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MCP6H04 Evaluation Board User's Guide

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MCP6H04 EVALUATION BOARD USER'S GUIDE

Table of Contents

NOTES:

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 "DSXXXXXA", where "XXXXX" 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 MCP6H04 Evaluation Board. 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 MCP6H04 Evaluation Board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP6H04 Evaluation Board.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to set up and operate the MCP6H04 Evaluation Board.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the MCP6H04 Evaluation Board.
- **Appendix B. "Bill of Materials"** – Lists the parts used to build the MCP6H04 Evaluation Board.

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	*File>Save*
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>
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	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	*`file`*`.o`, where *`file`* 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	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

RECOMMENDED READING

This user's guide describes how to use the MCP6H04 Evaluation Board. Other useful documents are listed below. The following Microchip document is available and recommended as a supplemental reference resource.

- **MCP6H01/2/4 -** ***"1.2 MHz, 16V Op Amps"*** **(DS22243)**

THE MICROCHIP WEB SITE

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- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
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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.

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

DOCUMENT REVISION HISTORY

Revision A (October 2011)

- Initial Release of this Document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

The MCP6H04 Evaluation Board is described as follows:

- Assembly #:114-00375-R2
- Order#: MCP6H04EV
- Name: MCP6H04 Evaluation Board

1.2 BOARD DESCRIPTION

The MCP6H04 Evaluation Board is intended to support an instrumentation amplifier and show the capability of the MCP6H04 operational amplifier. The board has the following features:

- All amplifier resistors and capacitors are socketed
- Supports MCP6H04 Microchip quad op amp
  - SOIC-14 package
- Test points for connection to lab equipment
- Single supply configuration

Figure 1-1 shows the block diagram of the MCP6H04 Evaluation Board. Lab equipment can be attached (via test points) to measure the amplifier response.

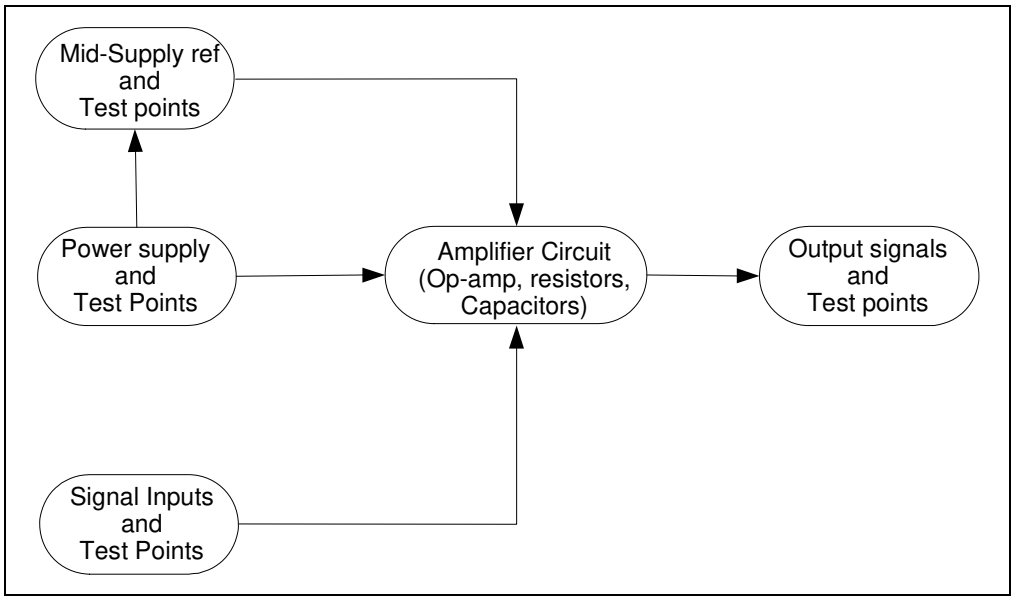

FIGURE 1-1: *MCP6H04 Evaluation Board - Block Diagram.*

1.3 WHAT THE MCP6H04 EVALUATION BOARD KIT INCLUDES

- MCP6H04 Evaluation Board, 102-00375
- Important Information Sheet
- Accessories Bag – contains loose parts for populating sockets on board, such as resistors and capacitors

FIGURE 1-2: *MCP6H04 Evaluation Board View.*

Chapter 2. Installation and Operation

2.1 INTRODUCTION

This chapter describes how to set up the MCP6H04 Evaluation Board. Topics discussed in this chapter include:

- Required Tools
- MCP6H04 Evaluation Board Set-Up
- MCP6H04 Evaluation Board Operation

2.2 REQUIRED TOOLS

The following tools are required for testing the functionality of the board:

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

2.3 MCP6H04 EVALUATION BOARD SET-UP

The MCP6H04 Evaluation Board uses a quad op amp in difference amplifier configuration with input buffers and voltage reference. Figure 2-1 shows the circuit diagram of the board.

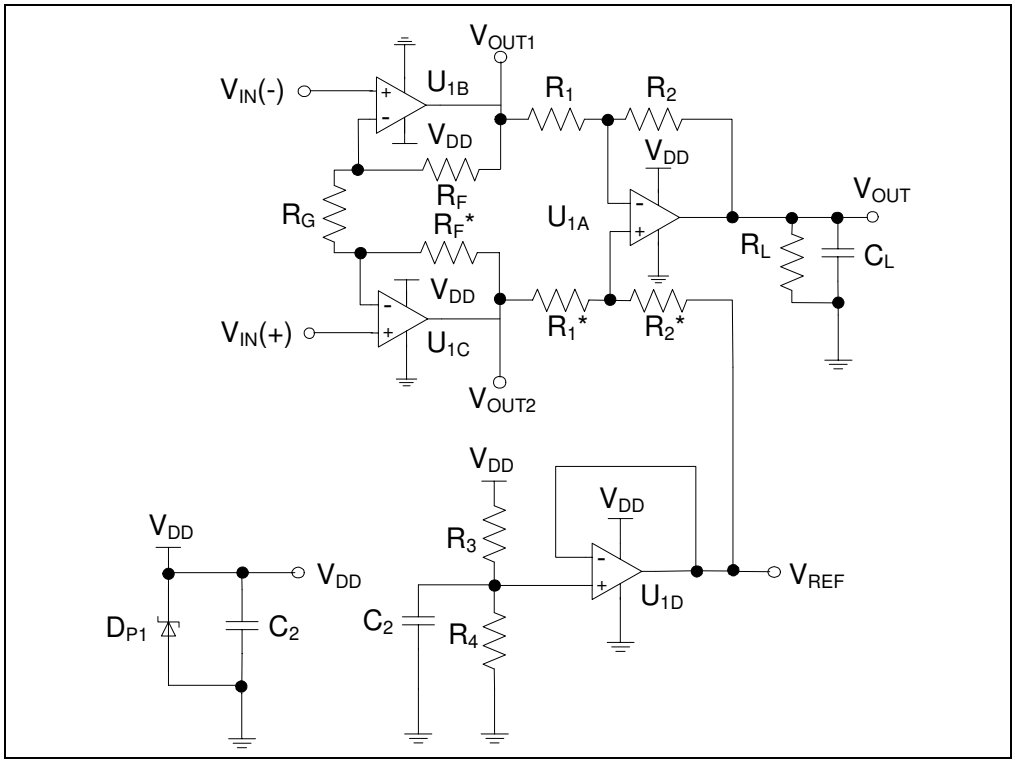

FIGURE 2-1: *MCP6H04 Evaluation Board Circuit Diagram.*

The power supply voltage needs to be in the allowed range for the op amp. The MCP6H04 device supports a maximum of 16V power supply. The power supply is protected by a Zener diode with a nominal voltage of 16V and bypassed by a 1 µF capacitor (see Figure 2-3).

The mid-supply reference voltage consists of a voltage divider and a buffer amplifier (see Figure 2-4).

The resistors that are part of the amplifier are placed in pin sockets, which are labeled.

All component labels on board are consistent with those on the schematic. The op amp on board is a 14-lead SOIC package, and is bypassed by a 0.1 µF capacitor.

The test points for the power supply, ground, input signals, output signals, and voltage reference allow lab equipment to be connected to the board. The MCP6H04 Evaluation Board top view is shown in Figure 2-2.

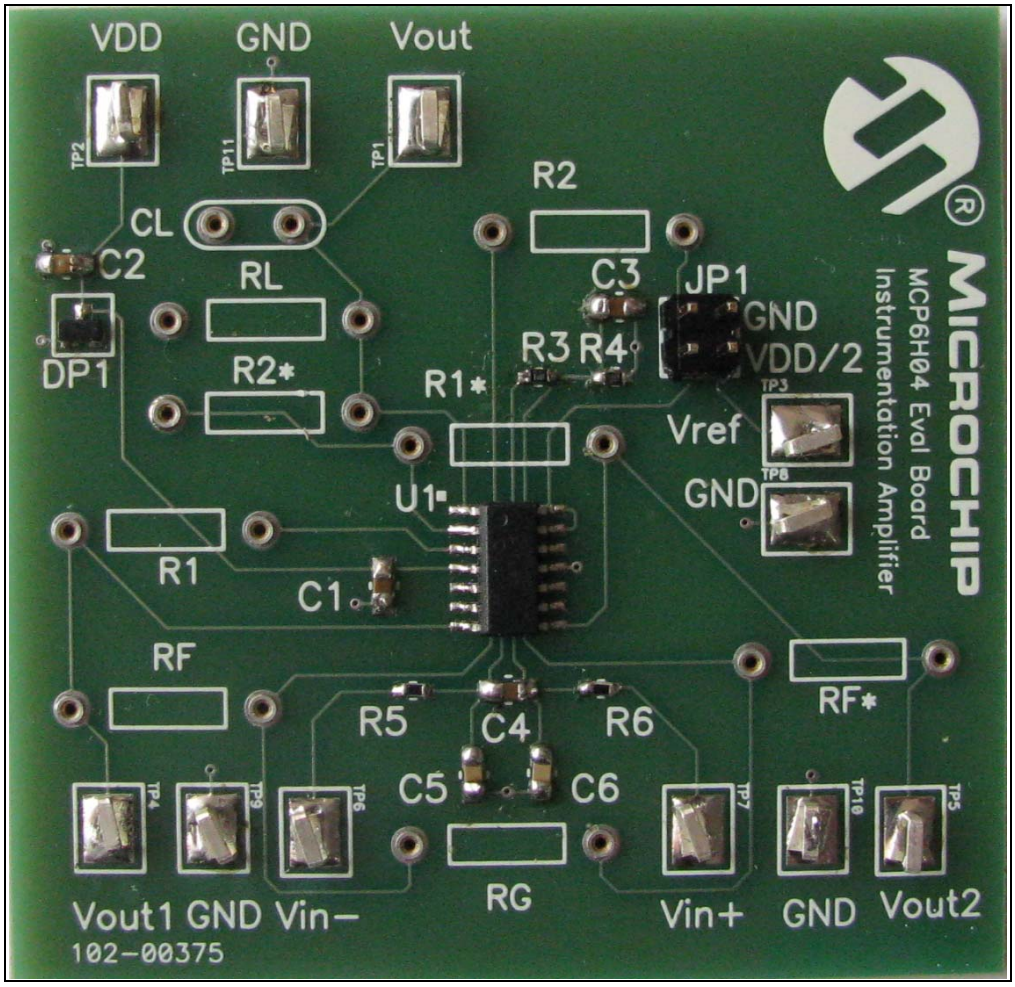

FIGURE 2-2: *MCP6H04 Evaluation Board Top View.*

2.3.1 Top Level Amplifier Circuit Diagram

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_2 = 1 µF). D_{P1} is a Zener diode with a nominal voltage of 16V.

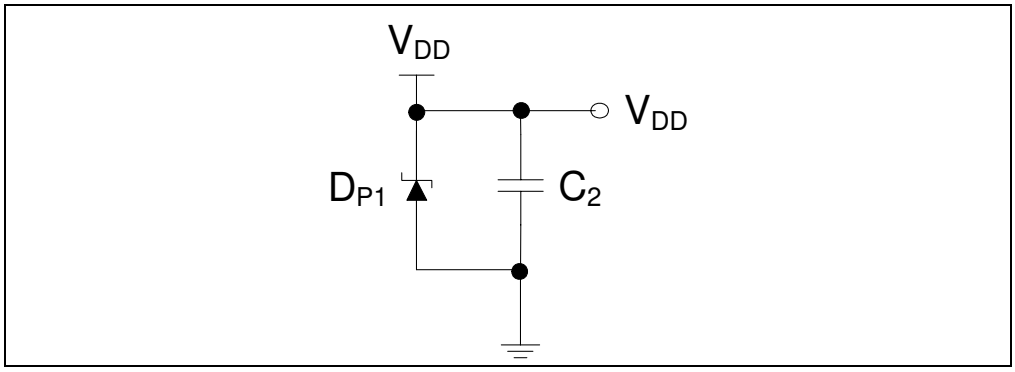

FIGURE 2-3: *Circuit Diagram for Power Supply.*

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 (R_3 = R_4 = 100K, C_3 =0.1 µF).

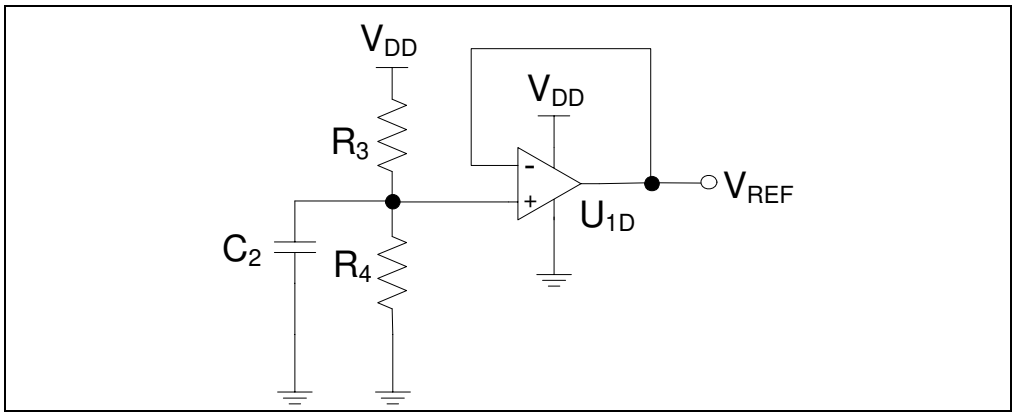

FIGURE 2-4: *Mid-Supply Reference Block.*

2.3.1.3 OUTPUT LOAD BLOCK

The output load consists of a capacitor and a resistor. Figure 2-5 shows the circuit diagram of the output load (R_L = 10K, C_L = 56 pF).

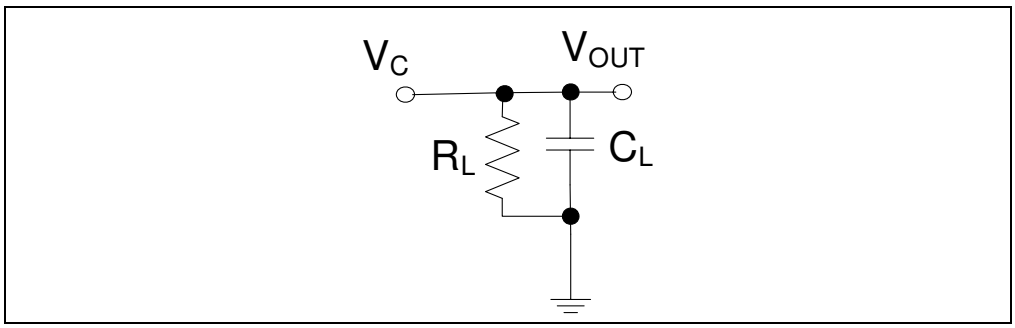

FIGURE 2-5: *Output Load Block.*

2.3.1.4 INPUT STAGE

The input stage consists of two resistors and three capacitors. All three capacitors are forming a noise filter. Figure 2-6 shows the circuit diagram of the input stage ($C_5 = C_6 = 10$ nF, $C_4 = 100$ nF and $R_5 = R_6 = 1$K).

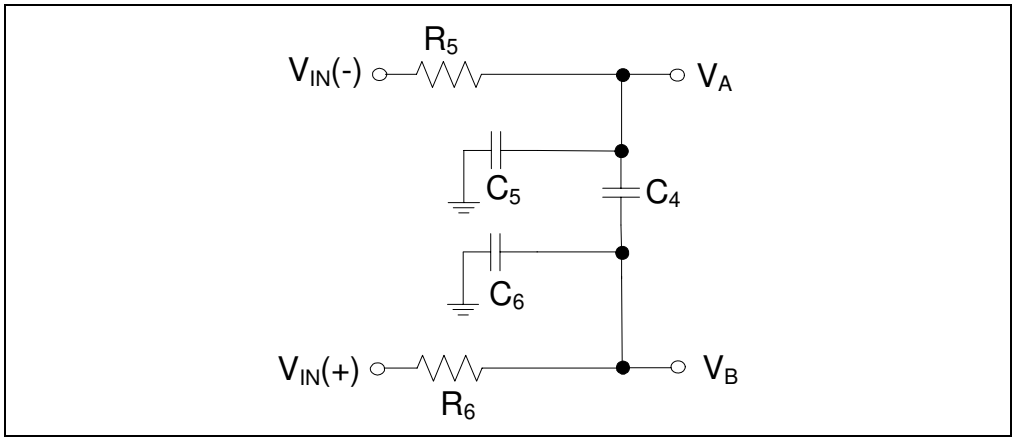

FIGURE 2-6: *Input Stage Block.*

2.3.1.5 INPUT BUFFER BLOCK

The input buffer block consists of two op amps in buffer configuration with outputs tied together through one resistor. Figure 2-7 shows the circuit diagram of the input buffer block ($R_F = R_F^* = 50$K, $R_G = 1$K).

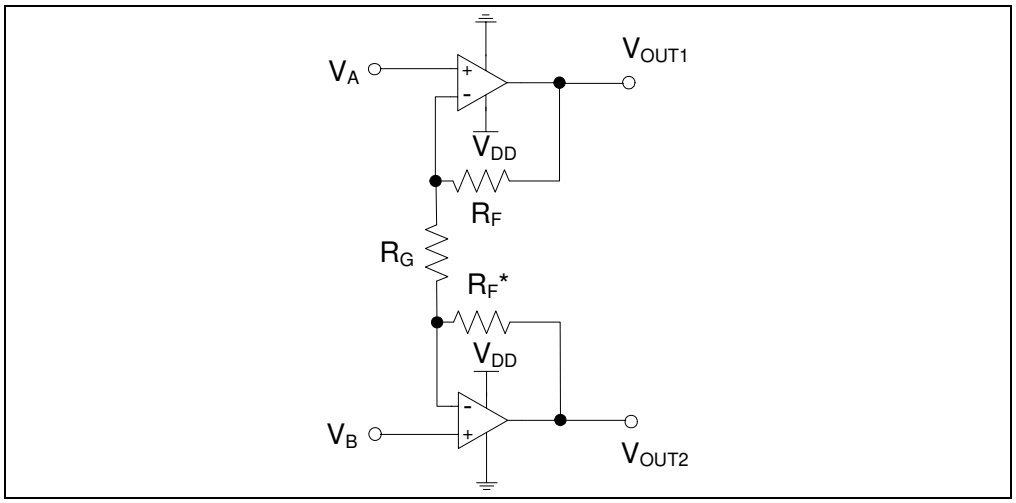

FIGURE 2-7: *Input Buffer Block.*

2.3.1.6 DIFFERENCE AMPLIFIER

This circuit amplifies the difference between two voltages, while rejecting the Common mode input voltage. Output voltage can be shifted by a reference voltage for single supply operation.

Fill the sockets with the recommended resistors and capacitors (see the circuit diagram shown in Figure 2-8).

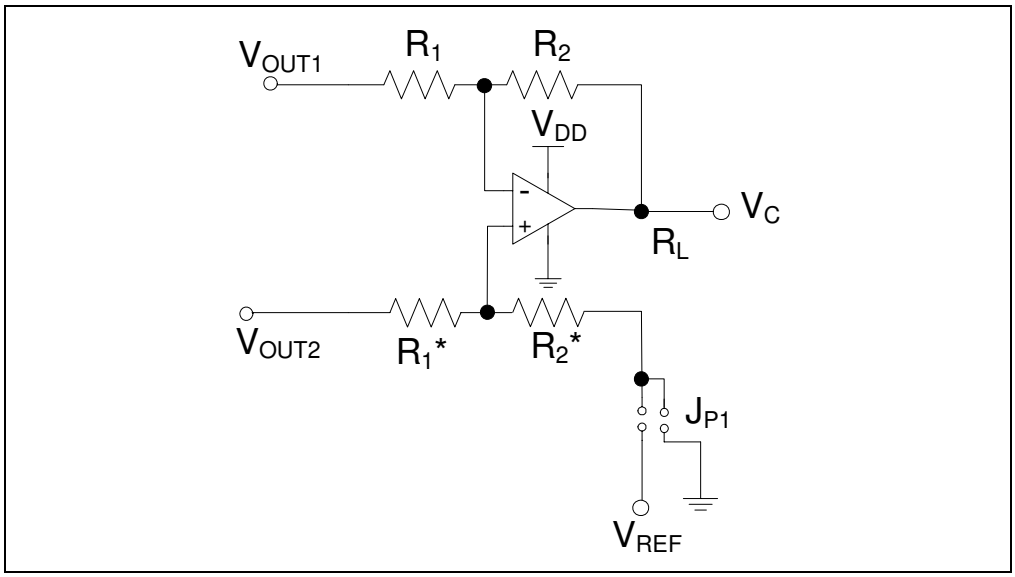

FIGURE 2-8: *Difference Amplifier Block.*

The jumper positions have the following effect:

- JP1 connected to ground: the output voltage will be centered on 0V.
- JP1 connected to V_{REF}: the output voltage will be centered on 8V.

2.4 MCP6H04 EVALUATION BOARD OPERATION

This section covers the following topics:

- Building the Amplifier
- Testing the Amplifier

2.4.1 Building the Amplifier

The accessory bag that comes with this kit facilitates the evaluation of the amplifier described below.

The amplifier characteristics are:

- Instrumentation amplifier (Single supply operation)
- Power supply voltage = 16V
- Desired Gain = 101 V/V
- Load Capacitance = 56 pF

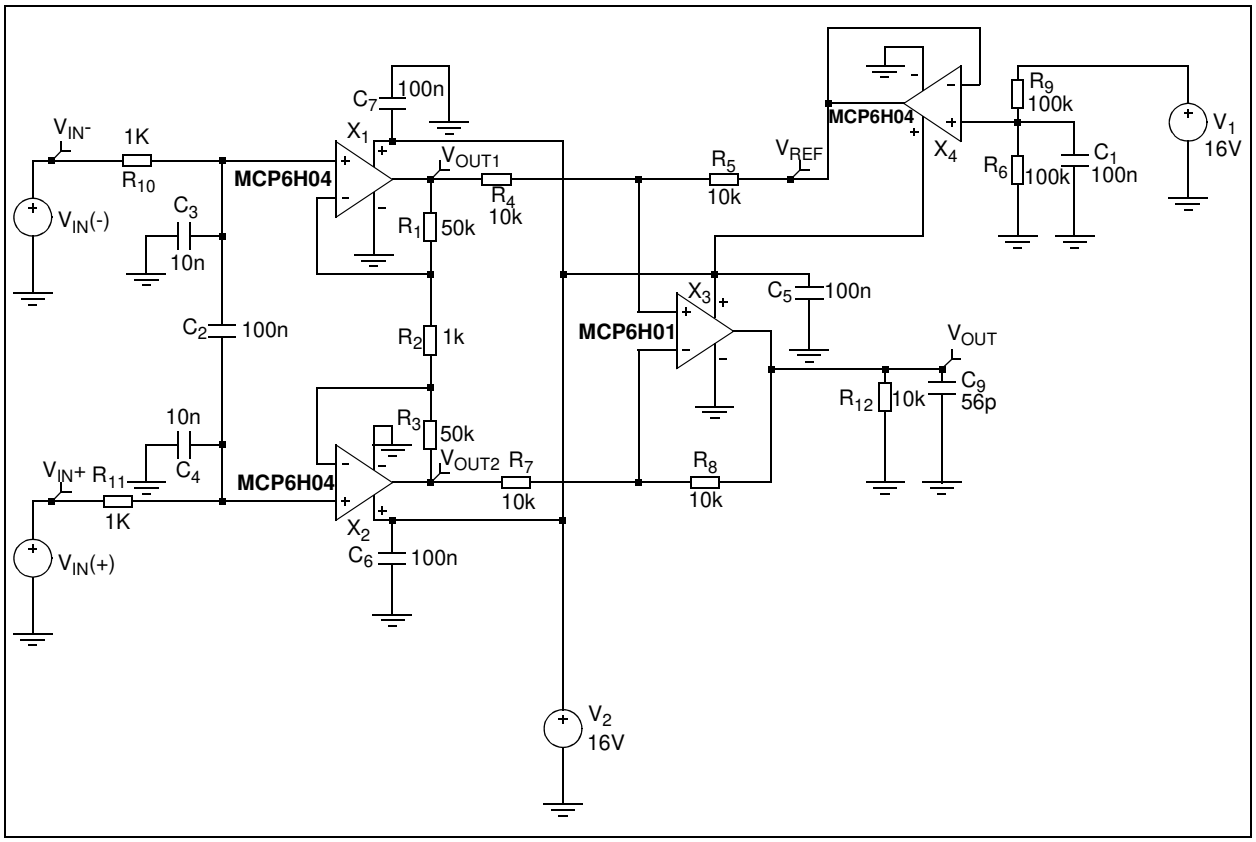

FIGURE 2-9: *Schematic of the Instrumentation Amplifier Designed for Simulation.*

Figure 2-10 shows the same circuit redrawn to emphasize the instrumentation amplifier.

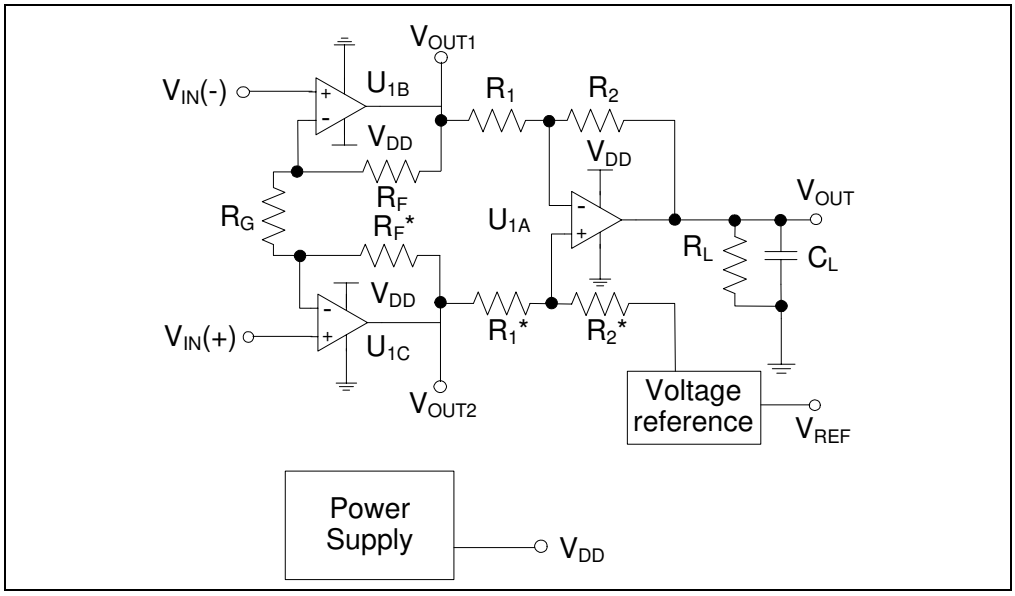

FIGURE 2-10: *Instrumentation Amplifier Diagram Block.*

Each of the components in Figure 2-10 that need to be inserted in a socket on the MCP6H04 Evaluation Board is listed in Table 2-1 and Table 2-2. The op amp is soldered on the PCB.

TABLE 2-1: AMPLIFIER COMPONENTS LIST

PCB Labels	Component Value
R_F	50K
R_F*	50K
R_G	1K
R_1	10K
R_1*	10K
R_2	10K
R_2*	10K
R_L	10K
C_L	56 pF

TABLE 2-2: JUMPER POSITIONS

Jumper	Position
JP1	$V_{DD}/2$
	GND

The fully assembled MCP6H04 Evaluation Board top view is shown in Figure 2-11.

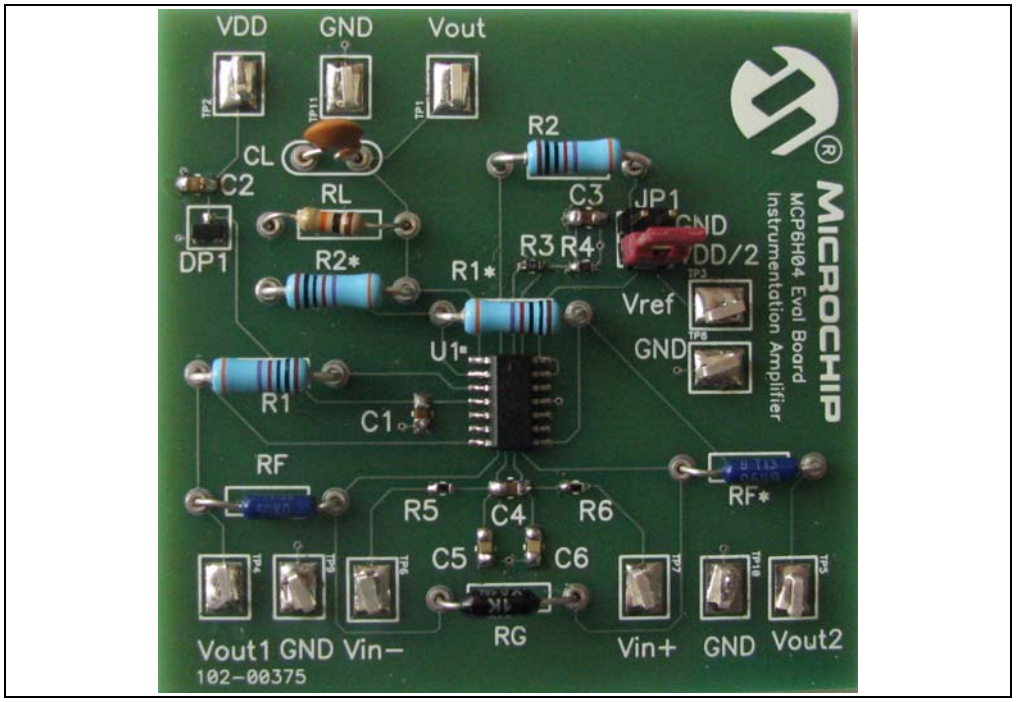

FIGURE 2-11: *MCP6H04 Evaluation Board Top View.*

2.4.2 Testing the Amplifier

2.4.2.1 CHECKING THE TEST POINTS

The test points for the power supply, ground, input signals and output signals allow lab equipment to be connected to the board. Figure 2-12 shows the test points to check.

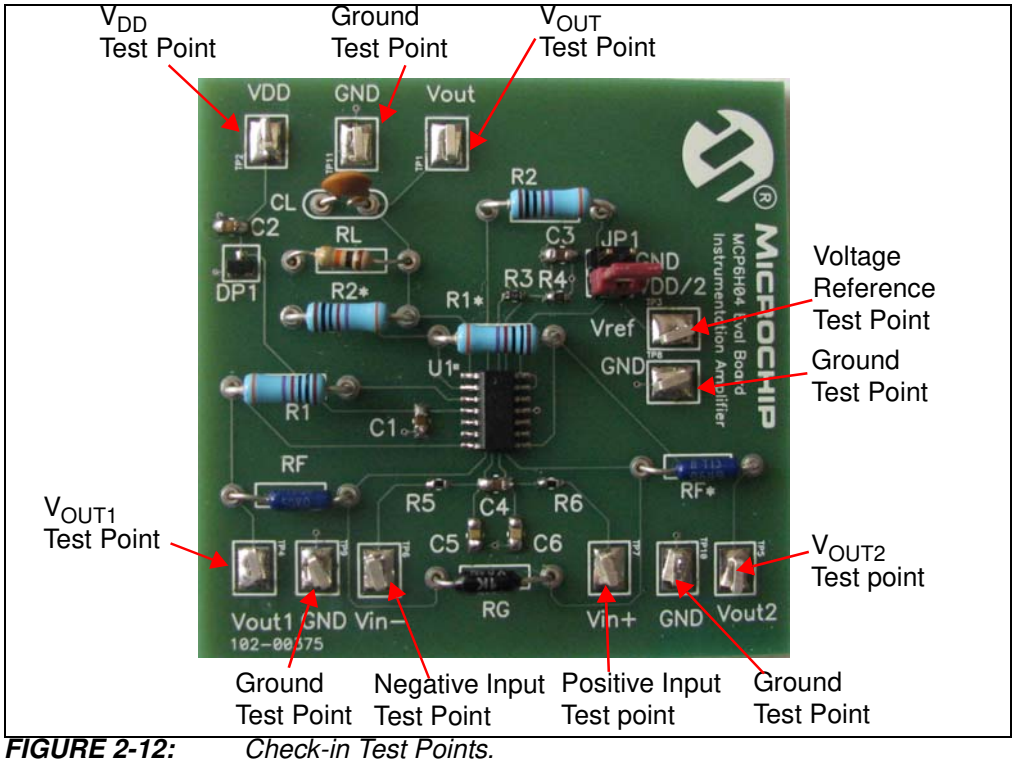

FIGURE 2-12: *Check-in Test Points.*

2.4.2.2 BOARD VALIDATION

All resistors in sockets have 0.1% tolerance and all soldered resistors have 1% tolerance. The capacitors have 20% tolerance.

2.4.2.2.1 Sine Wave Response

Settings in bench measurement:

- Set V_{IN} for Source(–) at 10 mV, 10 Hz, 0° phase and a Common mode voltage of 4V
- Set V_{IN} for Source(+) at 10 mV,10 Hz,180° phase and a Common mode voltage of 4V
- $V_{REF} = V_{DD}/2$
- V_{DD} = 16V
- The output signal is centered on 8V
- The amplifier's Gain is 101 V/V

Figure 2-13 shows the result of this measurement.

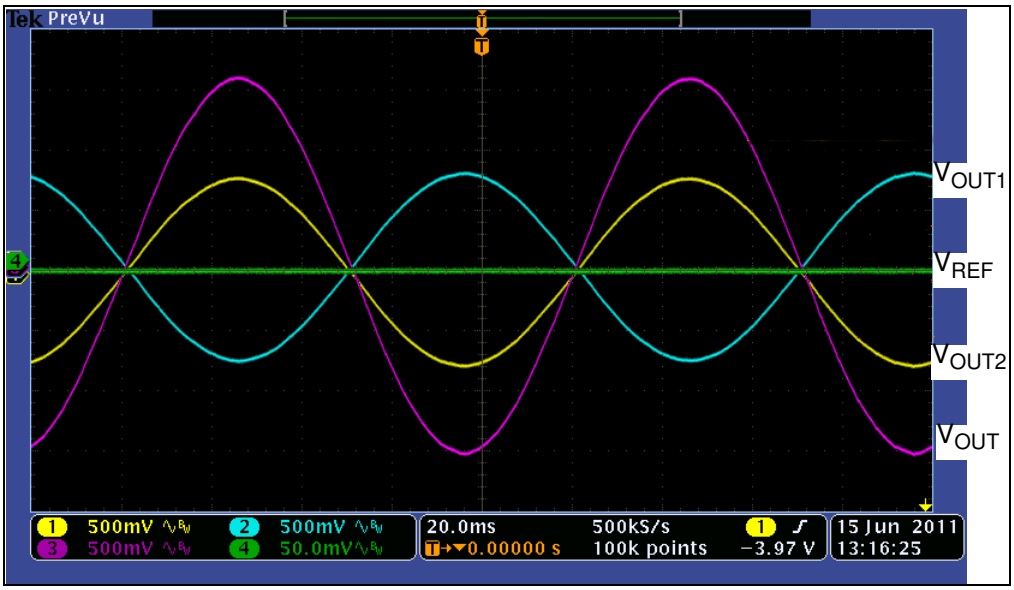

FIGURE 2-13: *Sine Wave Response.*

Simulation settings:

- Set V_{IN} for Source(-) at 10 mV, 10 Hz, 0° phase and Common mode voltage 4V
- Set V_{IN} for Source(+) at 10 mV,10 Hz,180° phase and Common mode voltage 4V
- $V_{REF} = V_{DD}/2$
- V_{DD}=16V
- The output signal is centered on 8V
- The amplifier's Gain is 101 V/V

Figure 2-14 shows the results.

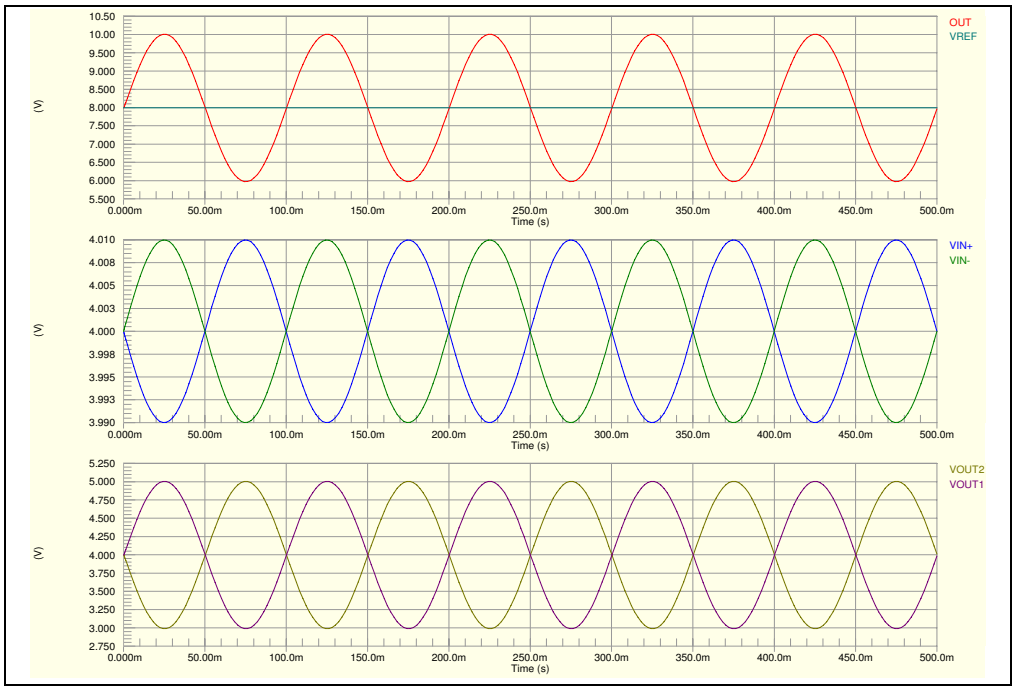

FIGURE 2-14: *Simulation of the Sine Wave Response.*

2.4.2.2.2 Square Wave Response

Settings in bench measurement:

- Set V_{IN} for Source(-) at 50 mV,10 Hz, 0° phase and Common mode voltage 4V
- Set V_{IN} for Source(+) at 50 mV,10 Hz, 180° phase and Common mode voltage 4V
- $V_{REF} = V_{DD}/2$
- V_{DD}=16V
- The output signal is centered on 8V
- The amplifier's Gain is 101V/V

Figure 2-15 shows the result of this measurement.

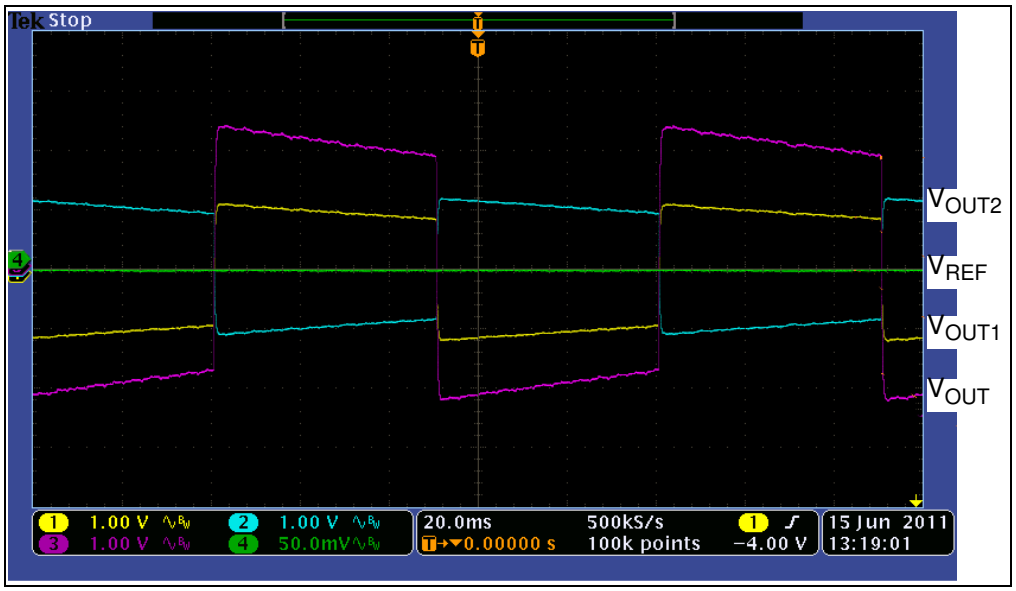

FIGURE 2-15: *Square Wave Response.*

Simulation settings:

- Set V_{IN} for Source(-) at 50 mV,10 Hz, 0° phase and common mode voltage 4V
- Set V_{IN} for Source(+) at 50 mV,10 Hz, 180° phase and common mode voltage 4V
- $V_{REF} = V_{DD}/2$
- V_{DD}=16V
- The output signal is centered on 8V
- The amplifier's Gain is 101V/V

Figure 2-16 shows the result of this simulation.

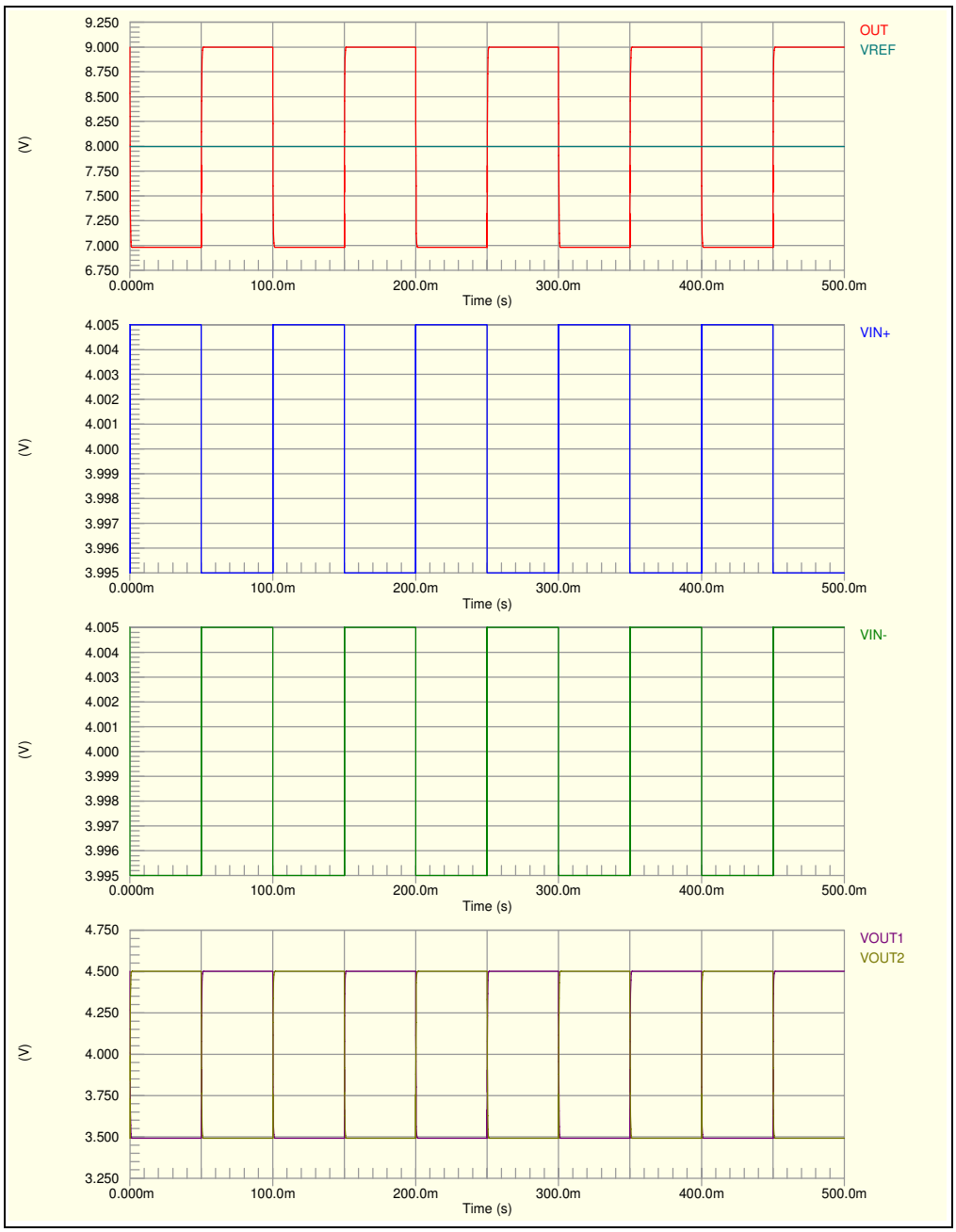

FIGURE 2-16: *Simulation of the Square Wave Response.*

2.4.2.2.3 DC Response

Settings in bench measurement:

- Set V_{IN} for Source(-) at 80 mV DC signal
- Set V_{IN} for Source(+) at 30 mV DC signal
- $V_{REF} = V_{DD}/2$
- V_{DD} = 16V

Figure 2-17 shows the result of this measurement.

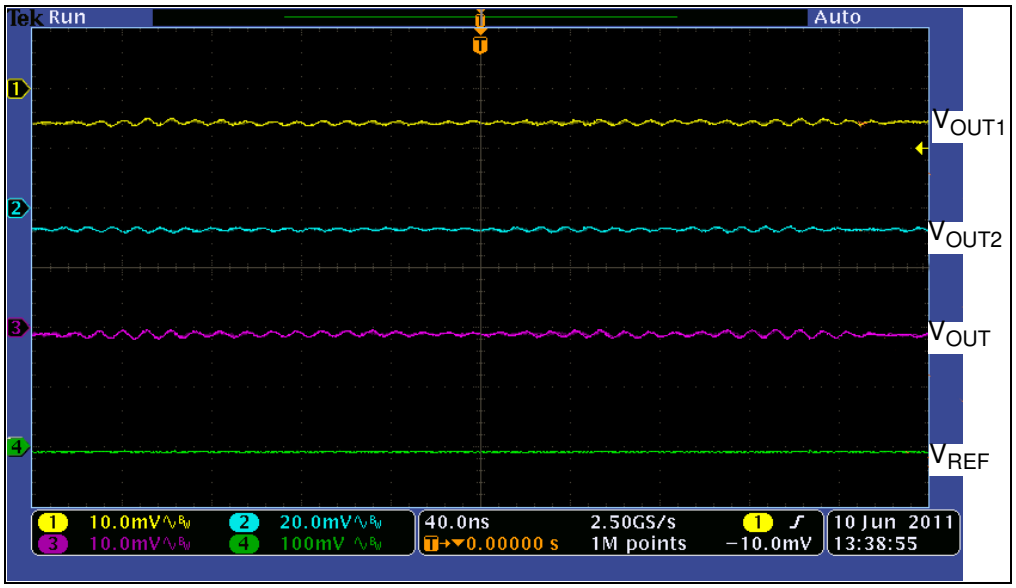

FIGURE 2-17: *DC Response.*

Simulation settings:

- Set V_{IN} for Source(-) at 80 mV DC signal
- Set V_{IN} for Source(+) at 30 mV DC signal
- $V_{REF} = V_{DD}/2$
- V_{DD} = 16V

Figure 2-18 shows the result of this measurement.

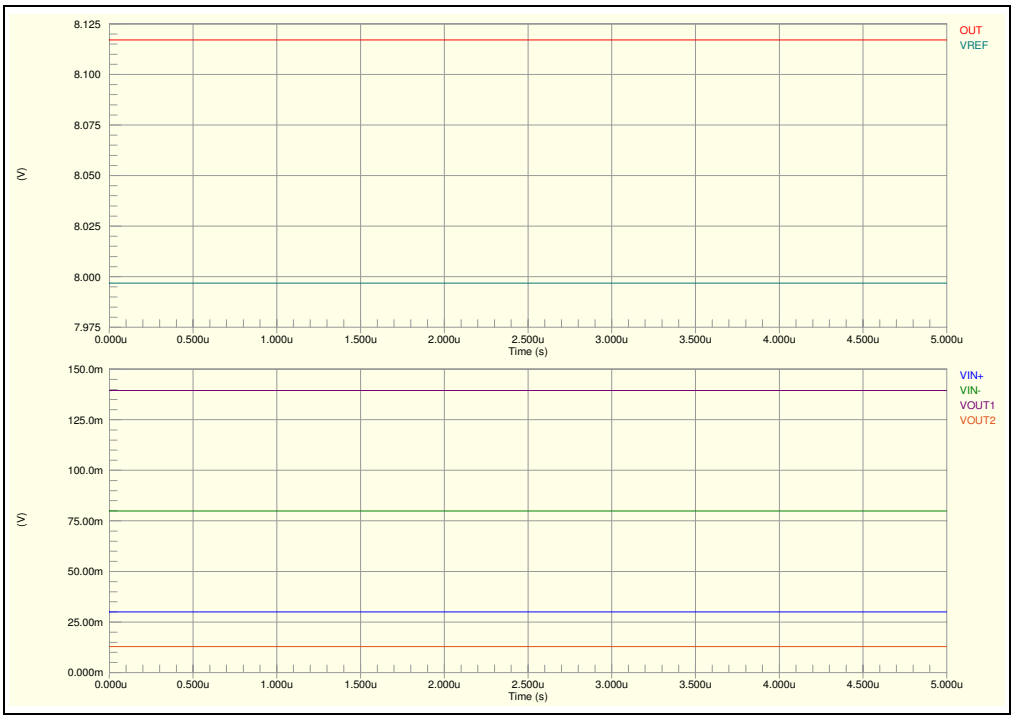

FIGURE 2-18: *Simulation of the DC Response.*

NOTES:

Appendix A. Schematic and Layouts

A.1 INTRODUCTION

This appendix contains the following schematics and layouts of the MCP6H04 Evaluation Board:

- Board – Schematic
- Board – Silk and Solder Mask
- Board – Top Metal Layer
- Board – Bottom Metal Layer (bottom View)