

DYY-AMP Evaluation Module (EVM)



ABSTRACT

This user's guide contains support documentation for the DYY-AMP Evaluation Module (EVM). Included in this document is a description of how to set up and configure the EVM, printed circuit board (PCB) layout, schematic, and bill of materials (BOM) for the DYY-AMP-EVM.

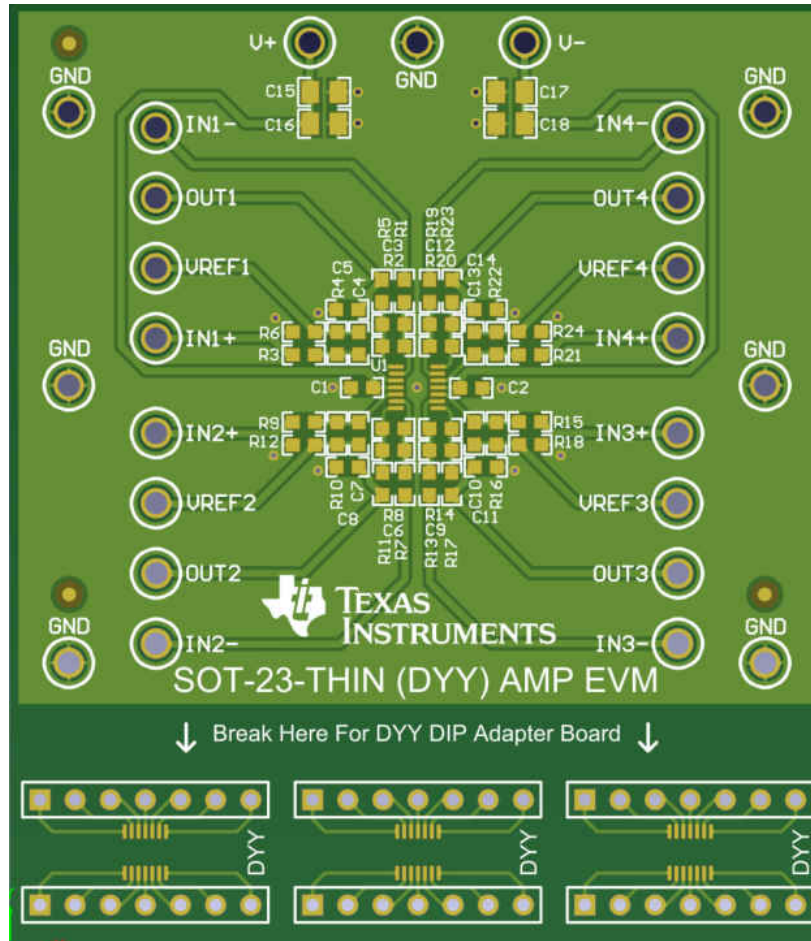


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1 Introduction

The DYY-AMP-EVM allows for quick evaluation of design concepts using SOT23-THIN (DYY) package amplifiers. The EVM can be configured into three circuit configurations: difference amplifier, non-inverting amplifier and inverting amplifier by populating different components on board. The EVM also contains removable DYY DIP adapter boards.

2 DYY-AMP-EVM Kit Contents

[Table 2-1](#) details the contents included in the DYY-AMP-EVM kit.

Table 2-1. DYY-AMP-EVM Kit Contents

Item	Description	Quantity
DYY-AMP-EVM	PCB	1
Header Strip	Header, 2.54 mm, 14× 1, Gold, TH	3

3 Circuit Configurations

By populating different components on the PCB, the DYY-AMP-EVM can be configured into three different circuits:

- Difference amplifier
- Non-inverting amplifier
- Inverting amplifier

4 Schematic and PCB Layout

This section provides the schematic and PCB layout of the DYY-AMP-EVM. Also included are the schematics for the three DYY-AMP-EVM circuit configuration options.

4.1 Schematic

Figure 4-1 displays the DYY-AMP-EVM circuit schematic.

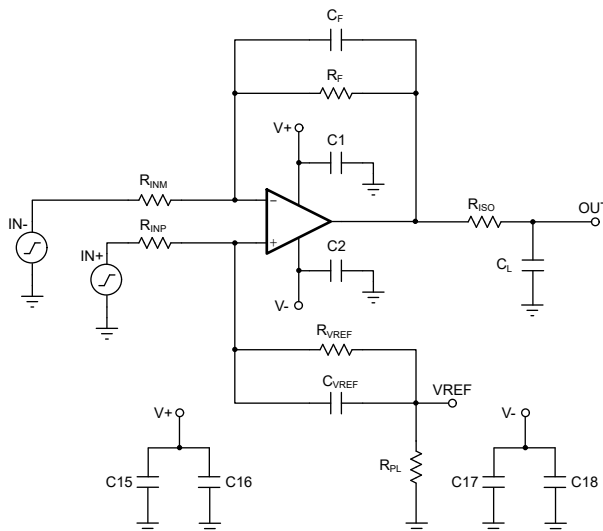


Figure 4-1. DYY-AMP-EVM Schematic

Table 4-1. DYY-AMP-EVM Components

CH	R _{INM}	R _F	C _F	R _{INP}	R _{VREF}	C _{VREF}	R _{PL}	R _{iso}	C _L
1	R1	R2	C3	R3	R4	C4	R6	R5	C5
2	R7	R8	C6	R9	R10	C7	R12	R11	C8
3	R13	R14	C9	R15	R16	C10	R18	R17	C11
4	R19	R20	C12	R21	R22	C13	R24	R23	C14

The schematic of the EVM is provided in silk screen located on the back of the PCB for easy reference. Figure 4-2 displays the schematic provided on the back of the PCB.

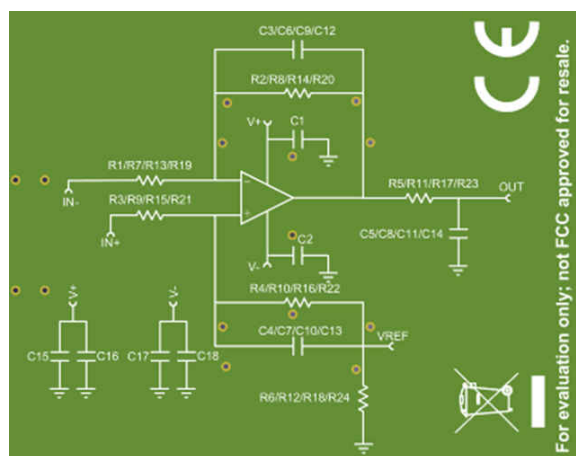


Figure 4-2. Silkscreen Schematic

4.2 Difference Amplifier

Figure 4-3 displays the schematic for the difference amplifier circuit configuration.

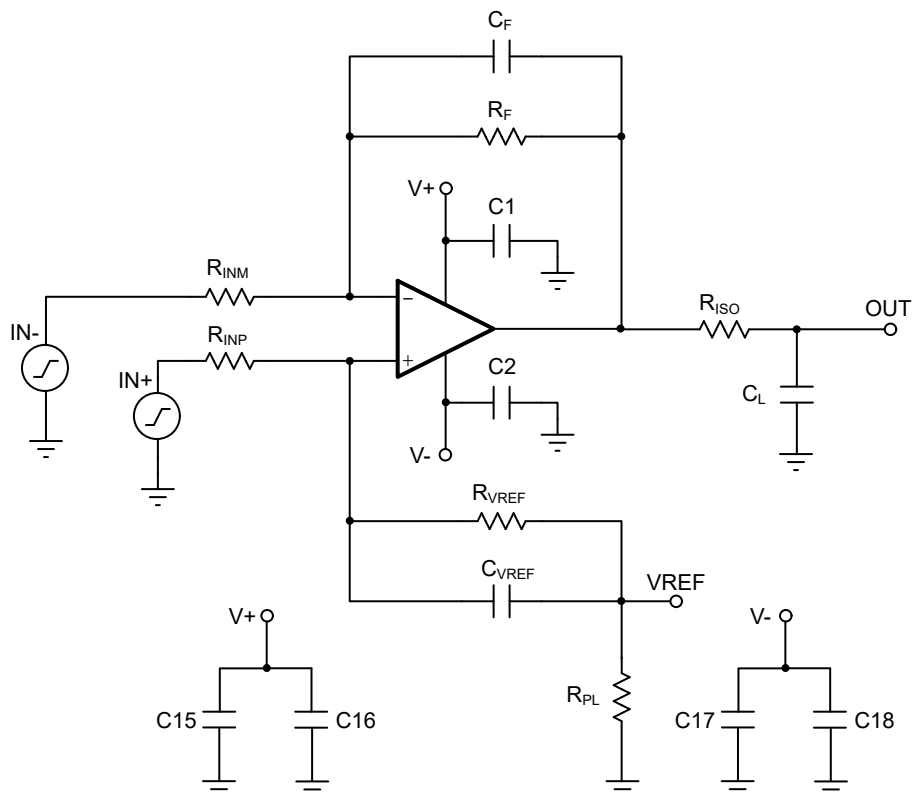


Figure 4-3. Difference Amplifier Schematic

Table 4-2. Difference Amplifier Components

CH	R _{INM}	R _F	C _F	R _{INP}	R _{VREF}	C _{VREF}	R _{PL}	R _{iso}	C _L
1	R1	R2	C3	R3	R4	C4	R6	R5	C5
2	R7	R8	C6	R9	R10	C7	R12	R11	C8
3	R13	R14	C9	R15	R16	C10	R18	R17	C11
4	R19	R20	C12	R21	R22	C13	R24	R23	C14

Equation 1 displays the transfer function of the difference amplifier circuit configuration. Note, Input signals IN+ and IN- are altered to IN_P and IN_M respectively in the transfer function for simplicity of the equation.

$$OUT = \left(\frac{R_{VREF}}{R_{INP} + R_{VREF}} \right) \times \left(1 + \frac{R_F}{R_{INM}} \right) \times IN_P + \left(\frac{R_{INP}}{R_{INP} + R_{VREF}} \right) \times \left(1 + \frac{R_F}{R_{INM}} \right) \times V_{ref} - \frac{R_F}{R_{INM}} \times IN_M \quad (1)$$

If $R_F = R_{VREF}$ and $R_{INM} = R_{INP}$, Equation 1 can simplify to Equation 2.

$$OUT = \frac{R_F}{R_{INM}} \times (IN_P - IN_M) + V_{ref} \quad (2)$$

Capacitors C_F and C_{VREF} provide the option to filter the output of the amplifier. Equation 3 calculates the cutoff frequency, f_c , of the filter; where $R_F = R_{VREF}$, $R_{INM} = R_{INP}$, and $C_F = C_{VREF}$.

$$f_c = \frac{1}{2 \times \pi \times R_F \times C_F} \quad (3)$$

Resistor R_{PL} can be used to set the V_{ref} pin to GND. A grounded V_{ref} is best used with a split power supply configuration. Do not externally drive the V_{ref} pin if R_{PL} is populated on the PCB.

Resistor R_{iso} , and capacitor C_L provide the option to create a RC filter, or test output loads for the amplifier. When not applicable, use a zero ohm resistor for R_{iso} and do not populate C_L .

Figure 4-4 displays the DYY-AMP-EVM populated with the required components to configure channel 1 as a difference amplifier with no load and V_{REF} tied to ground.

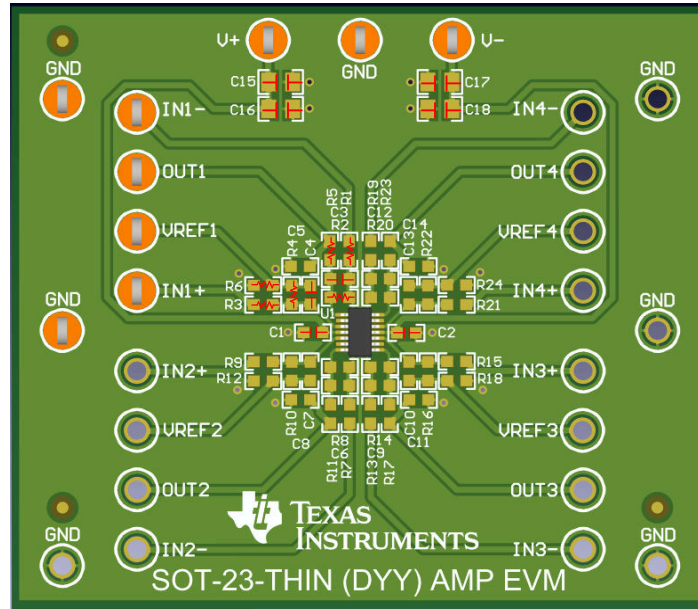


Figure 4-4. Difference Amplifier Configured on DYY-AMP-EVM, Channel 1

4.3 Non-inverting Amplifier

Figure 4-5 displays the schematic for the non-inverting amplifier circuit configuration. To configure the EVM in a non-inverting configuration short R_{INP} using a 0-Ω resistor or solder bridge, leave R_{VREF} and C_{VREF} unpopulated, and ground the input connection IN-. The input signal is applied directly to the high impedance non-inverting input terminal using the IN+ connection on the EVM.

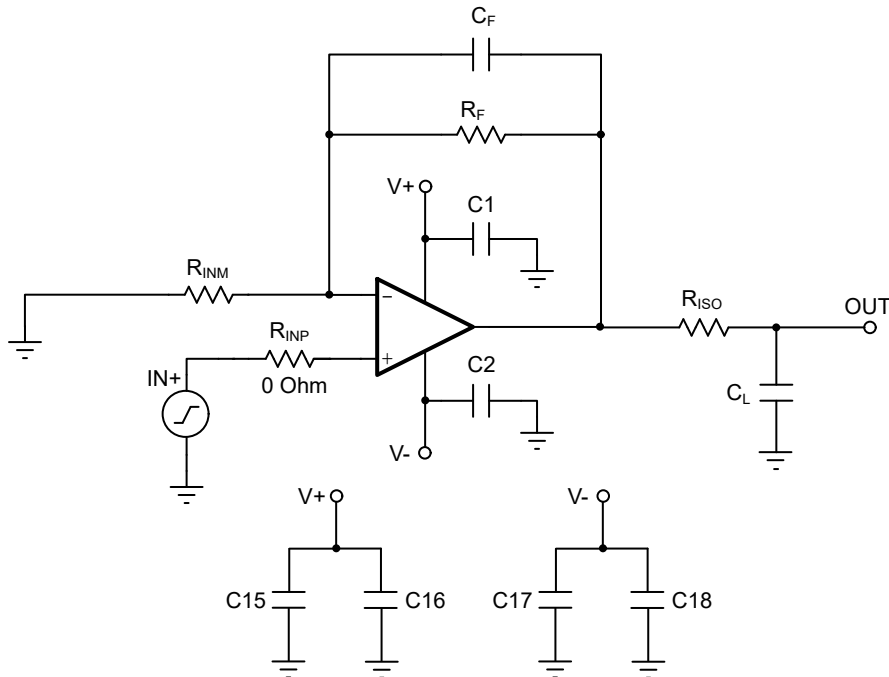


Figure 4-5. Non-inverting Amplifier Schematic

Table 4-3. Non-inverting Amplifier Components

CH	R_{INM}	R_F	C_F	R_{INP}	R_{ISO}	C_L
1	R1	R2	C3	R3	R5	C5
2	R7	R8	C6	R9	R11	C8
3	R13	R14	C9	R15	R17	C11
4	R19	R20	C12	R21	R23	C14

Equation 4 displays the DC transfer function of the non-inverting amplifier circuit configuration shown in Figure 4-5. Note, Input signals IN+ and IN- are altered to IN_P and IN_M respectively in the transfer function for simplicity of the equation.

$$OUT = \left(1 + \frac{R_F}{R_{INM}}\right) \times IN_P \quad (4)$$

Capacitor C_F provides the option to filter the output. The cutoff frequency, f_c , of the filter can be calculated using Equation 5.

$$f_c = \frac{1}{2 \times \pi \times R_F \times C_F} \quad (5)$$

Resistor R_{ISO} , and capacitor C_L provide the option to create a RC filter, or test output loads for the amplifier. When not applicable, use a zero ohm resistor for R_{ISO} and do not populate C_L .

Figure 4-6 displays the DYY-AMP-EVM populated with the required components to configure channel 1 as a non-inverting amplifier with no load.

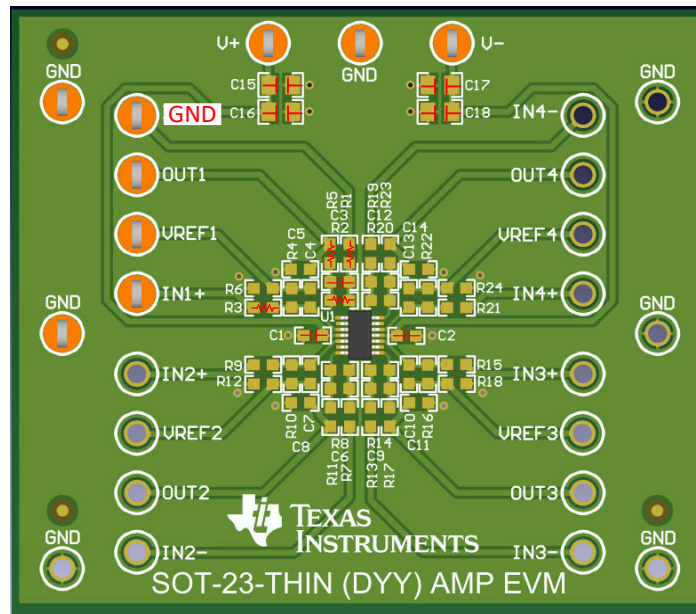


Figure 4-6. Non-inverting Amplifier Configured on DYY-AMP-EVM, Channel 1

4.4 Inverting Amplifier

Figure 4-7 shows the schematic for the inverting amplifier circuit configuration. To configure the EVM in an inverting configuration short R_{INP} using a 0- Ω resistor or solder bridge, leave R_{VREF} and C_{VREF} unpopulated, and apply the desired common mode voltage (V_{CM}) to the input connection, $IN+$. The input signal is applied using the input connection $IN-$.

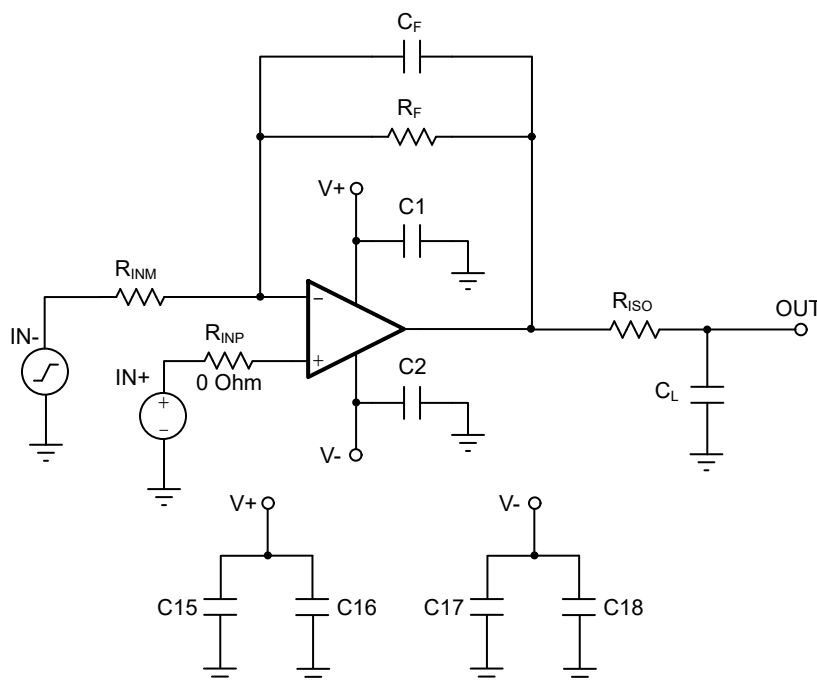


Figure 4-7. Inverting Amplifier Schematic

Table 4-4. Inverting Amplifier Components

CH	R_{INM}	R_F	C_F	R_{INP}	R_{ISO}	C_L
1	R1	R2	C3	R3	R5	C5
2	R7	R8	C6	R9	R11	C8
3	R13	R14	C9	R15	R17	C11
4	R19	R20	C12	R21	R23	C14

Equation 6 displays the DC transfer function for channel 1 of the inverting amplifier circuit configuration. Note, Input signals $IN+$ and $IN-$ are altered to IN_P and IN_M respectively in the transfer function for simplicity of the equation.

$$OUT = -\frac{R_F}{R_{INM}} \times IN_M + \left(1 + \frac{R_F}{R_{INM}}\right) \times IN_P \quad (6)$$

Capacitor C_F provides the option to filter the output. The cutoff frequency, f_c , of the filter can be calculated using Equation 7.

$$f_c = \frac{1}{2 \times \pi \times R_F \times C_F} \quad (7)$$

Resistor R_{ISO} , and capacitor C_L provide the option to create a RC filter, or test output loads for the amplifier. When not applicable, use a zero ohm resistor for R_{ISO} and do not populate C_L .

Figure 4-8 shows the DYY-AMP-EVM populated with the required components to configure channel 1 as an inverting amplifier with no load.

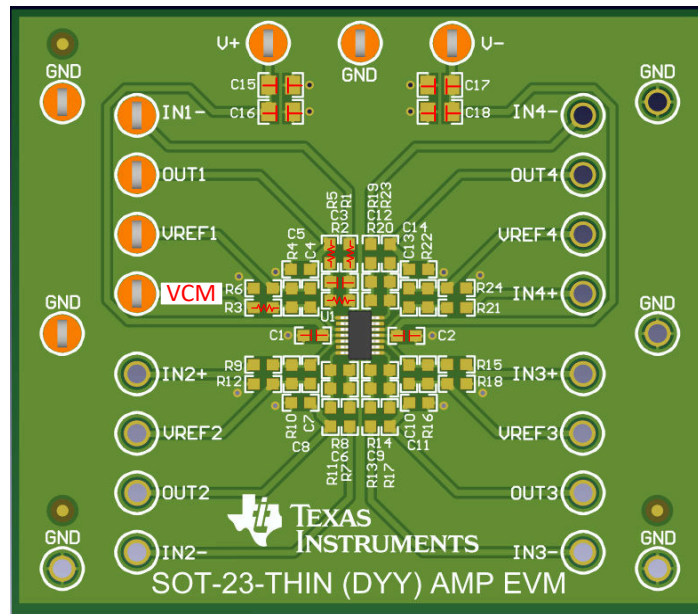


Figure 4-8. Inverting Amplifier Configured on DYY-AMP-EVM, Channel 1

4.5 PCB Layout

The DYY-AMP-EVM is a two layer board. The PCB layout of the top layer is displayed in Figure 4-9.

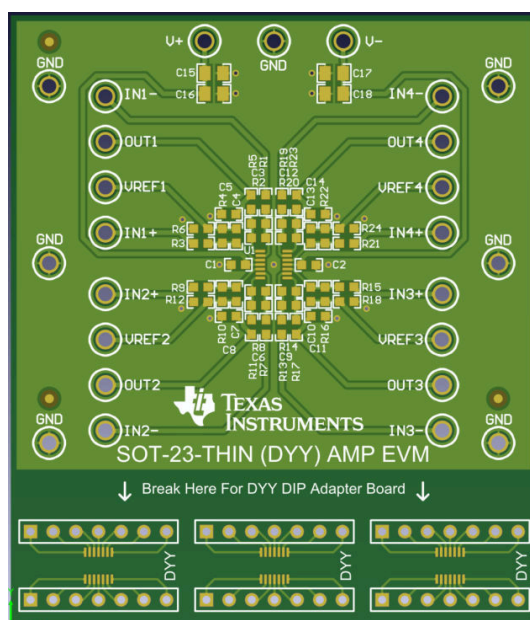


Figure 4-9. Top Layer PCB Layout

The PCB layout of the bottom layer is displayed in Figure 4-10.

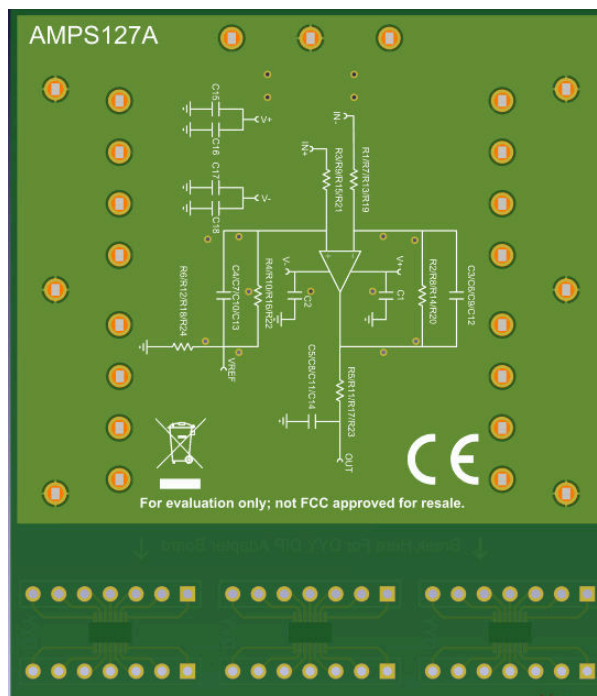


Figure 4-10. Bottom Layer PCB Layout

5 Connections

This section provides a description for each connection available on the EVM.

5.1 Power

The power supply connections for the DYY-AMP-EVM can only be applied using the test points located at the top of the PCB. The positive power supply connection is labeled V+, the negative power supply connection is labeled V-, and the ground connection is labeled GND. For the minimum and maximum supply voltages of the DYY-AMP-EVM, please refer to the relevant device datasheet.

C1 and C2 act as local decoupling capacitors for the amplifier, populate to provide a low impedance return current path for the amplifier. Capacitors C15-C18 are bulk decoupling capacitors for the positive and negative supply rail.

5.2 Input Connections

Signals for the input can be applied to the DYY-AMP-EVM through the use of test points. The input connections are labeled as IN+ and IN-, and the number correlates to the specific channel associated with the input.

5.3 Output Connections

Output connections are provided through the use of test points labeled as OUT. The following number correlates to the specific channel associated with the output.

5.4 Reference Voltage Connections

Signals or DC voltages for the reference voltage can be applied to the DYY-AMP-EVM through the test points labeled VREF. The following number correlates to the specific channel associated with the VREF pin. R_{PL} can be used to set the Vref pin to 0-V without the use of external connections. To set the VREF pin to GND, populate the respective pad with a 0 ohm resistor.

6 Bill of Materials (BOM)

Table 6-1. DYY-AMP-EVM BOM

Designator	Quantity	Description	Part Number
PCB	1	Printed-Circuit-Board	DYY-AMP-EVM
Header Strip	3	Header, 2.54 mm, 14× 1, Gold, TH	M22-2011405
R1-R24	24	0603 package resistor	
C1-C14	14	0603 package capacitor	
C15-C18	4	0805 package capacitor	

7 References

1. Texas Instruments, [DIYAMP-EVM](#) evaluation module.
2. Texas Instruments, [DUAL-DIYAMP-EVM](#) evaluation module.
3. Texas Instruments, [TLV90X1DPW-EVM](#) evaluation module.
4. Texas Instruments, [DIP-ADAPTER-EVM](#) evaluation module.
5. Texas Instruments, [How to Properly Configure Unused Operational Amplifiers](#) application brief.
6. Texas Instruments, [TI Precision Labs Training](#).

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