Amplifier Mezzanine Card User Guide

UG-1224

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Amplifier Mezzanine Card for ADC Drivers

FEATURES

Enables quick breadboarding and prototyping
User defined circuit configuration
Easy connection to other ADC evaluation boards

COMPATIBLE PULSAR EVALUATION BOARDS

10-lead PulSAR® evaluation board

GENERAL DESCRIPTION

The Analog Devices, Inc., amplifier mezzanine card (AMC) analog-to-digital converter (ADC) driver evaluates the performance of amplifiers in 8-lead, single and dual SOIC, 6-lead single SOT23, 8-lead dual MSOP, and 16-lead LFCSP packages. This add on board can be inserted on ADC evaluation boards using its 7-pin header. Figure 1 shows the AMC mounted on an Analog Devices, Inc., ADC evaluation board.

The AMC can support any of Analog Devices operational amplifiers and ADC drivers in different packages. The user can configure the ADC driver as a Sallen-Key low-pass, high-pass, or band-pass filter, as a multiple feedback low-pass, high-pass, or band-pass filter, or as an inverting and noninverting operational amplifier. The user can also configure the AMC to drive a single-ended, fully differential, or a single-ended signal to a differential ADC.

Optimized power and ground planes ensure low noise and high speed operation. Component placement and power supply bypassing are optimized for maximum circuit flexibility and performance. The AMC evaluation board accepts 0402 or 0603 surface mount technology (SMT) components, 1206 bypass capacitors, and 2.54 mm headers.

All components are placed on the primary side. No components are placed on the secondary side.

EVALUATION BOARD PHOTOGRAPH

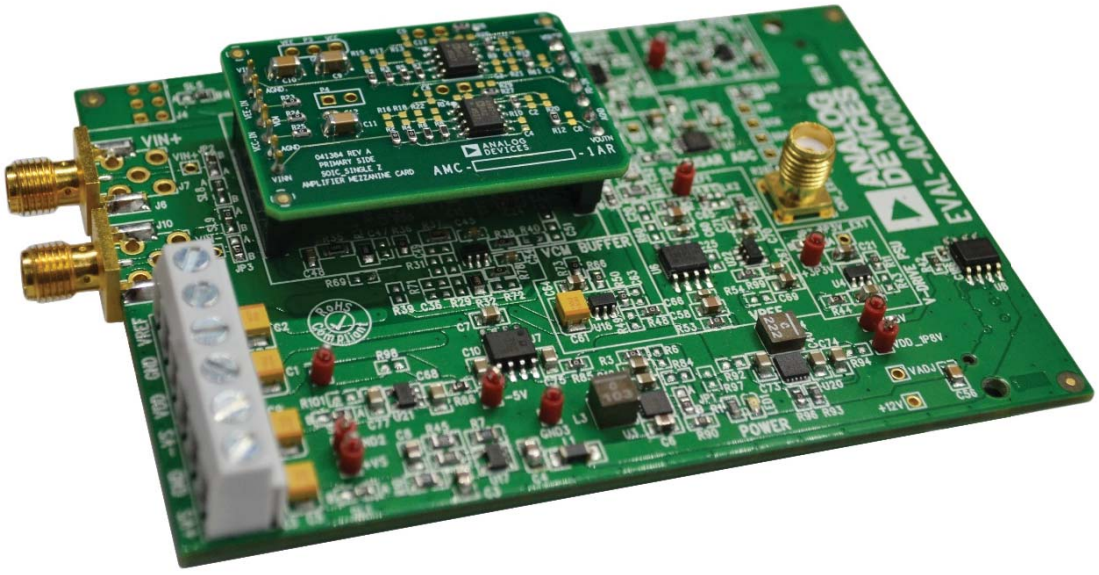

Figure 1.

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REVISION HISTORY

1/2019—Revision 0: Initial Version

BOARD ASSEMBLY

INTRODUCTION

The AMC allows the user to set the ADC driver to different types of active filter configurations and op amp layouts such as inverting and noninverting. The user can also configure the AMC to drive a single-ended, fully differential, and a single-ended signal to differential ADC.

SINGLE AMPLIFIER

The AMC for single amplifiers can support ADC drivers that come in 8-lead SOIC and 6-lead SOT23 packages (see Figure 2 and Figure 3).

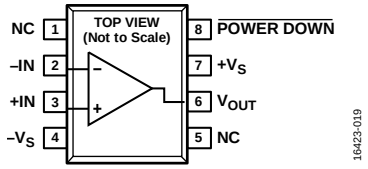

Figure 2. Example of a Single Amplifier in SOIC Package

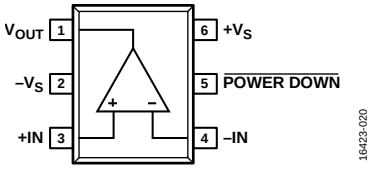

Figure 3. Example of a Single Amplifier on SOT23 Package

Low-Pass Filter

The user can configure a Sallen-Key, low-pass filter on the AMC.

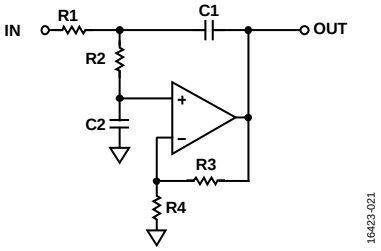

Figure 4. Sallen-Key, Low-Pass Filter

Place user defined capacitors on the R7 and R8 resistors, user defined capacitors on the C3 and C4 board positions, and resistors on the R1, R2, R3, R4, R9, R10, R17, and R18 resistors. Place a 0 Ω resistor on C5 and C6 for the feedback to achieve the Sallen-Key low-pass filter configuration.

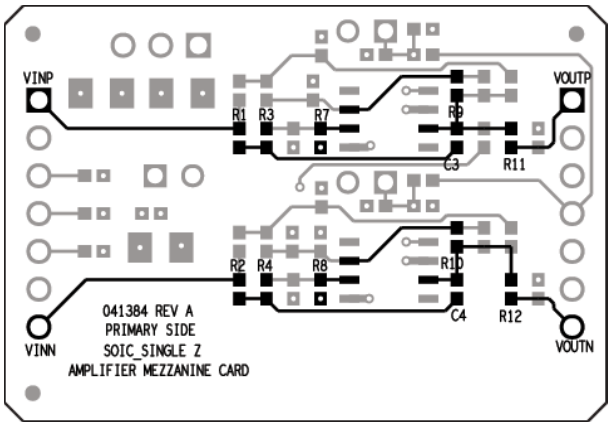

Figure 5. Sallen-Key, Low-Pass Filter for 8-Lead SOIC, Single Board Connections

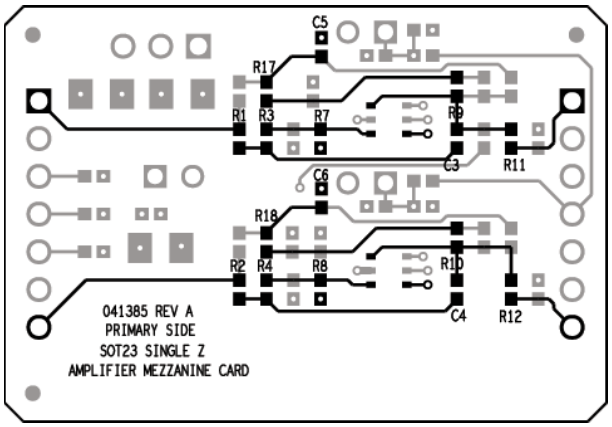

Figure 6. Sallen-Key, Low-Pass Filter for 6-Lead SOT23, Single Board Connections

Multiple Feedback, Low-Pass Filter

The user can configure a multiple feedback, low-pass filter on the AMC.

Place a 0 Ω resistor on R7 and R8 to connect the noninverting input to ground, and place the user defined capacitors on the C1, C2, C5, and C6 capacitors and the resistors on the R15, R16, R17, R18, R19, and R20 resistors.

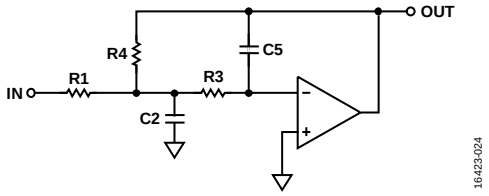

Figure 7. Multiple Feedback, Low-Pass Filter

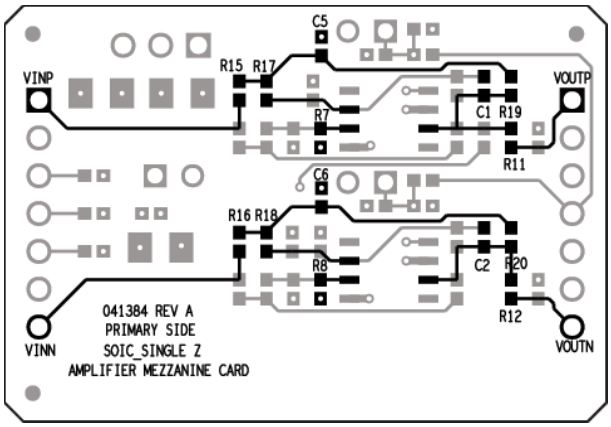

Figure 8. Multiple Feedback, Low-Pass Filter for 8-Lead SOIC, Single Board Connections

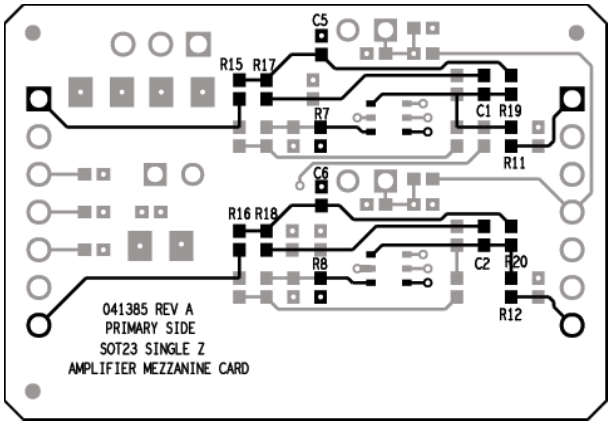

Figure 9. Multiple Feedback, Low-Pass for 6-Lead SOT23, Single Board Connections

High-Pass Filter

Place capacitors on the R1, R2, R3, and R4 resistors, resistors on the R7, R8, R9, R10, R17, and R18 resistors, and resistors on the C3 and C4 capacitors. Place a 0 Ω resistor on C5 and C6 to configure the AMC board into a Sallen-Key high-pass filter. This configuration is similar to the low-pass filter except replace the resistors on the noninverting input to capacitors and vice versa.

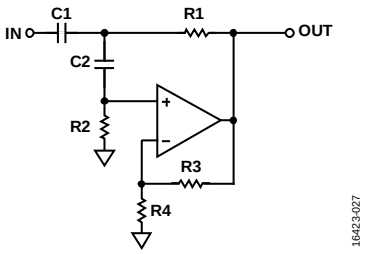

Figure 10. Sallen-Key, High-Pass Filter

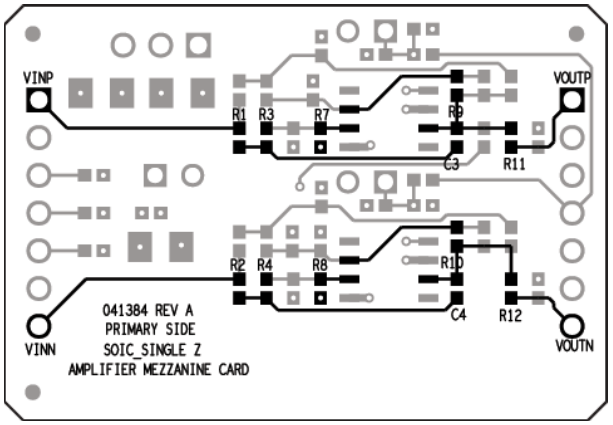

Figure 11. Sallen-Key, High-Pass Filter for 8-Lead SOIC, Single Board Connections

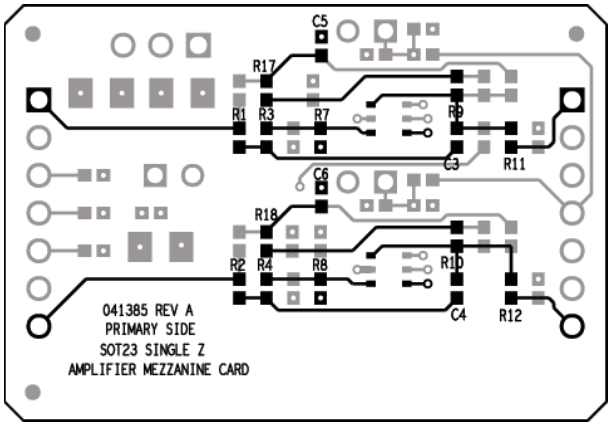

Figure 12. Sallen-Key, High-Pass Filter for 6-Lead SOT23, Single Board Connection

For the multiple feedback, high-pass filter configuration, place the user defined capacitors on the R15, R16, R17, R18, R19, and R20 resistors, resistors on the R9 and R10 resistors, and resistors on the C5 and C6 capacitors. Place a 0 Ω resistor on R7 and R8.

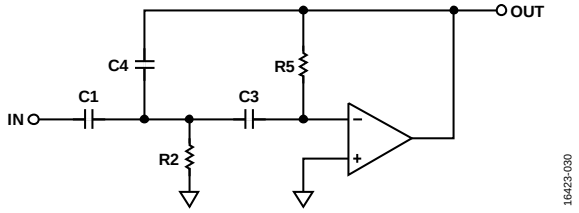

Figure 13. Multiple Feedback, High-Pass Filter

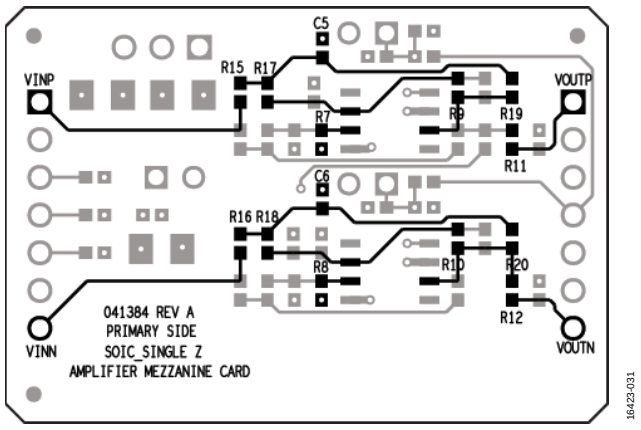

Figure 14. Multiple Feedback, High-Pass Filter for 8-Lead SOIC, Single Board Connections

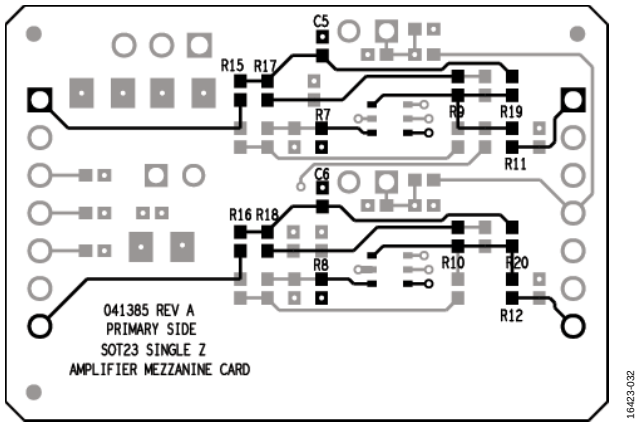

Figure 15. Multiple Feedback, High-Pass Filter for 6-Lead SOT23, Single Board Connections

Band-Pass Filter

In a Sallen-Key, band-pass filter, place capacitors on the R3, R4, R5, and R6 resistors, resistors on the R1, R2, R7, R8, R9, R10, R13, and R14 resistors, and resistors on the C3 and C4 capacitors. Place a 0 Ω resistor on C5 and C6 and put a jumper on P3 to short VCM to ground.

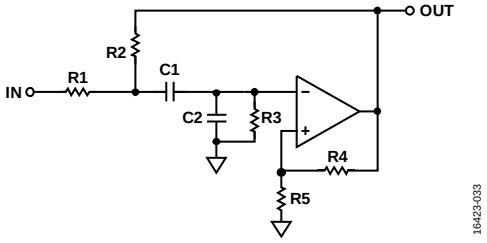

Figure 16. Sallen-Key, Band-Pass Filter

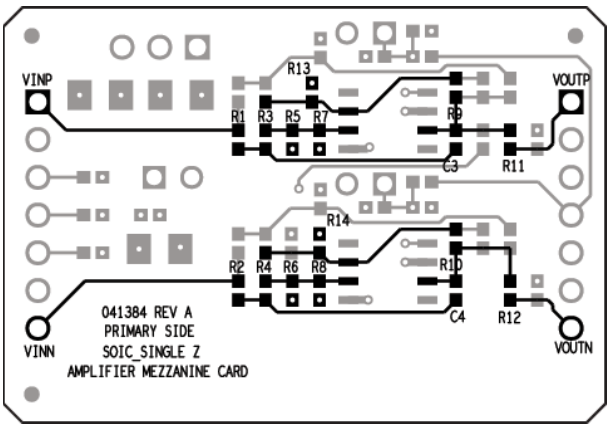

Figure 17. Sallen-Key, Band-Pass Filter for 8-Lead SOIC, Single Board Configuration

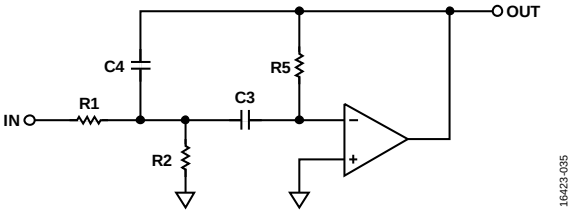

Figure 18. Multiple Feedback, Band-Pass Filter

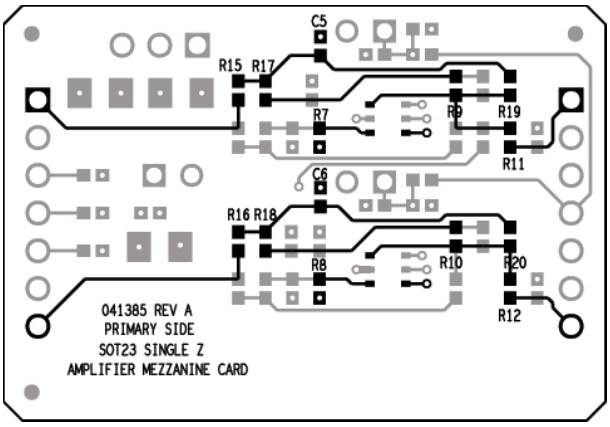

Figure 19. Multiple Feedback, Band-Pass Filter for 8-Lead SOIC, Single Board Connections

To achieve a multiple feedback, band-pass filter, place capacitors on the R17, R18, R19, and R20 resistors, resistors on the R9, R10, R15, and R16 resistors, and resistors on the C5 and C6 capacitors. Place a 0 Ω resistor on R7 and R8.

Inverting Configuration

For the inverting configuration, place 0 Ω resistors on R7, R8, R15, and R16. Place the user defined resistor values to set the gain of the amplifier on R9 and R10 for R_F and R17 and R18 for R_G.

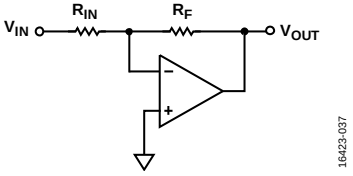

Figure 20. Inverting Amplifier

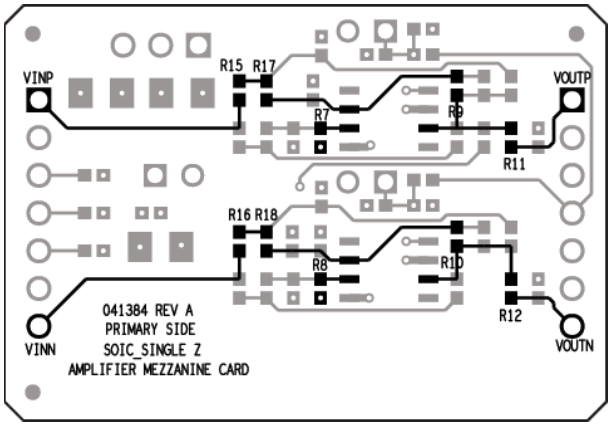

Figure 21. Inverting Amplifier for 8-Lead SOIC, Single Board Configuration

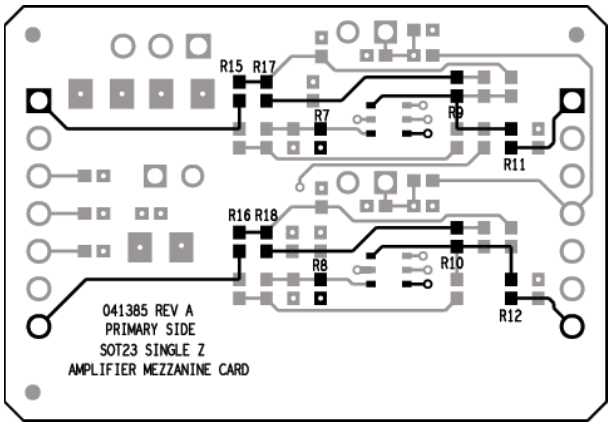

Figure 22. Inverting Amplifier for 6-Lead SOT23, Single Board Configuration

Noninverting Configuration

To configure the AMC board into a noninverting amplifier, place 0 Ω resistors at R1, R2, R3, and R4 to connect the input to the noninverting input of the amplifier. To set the gain of the amplifier, place the user defined resistor values on R9 and R10 for R_F and R17 and R18 for R_G and place a 0 Ω resistor on C5 and C6 to connect R_G to ground.

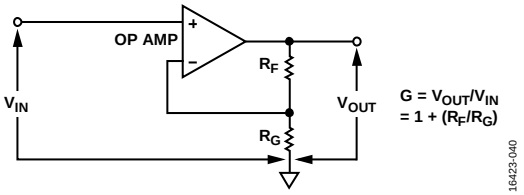

Figure 23. Noninverting Amplifier Configuration

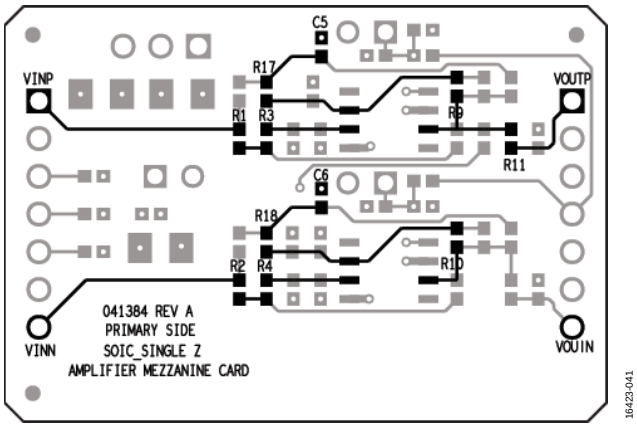

Figure 24. Noninverting Amplifier for 8-Lead SOIC, Single Board Configuration

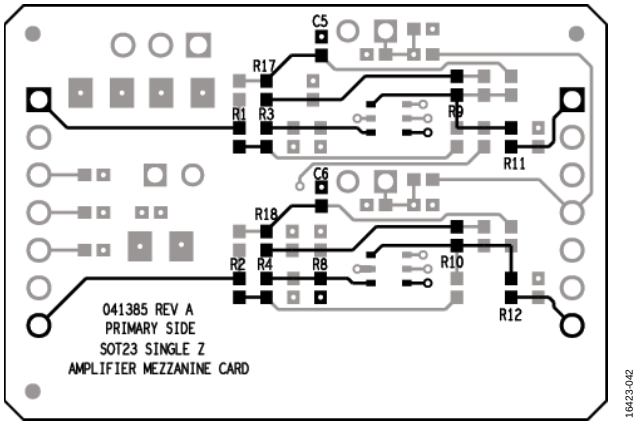

Figure 25. Noninverting Amplifier Configuration for 6-Lead SOT23, Single Board Configuration

DUAL AMPLIFIER

The AMC also supports dual amplifiers that can aid op amps and ADC drivers that come in 8-lead MSOP and 8-lead SOIC packages. Dual amplifier have two amplifiers inside one package.

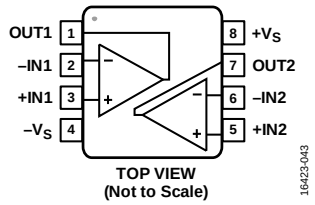

Figure 26. Dual Amplifier, 8-Lead MSOP (RM) and 8-Lead SOIC (R) Package

Low-Pass Filter

Similar to single amplifiers, the user can configure the dual amplifier to different types of filter topologies except instead of two ICs, the user only uses one IC.

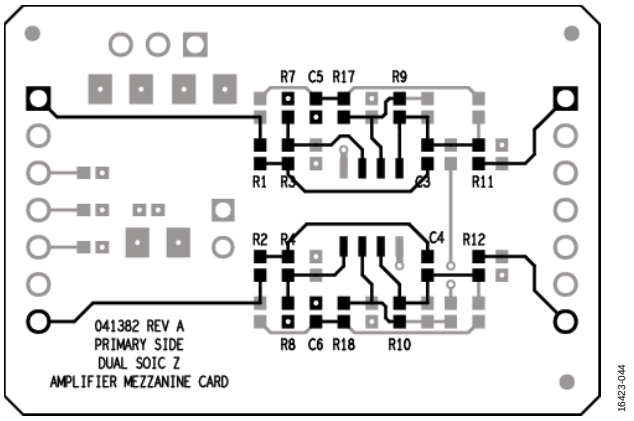

Figure 27. Sallen-Key, Low-Pass Filter 8-Lead SOIC, Dual Board Configuration

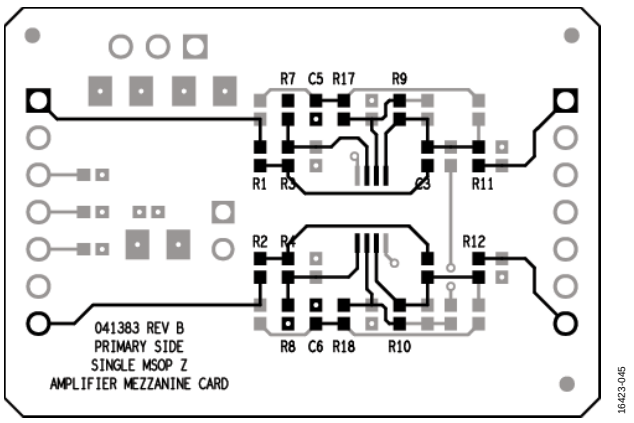

Figure 28. Sallen-Key, Low-Pass Filter 8-Lead MSOP, Dual Board Configuration

A Sallen-Key, low-pass filter can also be configured on the dual AMC. To set the cutoff frequency of the filter, place the user defined resistor values for the filter on R1 and R3 on one amplifier and R2 and R4 for the other one. Place the user defined capacitor values on R7 and C3 for the first amplifier and R8 and C4 for the second amplifier. To set the gain of the amplifier, place the necessary feedback resistors on R9 and R10 for the first and second amplifiers, as well as R_G on R17 and R18. Then, place a 0 Ω resistor on C5 and C6 to connect R_G straight to ground.

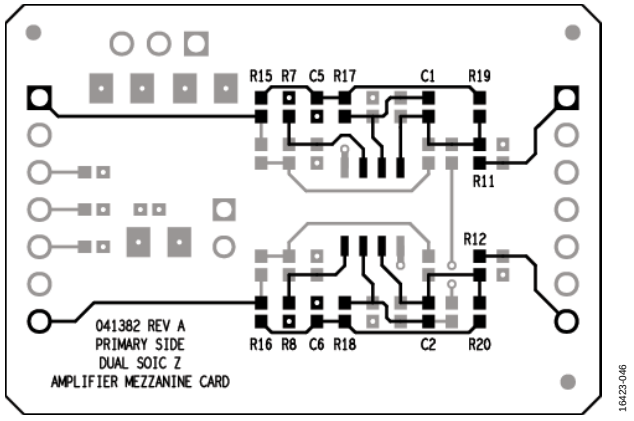

Figure 29. Multiple Feedback Low-Pass Filter 8-Lead SOIC, Dual AMC Configuration

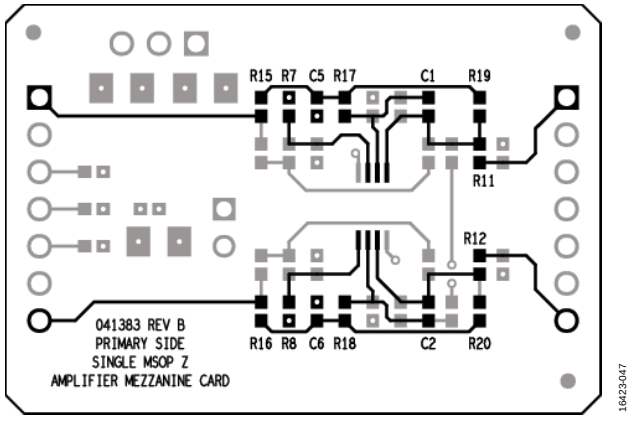

Figure 30. Multiple Feedback, Low-Pass Filter 8-Lead MSOP, Dual AMC Configuration

For a multiple feedback configuration, place the user defined resistor values on R15, R17, and R19 for the first amplifier and R16, R18, and R20 for the second amplifier. Place the capacitors on C1 and C5 for the first amplifier and C2 and C6 for the second amplifier.

High-Pass Filter

To achieve a Sallen-Key, high-pass filter configuration, place a 0 Ω resistor at C5 and C6, then place the user defined resistor values for the gain setting on R9 and R10 (R_F) and R17 and R18 (R_G). Place resistors on R7, R8, C3, and C4 as well as capacitors on R1, R2, R3, and R4 to dictate the cutoff frequency. The configuration is almost the same as in Sallen-Key, low-pass filter, but the resistors and capacitors interchange in the noninverting input of the amplifier.

In the case of a multiple feedback, high-pass filter, place the 0 Ω resistor on R7 for the first amplifier and R8 for the second. Then, place the user defined resistor values on C5 and R9 for the first amplifier and C6 and R10 for the second amplifier. Then, place capacitors on R15, R17, and R19 for the first amplifier and on R16, R18, and R20 for the second amplifier.

Band-Pass Filter

For a band-pass filter in a Sallen-Key configuration, connect VCM to ground and place the user defined resistor values to design the filter on R1, R2, R7, R8, C3, C4, R4, R3, R5, and R6. To set the gain of the amplifier, place R_F on R9 and R_G on R13. Do the same for the second amplifier with R_G on R14 and R_F on R10.

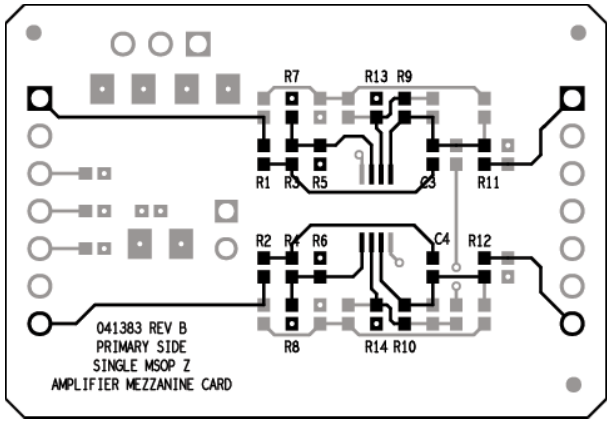

Figure 31. Sallen-Key, Band-Pass Filter for 8-Lead MSOP, Dual Board Configuration

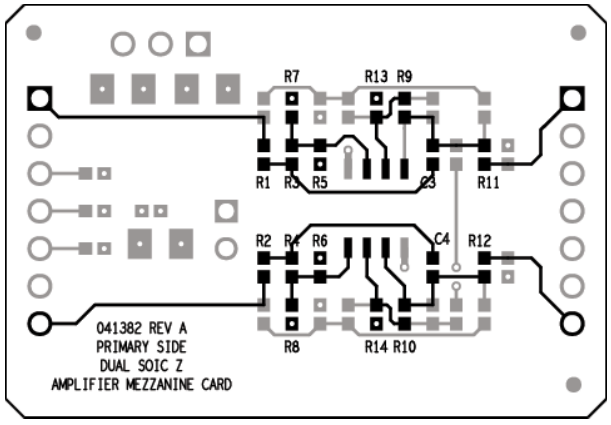

Figure 32. Sallen-Key, Band-Pass Filter for 8-Lead SOIC, Dual Board Configuration

In the case for multiple feedback, band-pass filters, mount a 0 Ω resistor on R7 and R8. Place the user defined resistor values on R9, R10, R15, R17, C5, and C6. As well as the user defined capacitors values on R17, R18, R19, and R20 (see Figure 44).

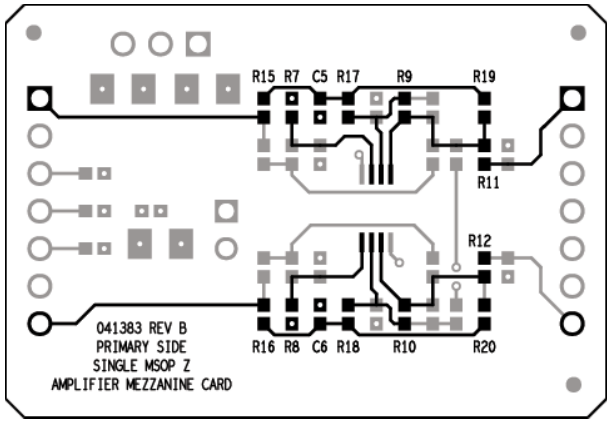

Figure 33. Multiple Feedback, Band-Pass Filter for 8-Lead MSOP, Dual Board Configuration

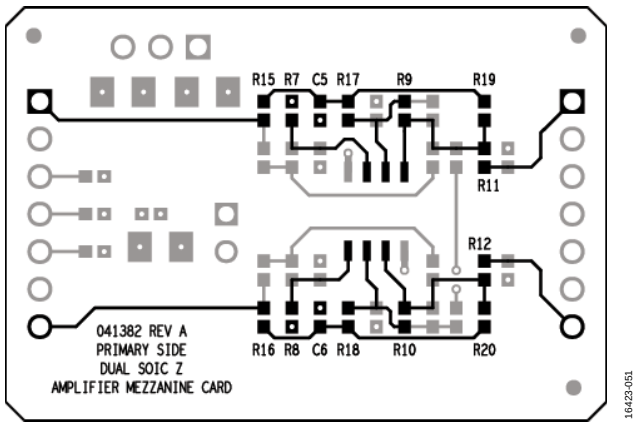

Figure 34. Multiple Feedback, Band-Pass Filter for 8-Lead SOIC, Dual Board Configuration

Inverting Configuration

Place 0 Ω resistors on R7, R8, R15, and R16. Set the gain of the amplifier with R9 and R10 for R_F and R17 and R18 for R_G.

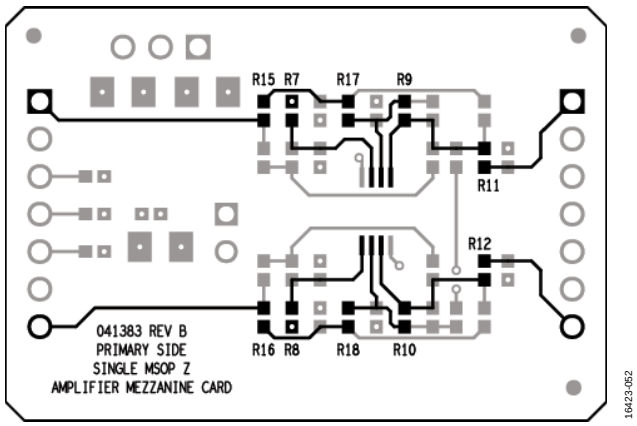

Figure 35. Inverting Amplifier for 8-Lead MSOP, Dual Board Configuration

Noninverting Configuration

Place 0 Ω resistors on R1, R2, R3, and R4 to connect the input to the noninverting input of the amplifier. Set the gain with R9 and R10 for R_F and R17 and R18 for R_G and place a 0 Ω resistor on C5 and C6 to connect R_G to ground.

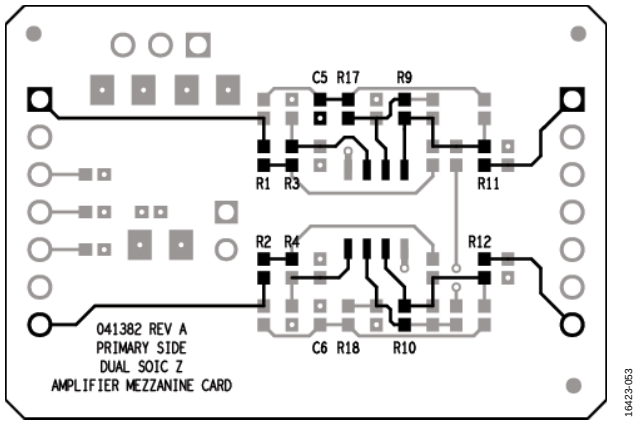

Figure 36. Noninverting Amplifier for 8-Lead SOIC, Dual Board Configuration

FULLY DIFFERENTIAL AMPLIFIER

The AMC for fully differential amplifiers supports 16-lead LFCSP packages. Two basic configurations are shown in Figure 37 and Figure 38. For additional configurations, refer to the schematic in Figure 49.

DIFFERENTIAL INPUT CONFIGURATION

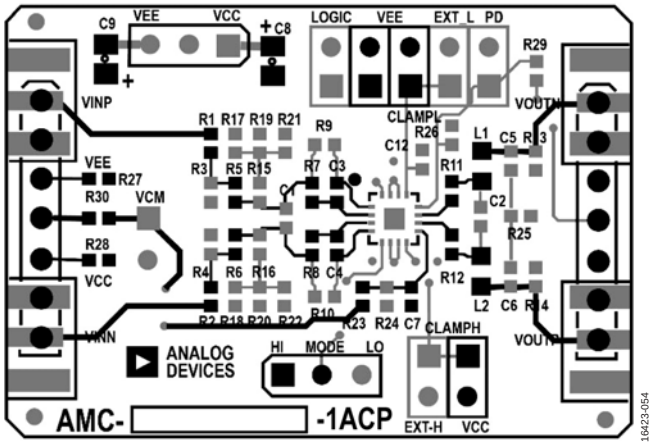

Figure 37. Standard Differential Input Configuration

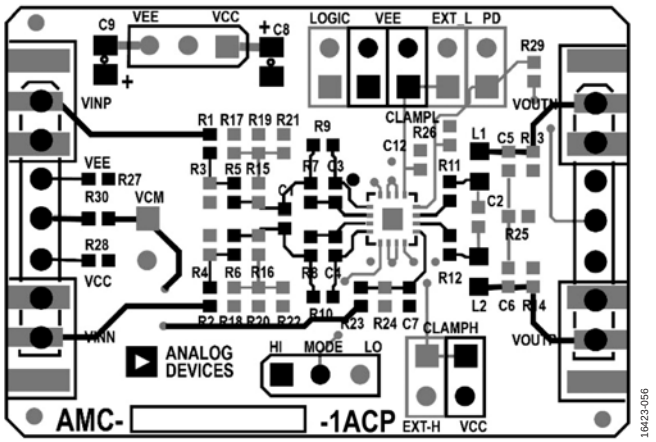

Figure 38. Multiple Feedback, Low Pass Filter Configuration

Install 0 Ω resistors on R1, R2, R5, R6, R11, R12, L1, and L2. Install 0 Ω resistors on R27, R28, R30, and R23. Install a 0.1 µF capacitor on C7. Install supply bypass capacitors on C8 and C9. C3 and C4 are the feedback resistors. R7 and R8 are the gain resistors. Install jumpers on the second and third positions on the MODE jumper and CLAMPH jumper (see Figure 37).

MULTIPLE FEEDBACK LPF CONFIGURATION

Fully differential amplifier based, multiple feedback, low-pass filters (LPFs) can be designed using an op-amp based, multiple feedback filter configuration, as shown in Figure 39.

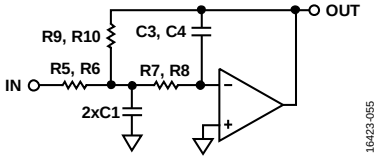

Figure 39. Multiple Feedback, Low Pass Filter

Install 0 Ω resistors on R1, R4, R11, R12, L1, L2, R27, R28, R30, and R23. Install a 0.1 µF capacitor on C7. Install jumpers on the second and third positions on the MODE jumper and CLAMPH jumper (see Figure 38).

SCHEMATIC, ASSEMBLY DRAWINGS, AND BOARD LAYOUT

8-LEAD SOIC SINGLE AMC SCHEMATIC

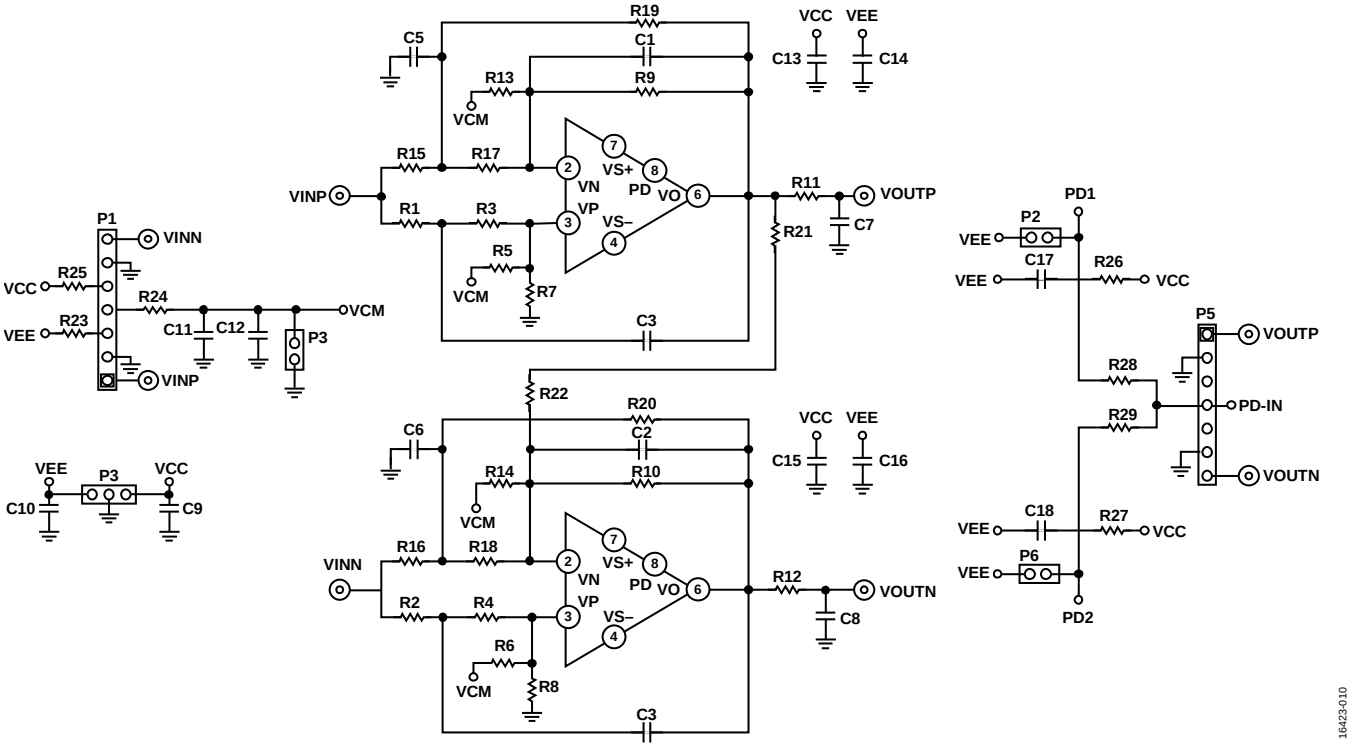

Figure 40. 8-Lead SOIC, Single AMC Schematic

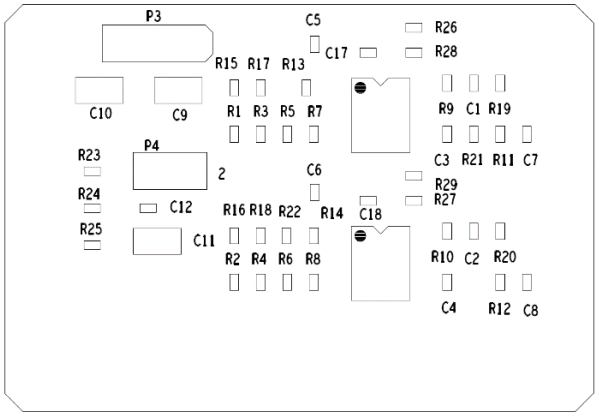

Figure 41. 8-Lead SOIC, Single AMC Assembly Drawing, Primary Side

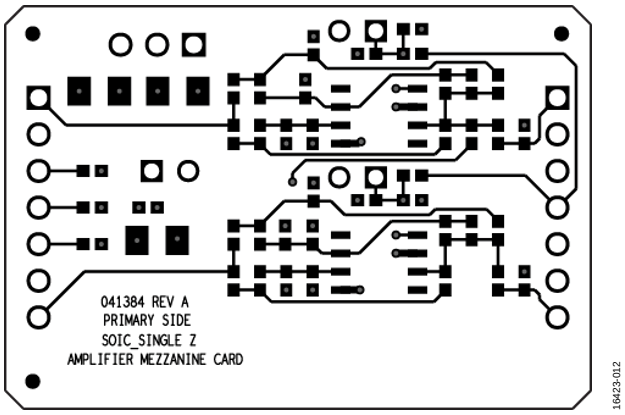

Figure 42. 8-Lead SOIC, Single AMC Layout Pattern, Primary Side

6-LEAD SOT23 SINGLE AMC SCHEMATIC

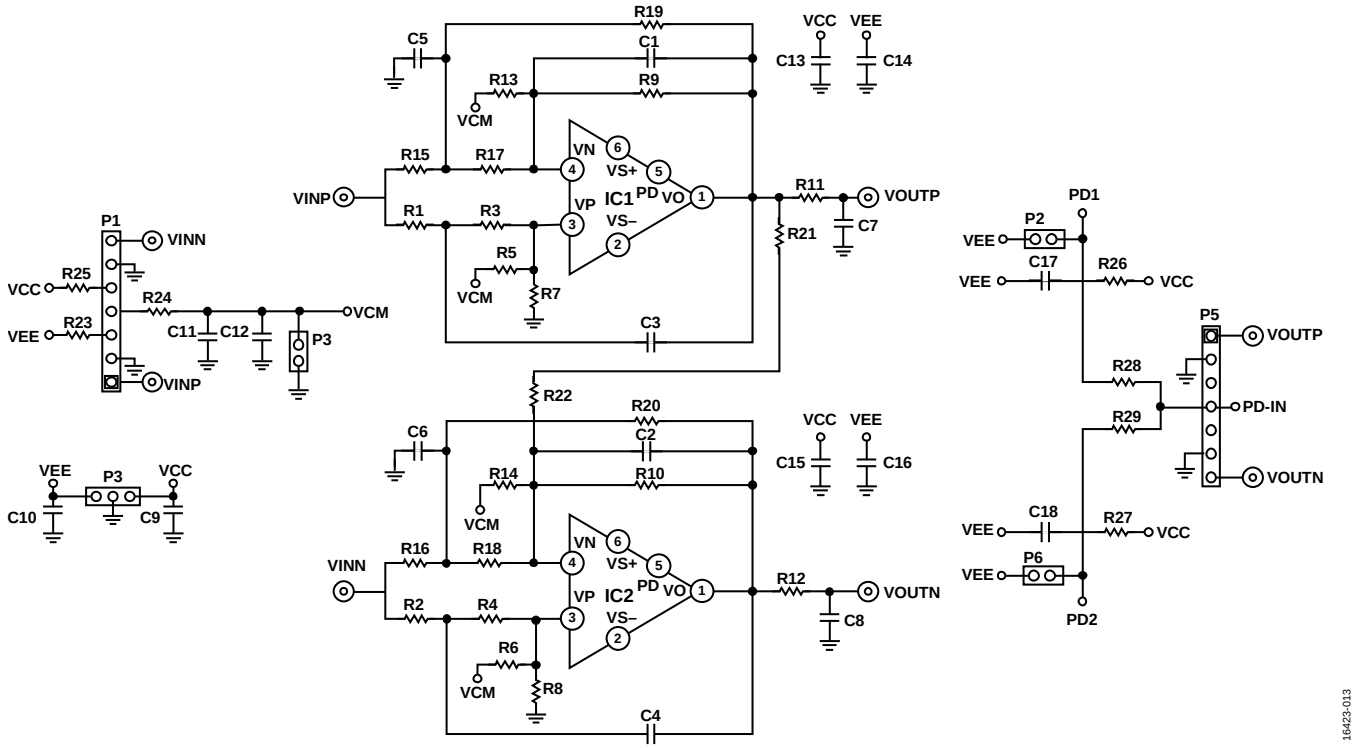

Figure 43. 6-Lead SOT23, Single AMC Schematic

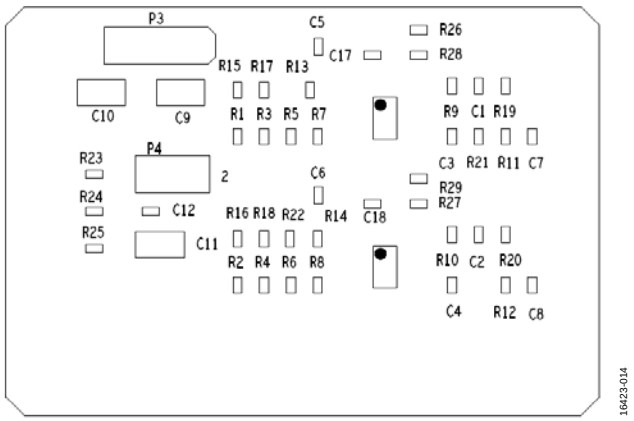

Figure 44. 6-Lead SOT23, Single AMC Assembly Drawing, Primary Side

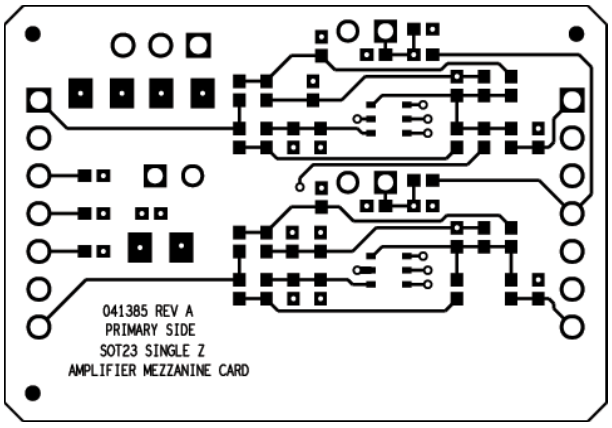

Figure 45. 6-Lead SOT23, Single AMC Layout Pattern, Primary Side

8-LEAD MSOP AND SOIC DUAL AMC SCHEMATIC

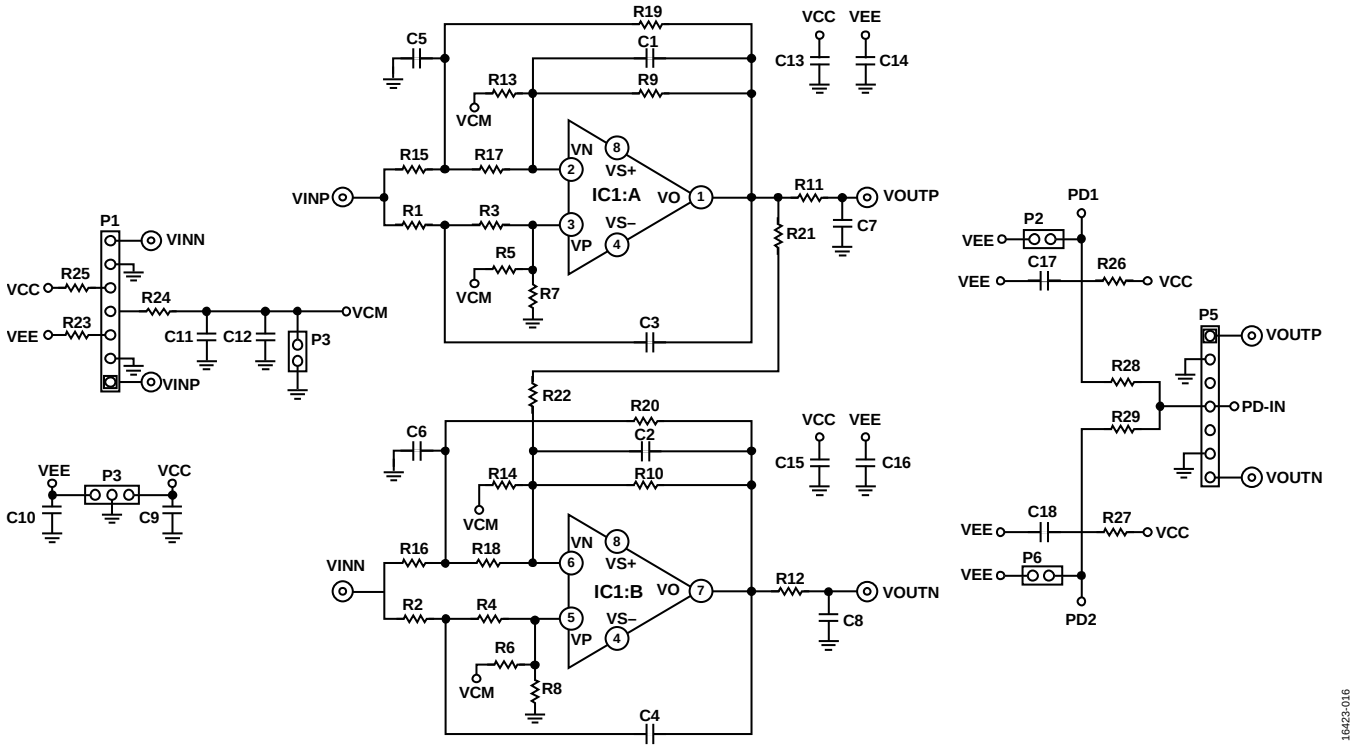

Figure 46. 8-Lead MSOP and SOIC, Dual AMC Schematic

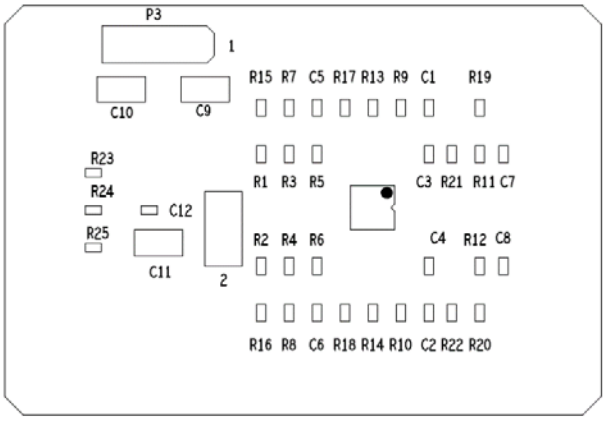

Figure 47. 8-Lead MSOP, Dual AMC Assembly Drawing, Primary Side

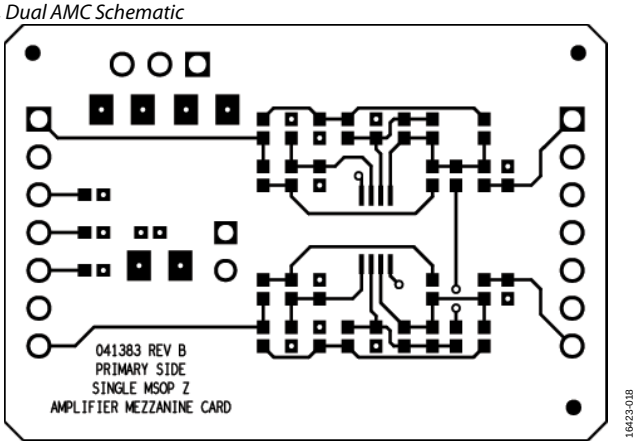

Figure 48. 8-Lead MSOP, Dual AMC Layout Pattern, Primary Side

16-LEAD LFCSP FULLY DIFFERENTIAL AMC SCHEMATIC

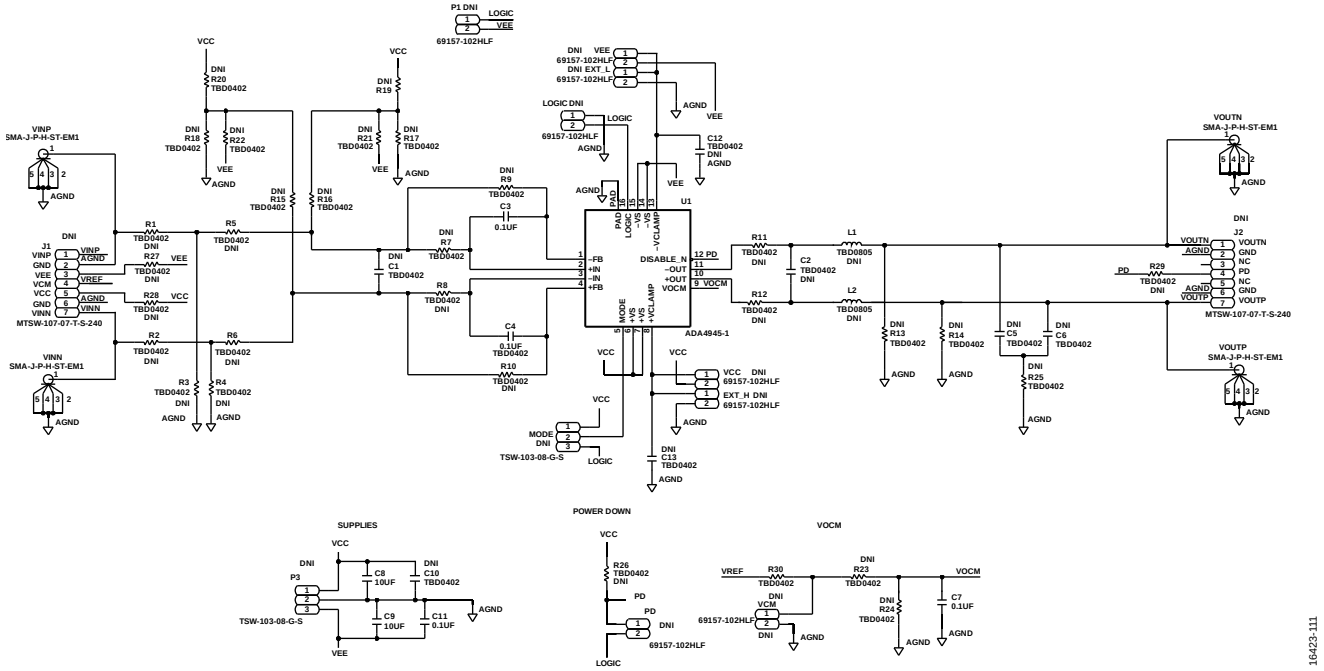

Figure 49. 16-Lead LFCSP, Single AMC Schematic

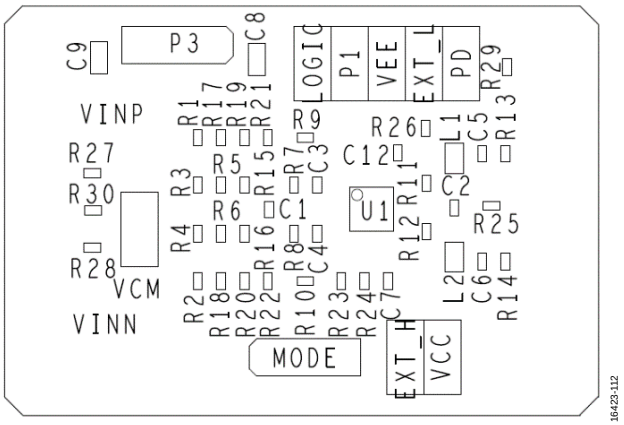

Figure 50. 16-Lead LFCSP, Single AMC Assembly Drawing, Primary Side

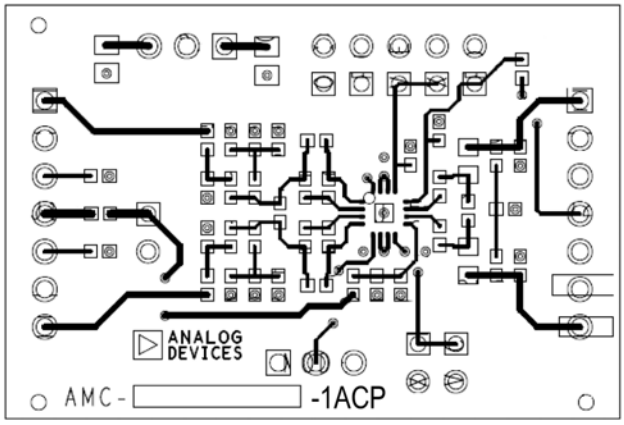

Figure 51. 16-Lead LFCSP, Single AMC Layout Pattern, Primary Side

NOTES

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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