EV58Y02
Configurable Amp and Filter Evaluation Board User's Guide

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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 website (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "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 will be useful to know before using the EV58Y02 Configurable Amp and Filter Evaluation Board. Items discussed in this chapter include:

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

DOCUMENT LAYOUT

This document describes how to use the EV58Y02 Configurable Amp and Filter Evaluation Board as a development tool to emulate and debug firmware on a target board. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the EV58Y02 Configurable Amp and Filter Evaluation Board.
- **Chapter 2. "Hardware Description"** – Contains a detailed description of the EV58Y02 Configurable Amp and Filter Evaluation Board.
- **Chapter 3. "Analysis"** – Detailed analysis about the EV58Y02 Configurable Amp and Filter Evaluation Board.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the EV58Y02 Configurable Amp and Filter Evaluation Board.
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the EV58Y02 Configurable Amp and Filter 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 EV58Y02 Configurable Amp and Filter Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as a supplemental reference resources:

MCP6491/2/4 - *"7.5 MHz, Low-Input Bias Current Op Amps"* Data Sheet (DS20002321)

MCP6481/2/4 - *"4 MHz, Low-Input Bias Current Op Amps"* Data Sheet (DS20002322)

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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 website at:
https://www.microchip.com/support.

DOCUMENT REVISION HISTORY

Revision A (October 2023)

- Initial release of this document.

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Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the EV58Y02 Configurable Amp and Filter Evaluation Board and covers the following topics:

- What Is the EV58Y02 Configurable Amp and Filter Evaluation Board?
- EV58Y02 Configurable Amp and Filter Evaluation Board Kit Contents

1.2 WHAT IS THE EV58Y02 CONFIGURABLE AMP AND FILTER EVALUATION BOARD?

During the design of a product, signal amplification and filtering become essential building blocks in the signal path of a transduced electrical signal of physical variables. Amplification and filtering allow the measured variable to be digitized and readable by other machine or human interfaces.

The EV58Y02 Configurable Amp and Filter Evaluation Board consists of 3 boards:

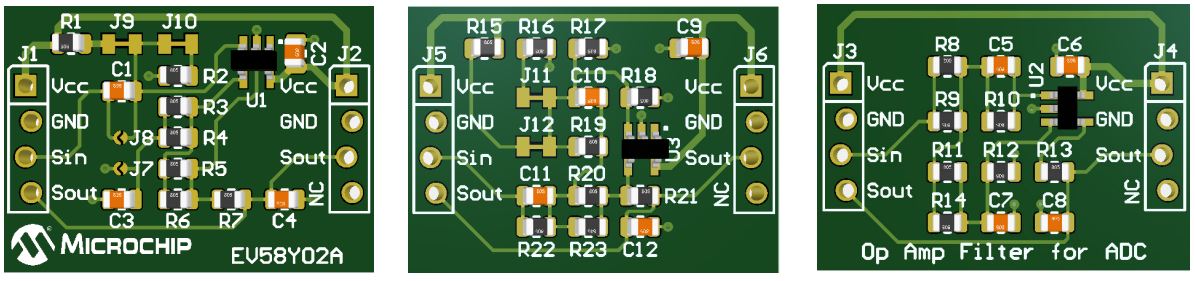
1. AC/DC Configurable Amplifier Board
2. Low-Pass Butterworth Filter Board
3. High-Pass Butterworth Filter Board

The complete circuit amplifies an AC or DC input signal and filters it with a low-pass and/or high-pass cascaded filter network. The circuit is designed to operate between 30 Hz to 20 kHz bandwidth.

1.3 EV58Y02 CONFIGURABLE AMP AND FILTER EVALUATION BOARD KIT CONTENTS

EV58Y02 Configurable Amp and Filter Evaluation Board kit includes the following:

- AC/DC Configurable Amplifier Board
- Low-Pass Butterworth Filter Board
- High-Pass Butterworth Filter Board
- Important Information sheet (this document).



Amplifier Board **Low-Pass Filter Board** **High-Pass Filter Board**

FIGURE 1-1: *EV58Y02 Configurable Amp and Filter Evaluation Board Kit Contents.*

NOTES:

Chapter 2. Hardware Description

2.1 AC/DC CONFIGURABLE AMPLIFIER BOARD

The Amplifier Board can be configured for either AC or DC coupling and a fixed gain of 50 to provide sufficient amplification of low voltage signals to drive an ADC.

a) AC-Coupled

- Open J8, J7. Connect C1, C3.

EQUATION 2-1:

$$V_{+} = \frac{V_{CC}}{R_2 + R_1} \times R_2$$

b) DC-Coupled

- Short J8, J7. Remove C1, C3.

EQUATION 2-2:

$$V_{+} = Sign_{in}$$

c) Gain

- The DC gain of the amplifier is set to 50 to amplify low V_{pk-pk} voltages to approximately 1V swing on the output of the amplifier.

EQUATION 2-3:

$$A = 1 + \frac{\langle R_6 \parallel R_5 \rangle}{R_3} = 1 + \frac{487\ k\Omega}{10\ k\Omega} = 49.7$$

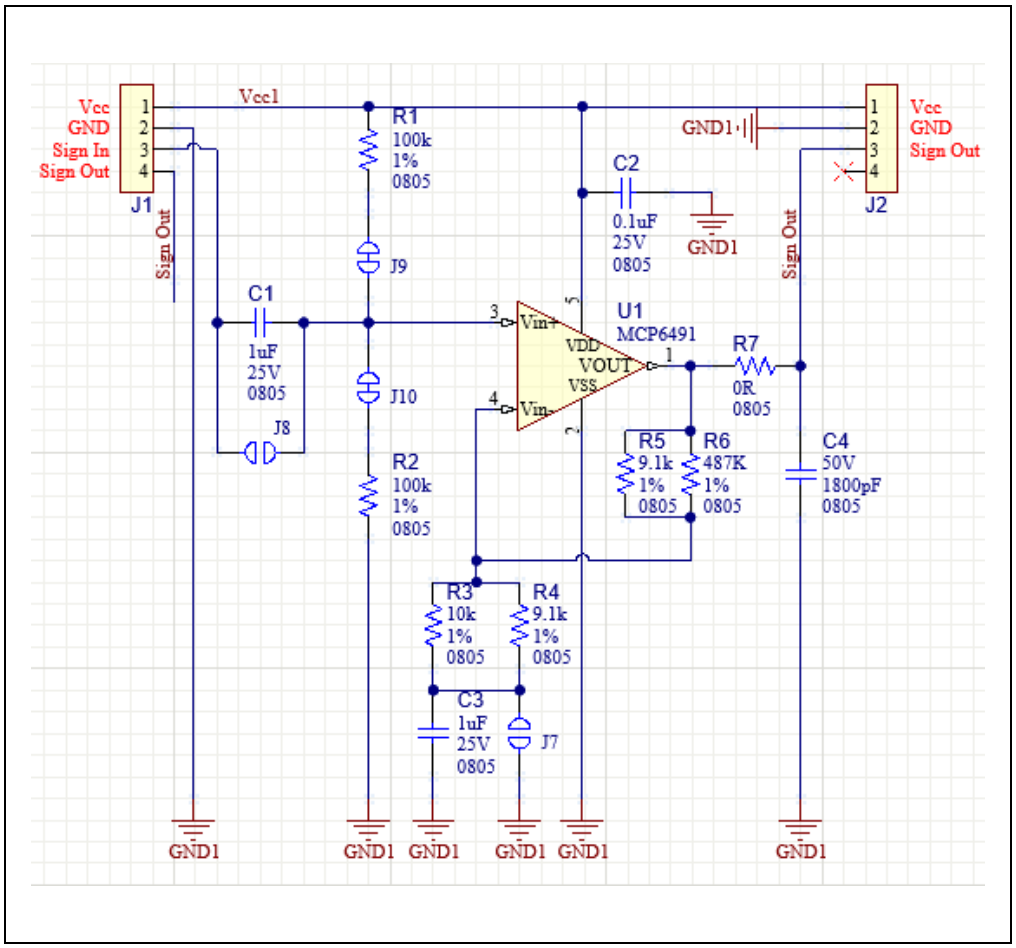


FIGURE 2-1: *Amplifier Board Schematic.*

2.2 LOW-PASS FILTER BOARD

A Sallen-Key Butterworth low-pass filter is used to provide a flat response with a cutoff frequency of 20 kHz. The input of the low-pass filter can be connected to the output of the amplifier circuit.

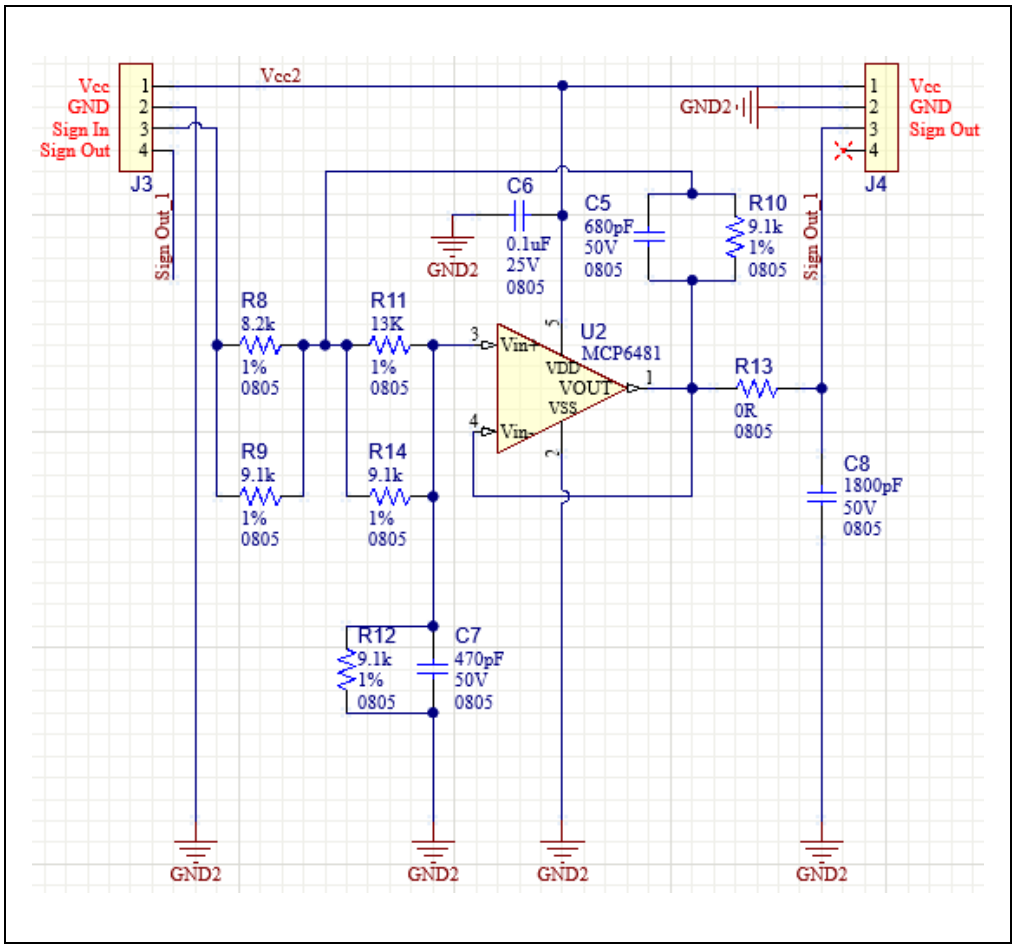


FIGURE 2-2: *Low-Pass Filter Board Schematic.*

2.3 HIGH-PASS FILTER BOARD

A Sallen-Key Butterworth high-pass filter is used to provide a flat response with a cutoff frequency of 30 Hz. The input of the high-pass filter can be connected to the output of the low-pass filter. Resistors R15 and R16 provide a DC bias to the input signal of approximately half of V_{CC} to avoid signal distortion on the output of the high-pass filter.

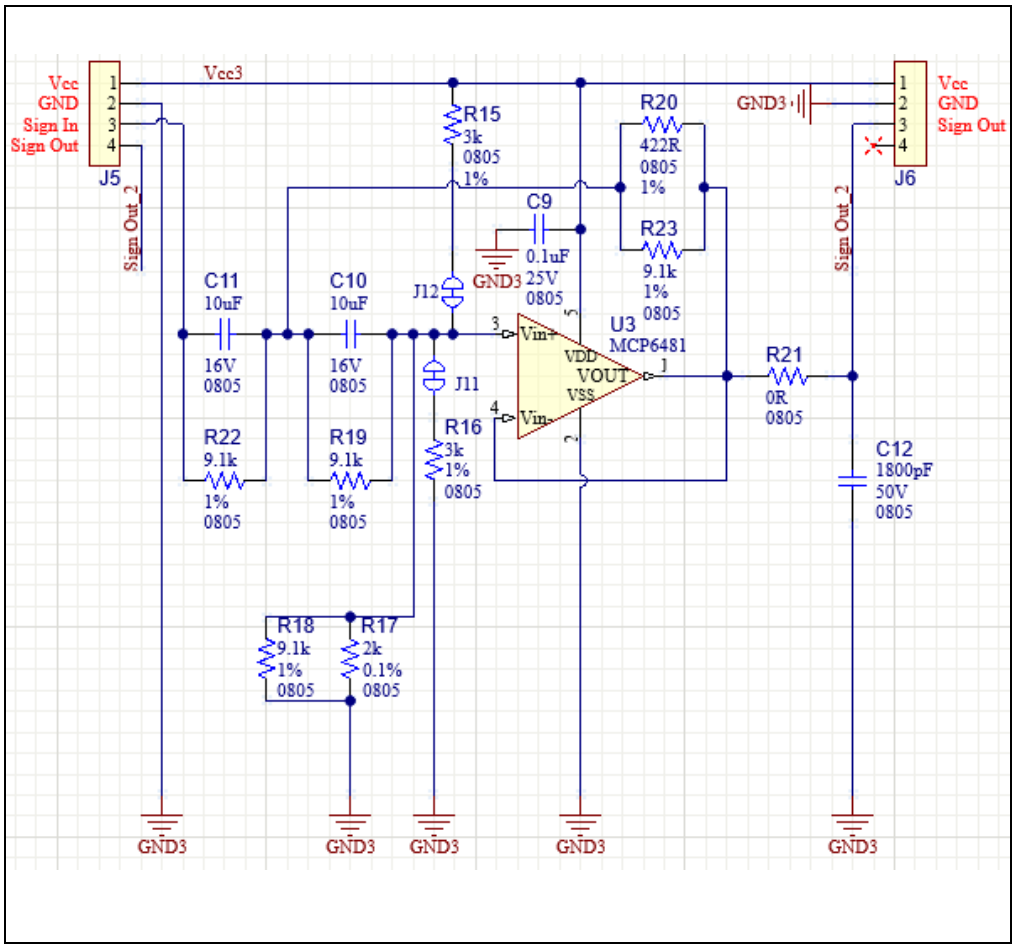


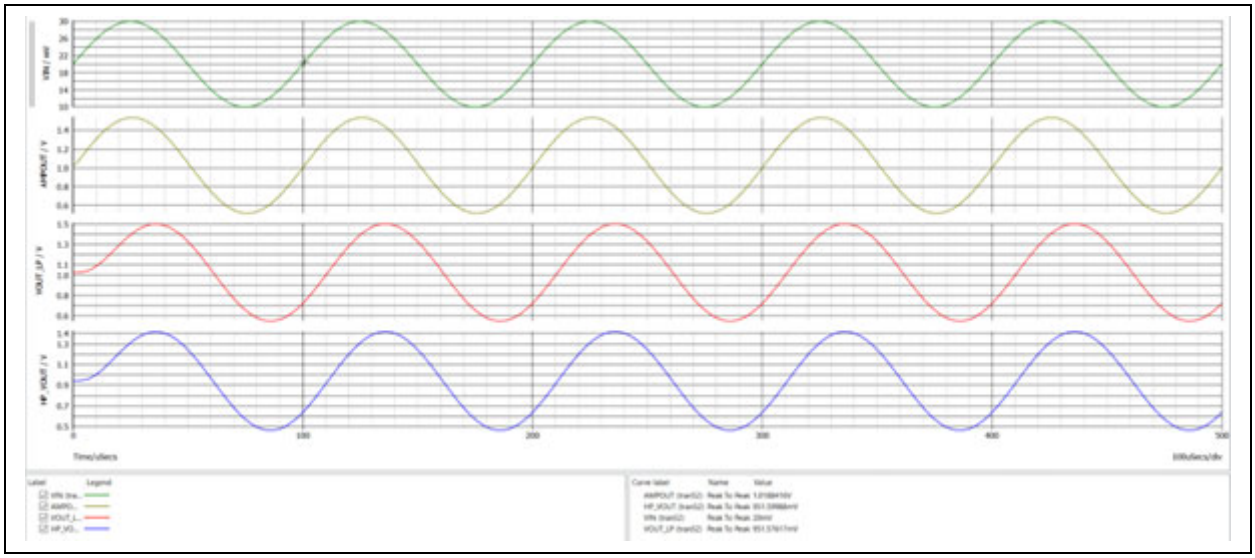
FIGURE 2-3: *High-Pass Filter Board Schematic.*

Chapter 3. Analysis

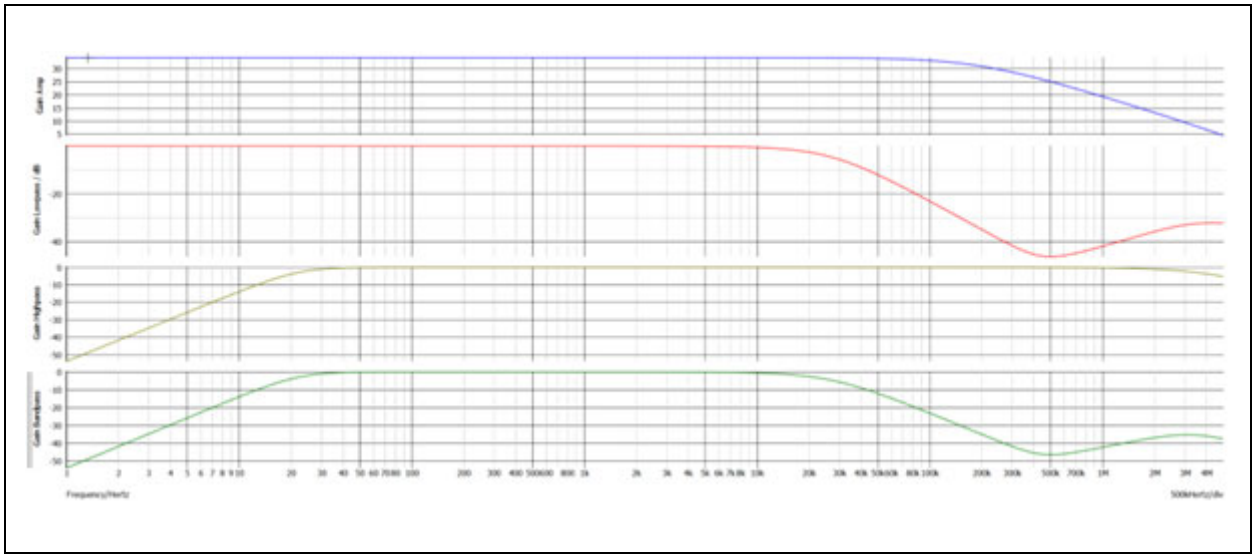
3.1 INPUT PARAMETERS

- Amplifier Gain = 50
- Vin_{offset} = 20 mV
- Vin_{pk-pk} = 20 mV
- $Vin_{Frequency}$ = 10 kHz

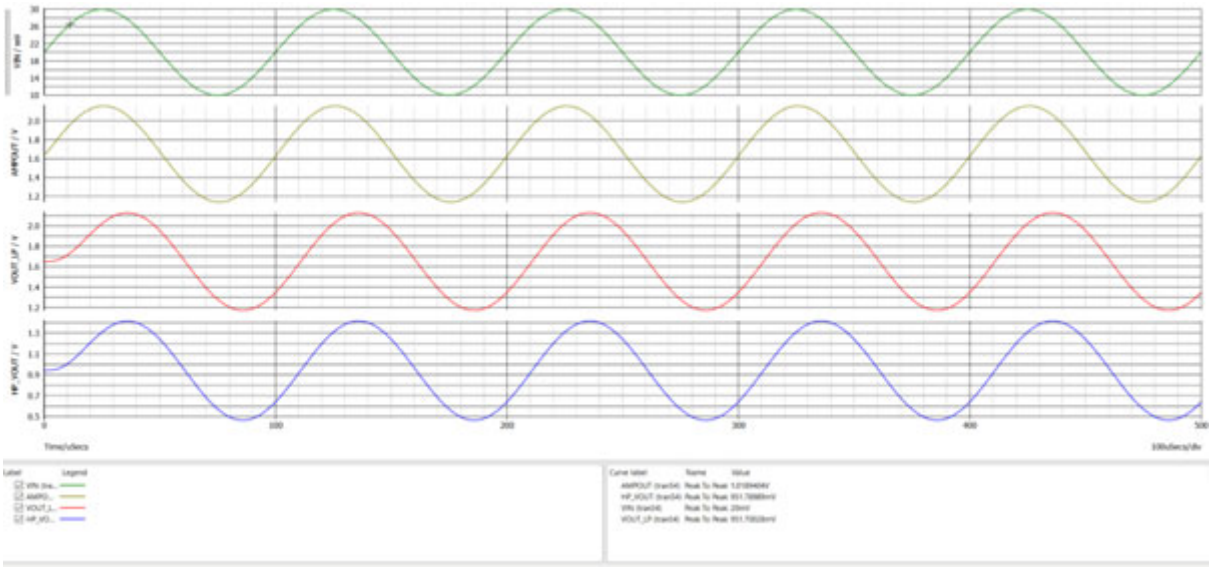
3.2 DC APPLICATION TRANSIENT ANALYSIS



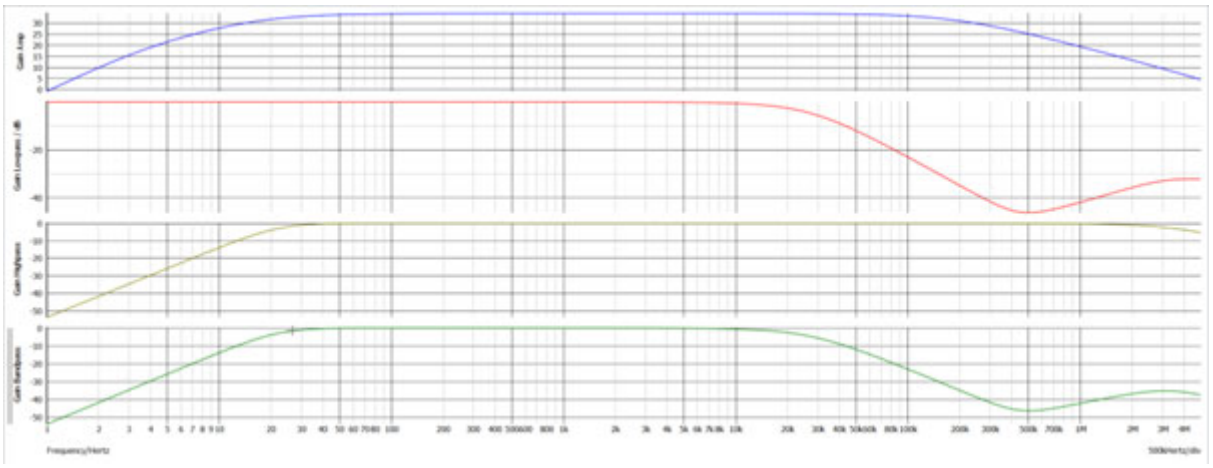
3.3 DC APPLICATION AC ANALYSIS



3.4 AC APPLICATION TRANSIENT ANALYSIS



3.5 AC APPLICATION AC ANALYSIS



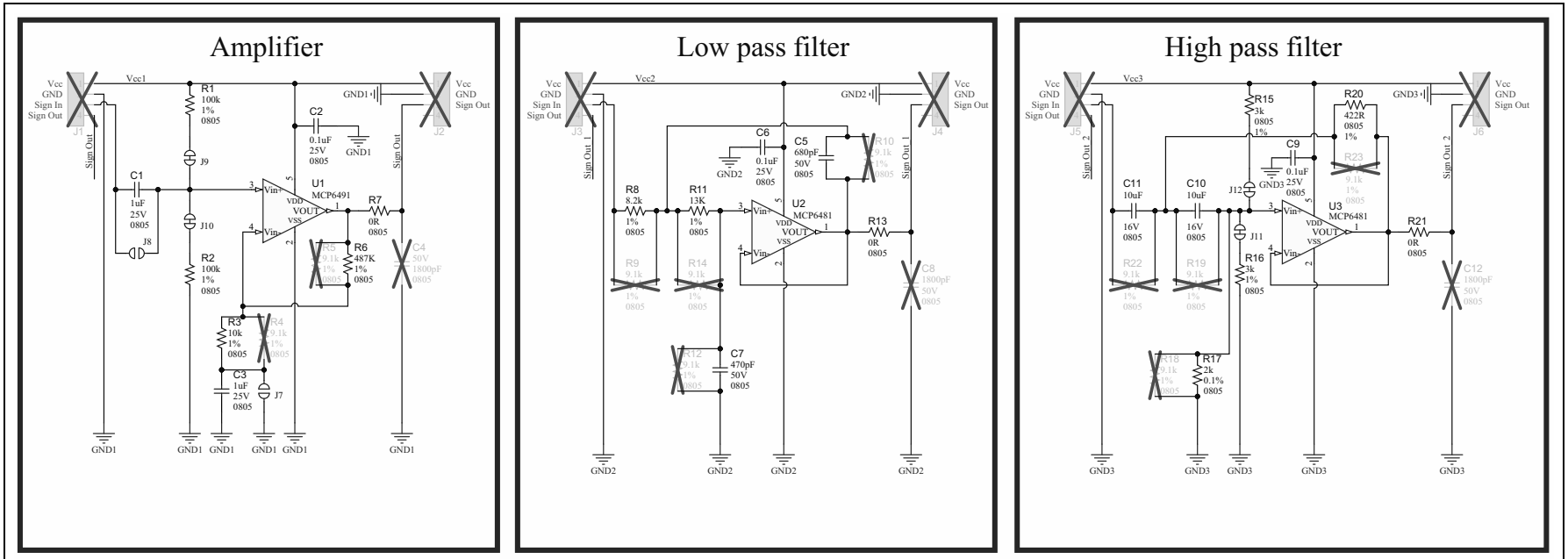
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

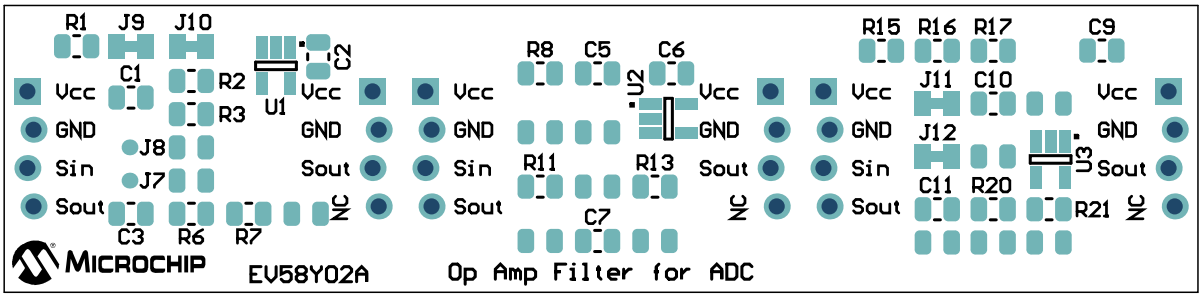
This chapter lists the parts used to build the EV58Y02 Configurable Amp and Filter Evaluation Board, as follows:

- EV58Y02 - Schematic
- EV58Y02 - Top Silk
- EV58Y02 - Top Copper and Silk
- EV58Y02 - Top Copper
- EV58Y02 - Bottom Copper
- EV58Y02 - Bottom Copper and Silk
- EV58Y02 - Bottom Silk

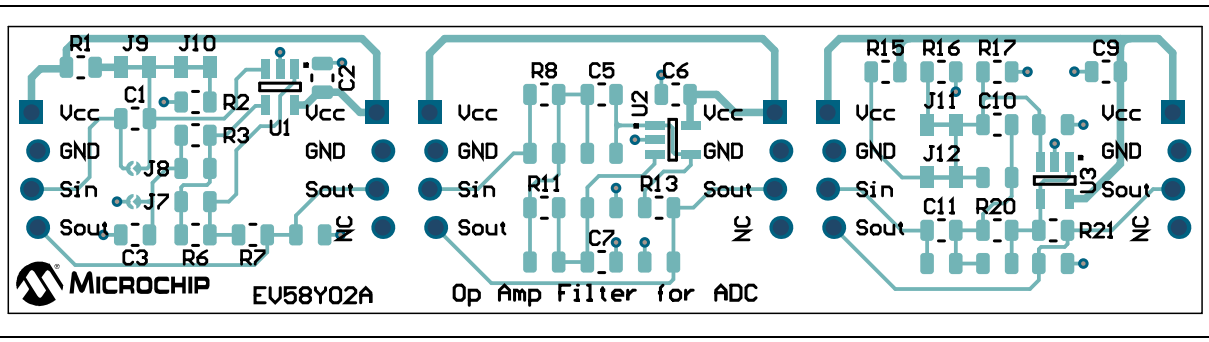
A.2 EV58Y02 - SCHEMATIC



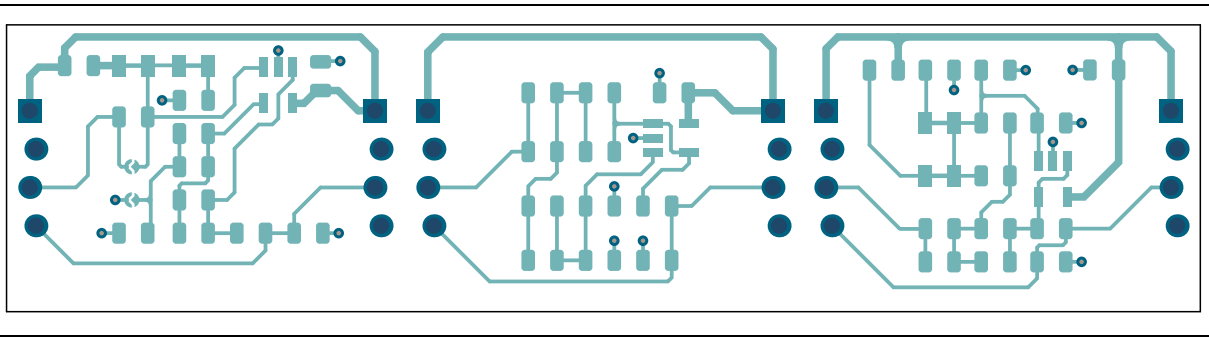
A.3 EV58Y02 - TOP SILK



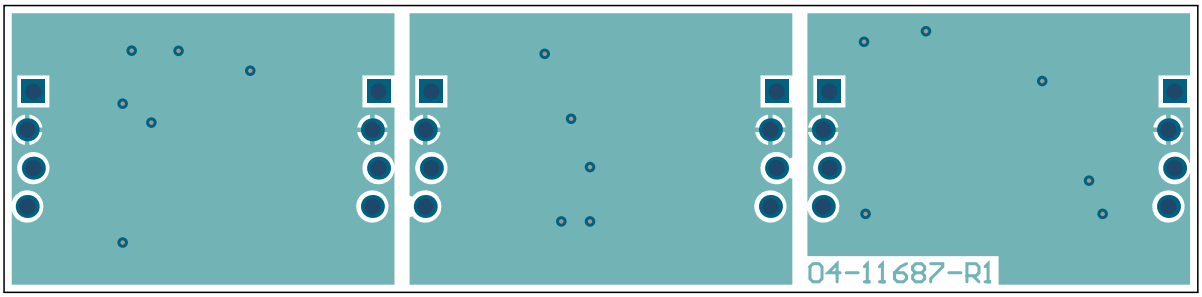
A.4 EV58Y02 - TOP COPPER AND SILK



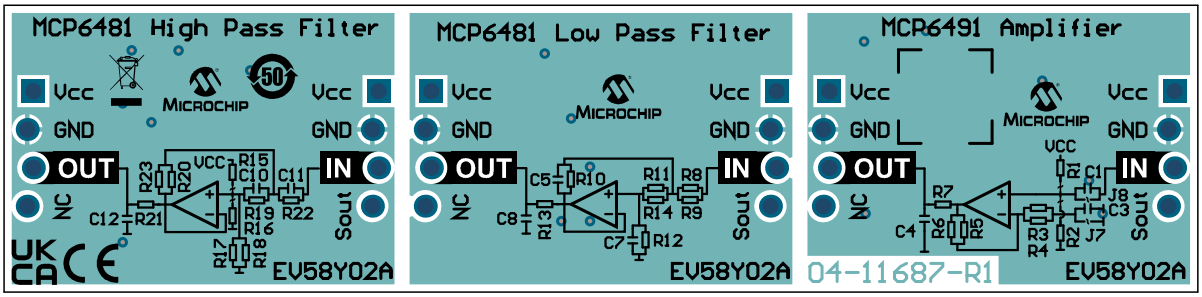
A.5 EV58Y02 - TOP COPPER



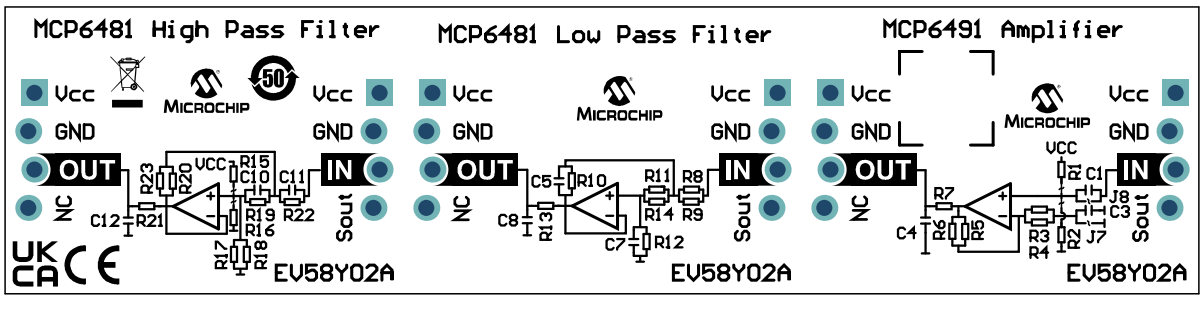
A.6 EV58Y02 - BOTTOM COPPER



A.7 EV58Y02 - BOTTOM COPPER AND SILK



A.8 EV58Y02 - BOTTOM SILK



Appendix B. Bill of Materials (BOM)

B.1 EV58Y02 CONFIGURABLE AMP AND FILTER EVALUATION BOARD - BILL OF MATERIALS (BOM)

TABLE B-1: EV58Y02 CONFIGURABLE AMP AND FILTER EVALUATION BOARD - BOM

Qty.	Reference	Description	Manufacturer	Part Number
2	C1, C3	Ceramic Capacitor, 1 µF, 25V, 10%, X7R, Surface Mount, 0805.	KEMET	C0805C105K3RACTU
2	C10, C11	Ceramic Capacitor, 10 µF,16V, 10%, X5R, Surface Mount, 0805.	Murata Electronics North America, Inc.	GRM21BR61C106KE15L
3	C2, C6, C9	Ceramic Capacitor, 0.1 µF, 25V, 10%, X7R, Surface Mount, 0805.	KEMET	C0805C104K3RACTU
1	C5	Ceramic Capacitor, 680 pF, 50V, 5%, X7R, Surface Mount, 0805.	Kyocera AVX	08055C681JAT2A
1	C7	Ceramic Capacitor, 470 pF, 50V, 5%, NP0, Surface Mount, 0805.	Murata Electronics North America, Inc.	GRM2165C1H471JA01D
1	LABEL	Label, PCBA, 6x6 mm, Info Text.	ACT Logimark AS	505462
1	PCB1	EV58Y02 Configurable Amp and Filter Evaluation Board - Printed Circuit Board.	Microchip Technology inc.	**04-11687-R1**
2	R1, R2	Resistor, Thick Film, 100 kΩ, 1%, 1/8W, Surface Mount, 0805.	Panasonic Industry Co., Ltd.	ERJ-6ENF1003V
1	R11	Resistor, Thick Film, 13 kΩ, 1%, 1/8W, Surface Mount, 0805.	Panasonic Industry Co., Ltd.	ERJU06F1302V
2	R15, R16	Resistor, Thick Film, 3 kΩ, 1%, 1/8W, Surface Mount, 0805.	Panasonic Industry Co., Ltd.	ERJ-6ENF3001V
1	R17	Resistor, Thin Film, 2 kΩ, 0.1%, 1/10W, Surface Mount, 0805.	Stackpole Electronics, Inc.	RNCS0805BKE2K00
1	R20	Resistor, Thick Film, 422R, 1%, 1/8W, Surface Mount, 0805.	Panasonic Industry Co., Ltd.	ERJ-U06F4220V
1	R3	Resistor, Thick Film, 10 kΩ, 1%, 1/8W, Surface Mount, 0805.	Vishay/Dale	CRCW080510K0FKEA
1	R6	Resistor, Surface Mount, 487 kΩ, 1%, 1/8W, 0805.	Panasonic Industry Co., Ltd.	ERJ-U06F4873V
3	R7, R13, R21	Resistor, Thick Film, 0R, 1/8W, Surface Mount, 0805.	Panasonic Industry Co., Ltd.	ERJ-6GEY0R00V
1	R8	Resistor, Thick Film, 8.2 kΩ, 1%, 1/8W, Surface Mount, 0805.	Yageo Corporation	RC0805FR-078K2L
1	U1	MCHP Analog OP AMP 1-Ch 7.5 MHz MCP6491T-E/OT SOT-23-5.	Microchip Technology inc.	**MCP6491T-E/OT**
2	U2, U3	MCHP Analog OP AMP 1-Ch 4 MHz MCP6481T-E/OT SOT-23-5.	Microchip Technology inc.	**MCP6481T-E/OT**

TABLE B-2: EV58Y02 CONFIGURABLE AMP AND FILTER EVALUATION BOARD - BOM (NOT POPULATED)

Qty.	Reference	Description	Manufacturer	Part Number
0	C4, C8, C12	Ceramic Capacitor, 1800 pF, 50V, 10%, X7R, Surface Mount, 0805.	Kyocera AVX	08055C182KAT2A\4K
0	J1, J2, J3, J4, J5, J6	Connector, HDR-2.54, Male, 1x4, Gold, 5.84 MH, Through Hole, Vertical.	Wurth Elektronik	61300411121
0	R4, R5, R9, R10, R12, R14, R18, R19, R22, R23	Resistor, Thick Film, 9.1 kΩ, 1%, 1/8W, Surface Mount, 0805.	Panasonic Industry Co., Ltd.	ERJ-6ENF9101V

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