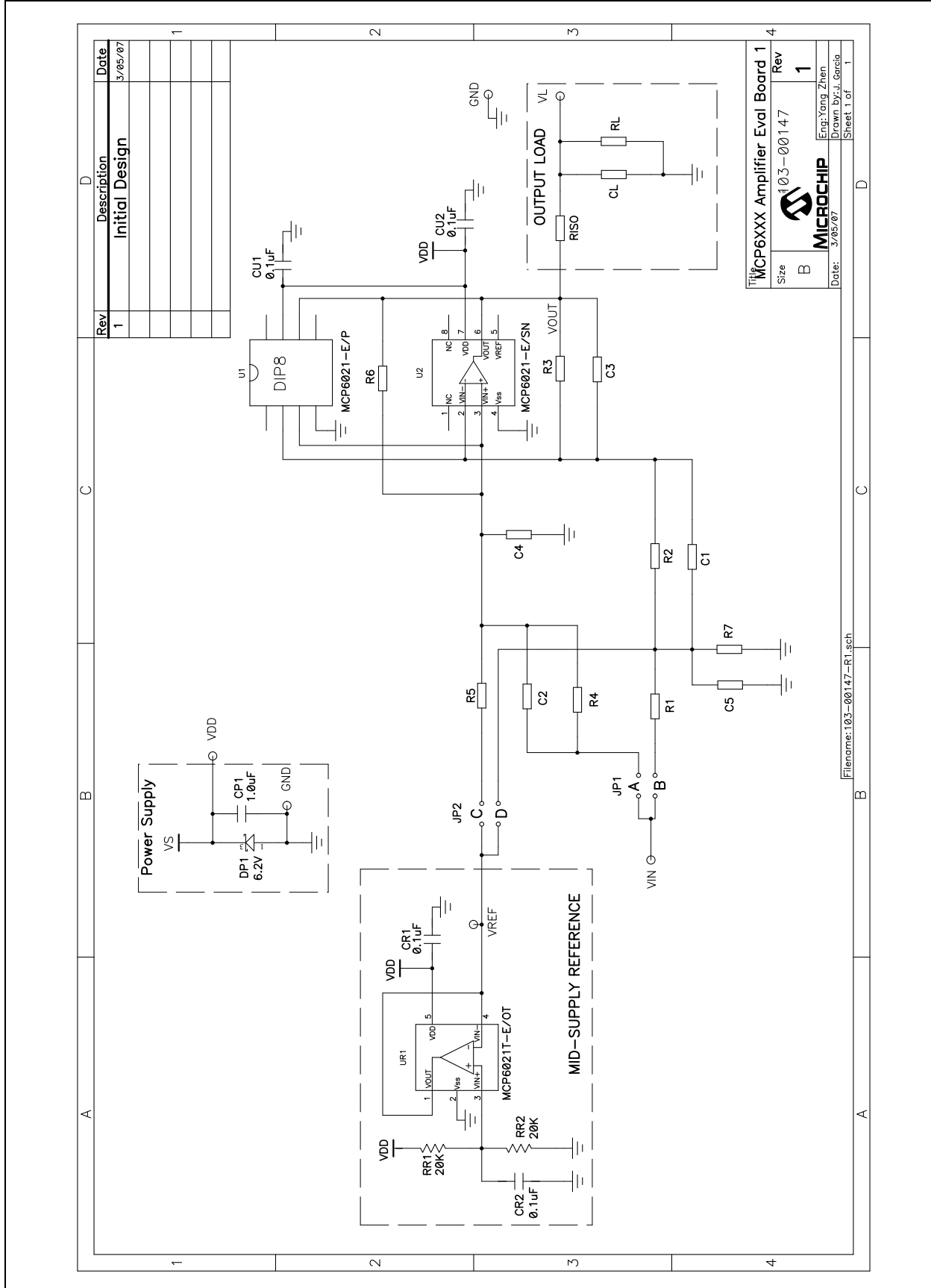
### A.1 INTRODUCTION

This appendix contains the following schematics and layouts for the MCP6XXX Amplifier Evaluation Board 1:

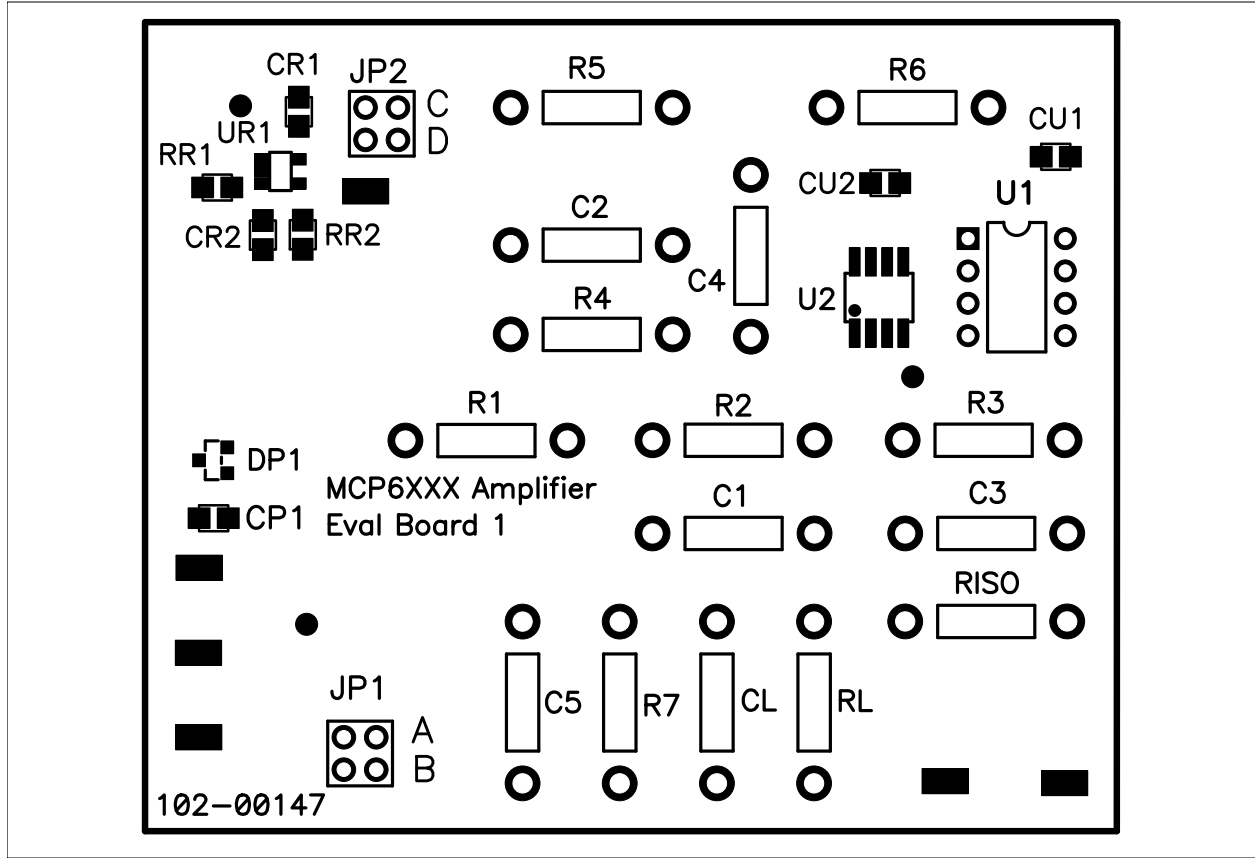
- Board – Schematic
- Board – Top Silk Layer
- Board – Top Metal Layer
- Board – Bottom Metal Layer

# MCP6XXX Amplifier Evaluation Board 1 User's Guide

## A.2 BOARD - SCHEMATIC

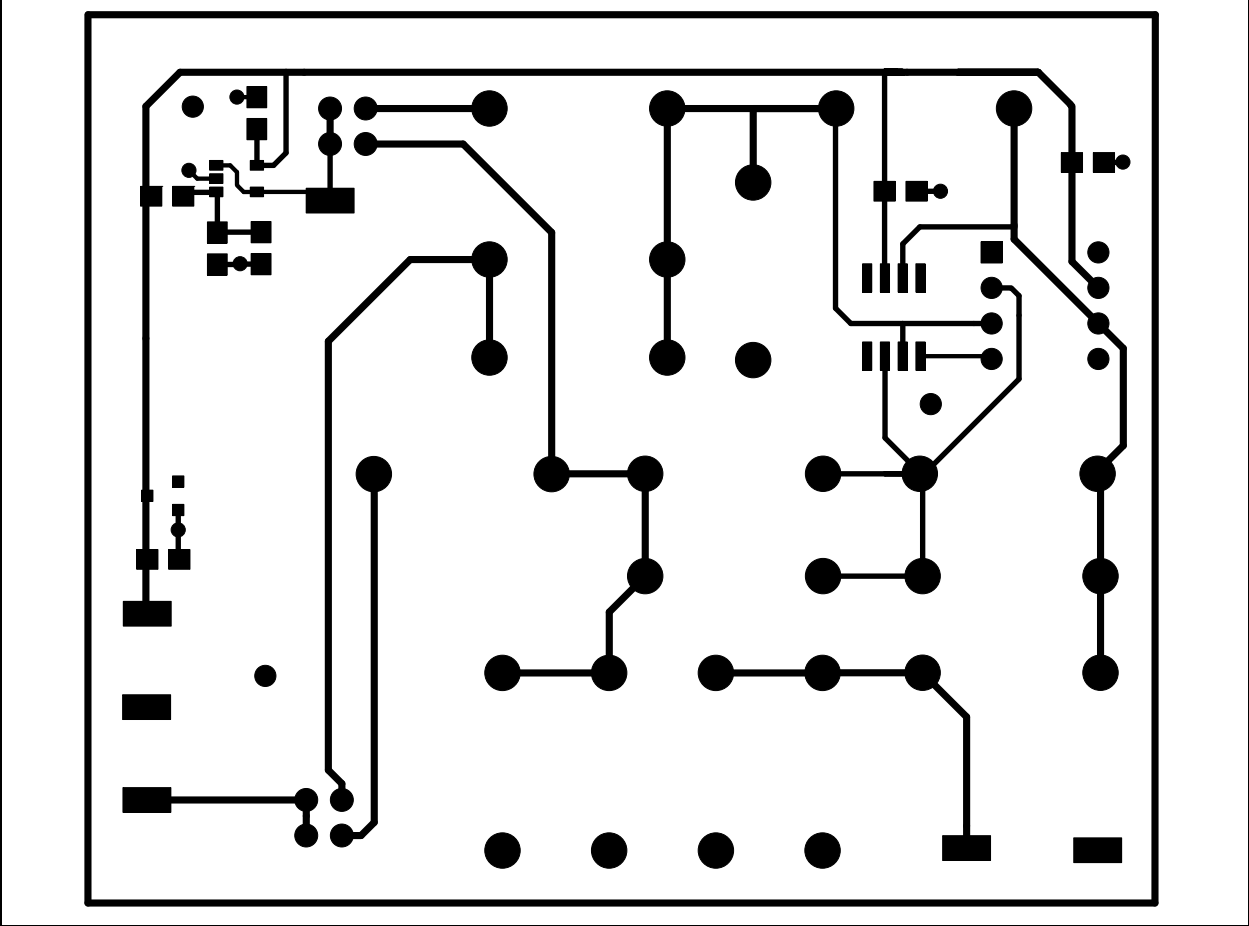


## A.3 BOARD - TOP SILK LAYER

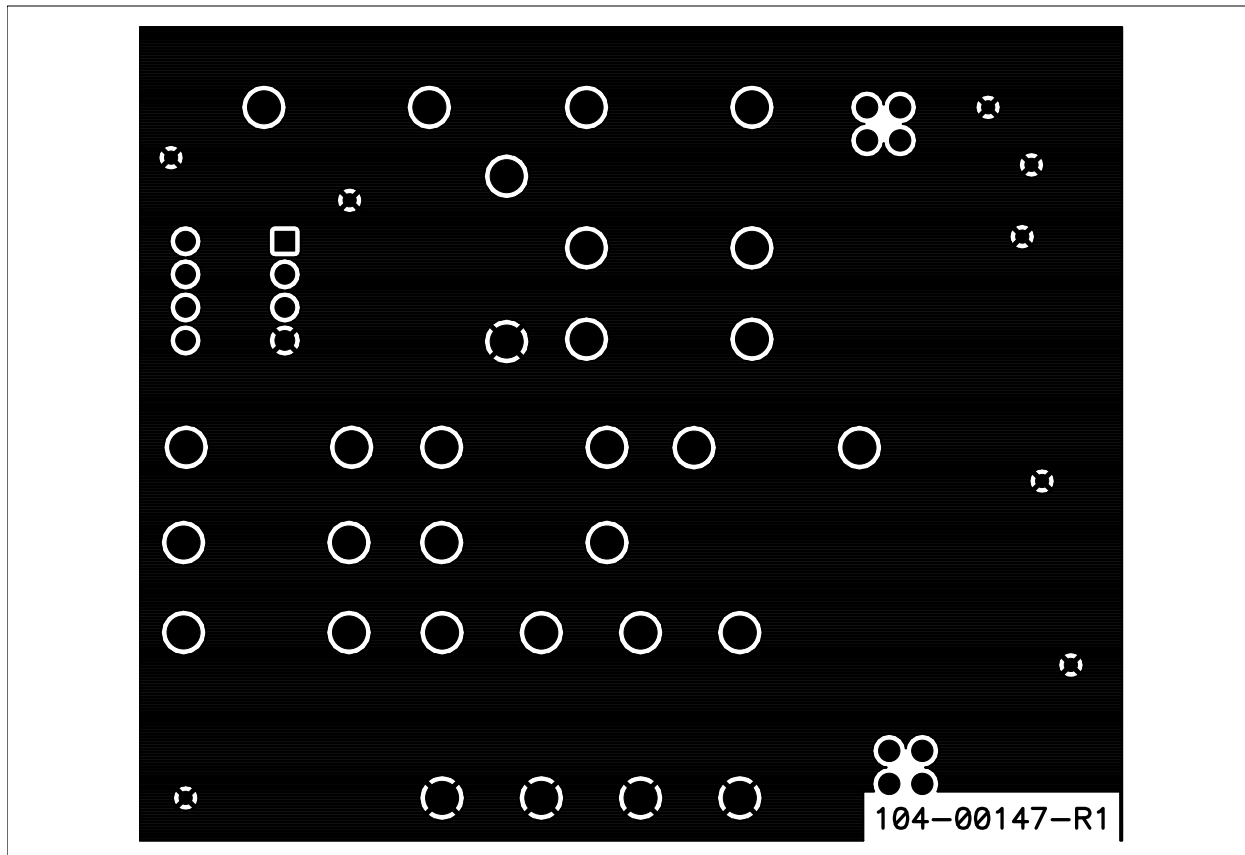


# MCP6XXX Amplifier Evaluation Board 1 User's Guide

## A.4 BOARD - TOP METAL LAYER



## A.5 BOARD - BOTTOM METAL LAYER



# MCP6XXX Amplifier Evaluation Board 1 User's Guide

---

---

NOTES:



# MCP6XXX AMPLIFIER EVALUATION BOARD 1 USER'S GUIDE

## Appendix B. Bill Of Materials (BOM)

### B.1 MCP6XXX AMPLIFIER EVALUATION BOARD 1 BOM

The Bill of Materials (BOM) in Table B-1 corresponds to Figure 2-1 and Figure 2-2. Unpopulated parts are in Table B-2.

**TABLE B-1: BILL OF MATERIALS (102-00147R1) (NOTE 1)**

Qty	Reference	Description	Manufacturer	Part Number
1	CP1	CAP CERAMIC 1UF 10% 25V X5R 0805	Panasonic® - ECG	ECJ-2FB1E105K
4	CR1, CR2, CU1, CU2	CAP CERAMIC .1UF 10% 25V X7R 0805	Panasonic - ECG	ECJ-2VB1E104K
1	DP1	DIODE ZENER 6.2V 350MW SOT-23	Fairchild Semiconductor	BZX84C6V2
4	EA Corner	BUMPER CLEAR .375X.15"DOME	Richco Plastic Co	RBS-12
2	J1, J2	CONN HEADR BRKWAY .100 04POS STR	Tyco Electronics/Amp	9-146258-0-02
1	PCB	RoHS Compliant Bare PCB, MCP6XXX Amplifier Evaluation Board 1	—	104-00147
30	Pin Socket	PIN RECPT .015/.025 DIA 0667 SER	Mill-Max®	0667-0-15-01-30-27-10-0
2	RR1, RR2	RES 20.0K OHM 1/8W 1% 0805 SMD	Panasonic - ECG	ERJ-6ENF2002V
2	Shunts for J1&J2	SOCKET,SHORT BLKS W TAB BLK	JAMECO VALUEPRO	2012JH-R
6	Test Points	PC TEST POINT COMPACT SMT	Keystone Electronics	5016
1	UR1	MCP6021 SOT-23-5 Single Op Amp	Microchip Technology Inc.	MCP6021T-E/OT
1	U1 Socket	CONN IC SOCKET 8POS DIP TIN	Tyco Electronics/Amp	2-641260-1

**Note 1:** The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

# Bill Of Materials (BOM)

**TABLE B-2: BILL OF MATERIALS – UNPOPULATED PARTS (102-00147R1)**

Qty	Reference	Description	Manufacturer	Part Number
1	U1	MCP6021 PDIP-8, Single Op Amp	Microchip Technology Inc.	MCP6021-E/P
1	U2	MCP6021 SOIC-8, Single Op Amp	Microchip Technology Inc.	MCP6021-E/SN
15	R1-R7, RISO, RL C1-C5, CL	Not Populated when shipped to customer	—	—

**Note 1:** The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

The BOM in Table B-3 corresponds to the collection of resistors, capacitors, jumpers and MCP6021 op amps that come in the Accessory Bag which is shipped in the MCP6XXX Amplifier Evaluation Board 1 Kit. These components are placed in a separate ESD bag. They support the circuit in **Section 2.4.1 “Building the Amplifier”**. Customers need to provide the resistors and capacitors for more amplifier circuits.

**TABLE B-3: BILL OF MATERIALS – ACCESSORY BAG PARTS (102-00147R1)**

Qty	Reference	Description	Manufacturer	Part Number
1	Accessory Bag	CAP CER 56PF 50V COG RADIAL	Murata Electronics	RPE5C1H560J2P1Z03B
1	Accessory Bag	JUMPER ZERO OHM 1/8W	Yageo Corporation	ZOR-12-B-52
1	Accessory Bag	RES 976 OHM 1/4W 1% METAL FILM	Yageo Corporation	MFR-25FBB-976R
1	Accessory Bag	RES 3.92K OHM 1/4W 1% METAL FILM	Yageo Corporation	MFR-25FBB-3K92
2	Accessory Bag	RES 1.96K OHM 1/4W 1% METAL FILM	Yageo Corporation	MFR-25FBB-1K96
1	ESD Sample Box	MCP6021 Single Op Amp PDIP-8	Microchip Technology Inc.	MCP6021-E/P

**Note 1:** The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.



# Bill Of Materials (BOM)

---

---

NOTES:



---

---

## WORLDWIDE SALES AND SERVICE

---

---

### AMERICAS

**Corporate Office**  
2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7200  
Fax: 480-792-7277  
Technical Support:  
<http://support.microchip.com>  
Web Address:  
[www.microchip.com](http://www.microchip.com)

**Atlanta**  
Duluth, GA  
Tel: 678-957-9614  
Fax: 678-957-1455

**Boston**  
Westborough, MA  
Tel: 774-760-0087  
Fax: 774-760-0088

**Chicago**  
Itasca, IL  
Tel: 630-285-0071  
Fax: 630-285-0075

**Dallas**  
Addison, TX  
Tel: 972-818-7423  
Fax: 972-818-2924

**Detroit**  
Farmington Hills, MI  
Tel: 248-538-2250  
Fax: 248-538-2260

**Kokomo**  
Kokomo, IN  
Tel: 765-864-8360  
Fax: 765-864-8387

**Los Angeles**  
Mission Viejo, CA  
Tel: 949-462-9523  
Fax: 949-462-9608

**Santa Clara**  
Santa Clara, CA  
Tel: 408-961-6444  
Fax: 408-961-6445

**Toronto**  
Mississauga, Ontario,  
Canada  
Tel: 905-673-0699  
Fax: 905-673-6509

### ASIA/PACIFIC

**Asia Pacific Office**  
Suites 3707-14, 37th Floor  
Tower 6, The Gateway  
Harbour City, Kowloon  
Hong Kong  
Tel: 852-2401-1200  
Fax: 852-2401-3431

**Australia - Sydney**  
Tel: 61-2-9868-6733  
Fax: 61-2-9868-6755

**China - Beijing**  
Tel: 86-10-8528-2100  
Fax: 86-10-8528-2104

**China - Chengdu**  
Tel: 86-28-8665-5511  
Fax: 86-28-8665-7889

**China - Fuzhou**  
Tel: 86-591-8750-3506  
Fax: 86-591-8750-3521

**China - Hong Kong SAR**  
Tel: 852-2401-1200  
Fax: 852-2401-3431

**China - Qingdao**  
Tel: 86-532-8502-7355  
Fax: 86-532-8502-7205

**China - Shanghai**  
Tel: 86-21-5407-5533  
Fax: 86-21-5407-5066

**China - Shenyang**  
Tel: 86-24-2334-2829  
Fax: 86-24-2334-2393

**China - Shenzhen**  
Tel: 86-755-8203-2660  
Fax: 86-755-8203-1760

**China - Shunde**  
Tel: 86-757-2839-5507  
Fax: 86-757-2839-5571

**China - Wuhan**  
Tel: 86-27-5980-5300  
Fax: 86-27-5980-5118

**China - Xian**  
Tel: 86-29-8833-7252  
Fax: 86-29-8833-7256

### ASIA/PACIFIC

**India - Bangalore**  
Tel: 91-80-4182-8400  
Fax: 91-80-4182-8422

**India - New Delhi**  
Tel: 91-11-4160-8631  
Fax: 91-11-4160-8632

**India - Pune**  
Tel: 91-20-2566-1512  
Fax: 91-20-2566-1513

**Japan - Yokohama**  
Tel: 81-45-471- 6166  
Fax: 81-45-471-6122

**Korea - Daegu**  
Tel: 82-53-744-4301  
Fax: 82-53-744-4302

**Korea - Seoul**  
Tel: 82-2-554-7200  
Fax: 82-2-558-5932 or  
82-2-558-5934

**Malaysia - Penang**  
Tel: 60-4-646-8870  
Fax: 60-4-646-5086

**Philippines - Manila**  
Tel: 63-2-634-9065  
Fax: 63-2-634-9069

**Singapore**  
Tel: 65-6334-8870  
Fax: 65-6334-8850

**Taiwan - Hsin Chu**  
Tel: 886-3-572-9526  
Fax: 886-3-572-6459

**Taiwan - Kaohsiung**  
Tel: 886-7-536-4818  
Fax: 886-7-536-4803

**Taiwan - Taipei**  
Tel: 886-2-2500-6610  
Fax: 886-2-2508-0102

**Thailand - Bangkok**  
Tel: 66-2-694-1351  
Fax: 66-2-694-1350

### EUROPE

**Austria - Wels**  
Tel: 43-7242-2244-39  
Fax: 43-7242-2244-393

**Denmark - Copenhagen**  
Tel: 45-4450-2828  
Fax: 45-4485-2829

**France - Paris**  
Tel: 33-1-69-53-63-20  
Fax: 33-1-69-30-90-79

**Germany - Munich**  
Tel: 49-89-627-144-0  
Fax: 49-89-627-144-44

**Italy - Milan**  
Tel: 39-0331-742611  
Fax: 39-0331-466781

**Netherlands - Drunen**  
Tel: 31-416-690399  
Fax: 31-416-690340

**Spain - Madrid**  
Tel: 34-91-708-08-90  
Fax: 34-91-708-08-91

**UK - Wokingham**  
Tel: 44-118-921-5869  
Fax: 44-118-921-5820

06/25/07



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.