

# EVM User's Guide: DIYAMC-0-EVM

## DIYAMC-0-EVM Evaluation Module

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### Description

The DIYAMC-0-EVM is a break-apart EVM with twenty configurations in a five-by-four grid layout. For isolated-amplifiers, the three output options include differential output, single-ended output with fixed gain, and single-ended output with ratiometric gain. For isolated-modulators the two clock options include internal clock and external clock. Each of these configurations is available in four package types: DEN, D, DWV, and DUB. This board gives users the ability to test a variety of devices from one EVM.

### Get Started

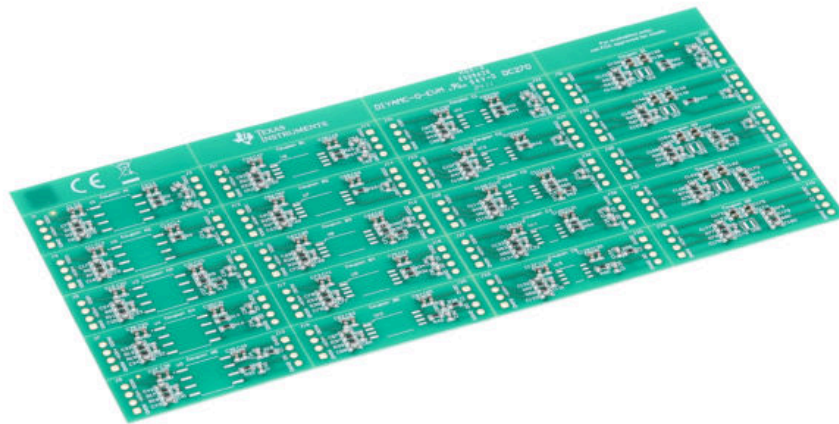
1. Order the [DIYAMC-0-EVM](#) on ti.com.
2. Order devices on ti.com.
3. Evaluate performance on the bench.

### Features

- 20 circuit configurations
  - Five output options x four package options
- Breadboard compatible
- Configuration description in silk screen
- Scored lines for clean break-away

### Applications

- [Motor drives](#)
- [Power delivery](#)
- [Onboard Chargers \(OBCs\)](#)
- [Traction inverter](#)
- [DC/DC converter](#)
- [Energy Storage System \(ESS\)](#)
- [EV charging](#)
- [Solar inverters](#)



# 1 Evaluation Module Overview

## 1.1 Introduction

Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the DIYAMC-0-EVM. This document includes how to set up the EVM, the printed circuit board (PCB) layout, schematics, and bill of materials (BOM).

## 1.2 Kit Contents

[Table 1-1](#) details the contents included in the DIYAMC-0-EVM kit.

**Table 1-1. DIYAMC-0-EVM Kit Contents**

Item	Description	Quantity
DIYAMC-0-EVM	PCB	1
<a href="#">Header Strip</a>	4 position 0.100 inch connectors	10

## 1.3 Specification

The DIYAMC-0-EVM provides the ability to evaluate various isolated data converter devices. The EVM includes four-position header strips and is designed to be breadboard compatible for easy evaluation. This provides a convenient method of evaluating a range of devices from one board able to be re-purposed. Refer to the data sheet of the installed device for detailed device specifications.

## 1.4 Device Information

The DIYAMC-0-EVM is compatible with a variety of devices. Refer to [Section 2.1](#) to determine the coordinating coupon for chosen device.

## 2 Hardware

Assembly of the DIYAMC-0-EVM involves identifying and breaking out the desired coupon from the EVM, soldering chosen components, and soldering header pins. This section presents the details of these procedures.

### 2.1 EVM Coupon Locations and Descriptions

Figure 2-1 maps the locations of each coupon and Table 2-1 matches the coupon to the corresponding circuit configuration. The EVM also provides the name of each individual circuit written in silk screen on the opposite side.

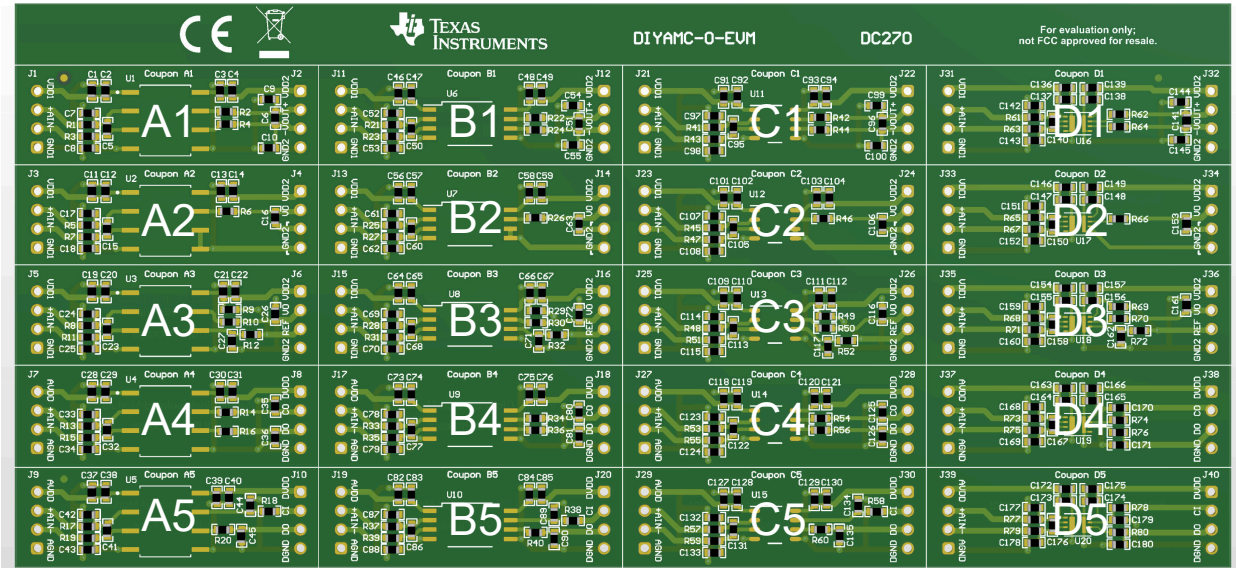


Figure 2-1. Location of Circuit Configurations

Table 2-1. Coupon and Circuit Configuration Legend

Coupon	Description
Coupon A1	Differential Output Isolated-Amplifier with DUB 8 Package
Coupon B1	Differential Output Isolated-Amplifier with DWV 8 Package
Coupon C1	Differential Output Isolated-Amplifier with DJ 8 Package
Coupon D1	Differential Output Isolated-Amplifier with DEN 8 Package
Coupon A2	Single-Ended Output, Fixed Gain Isolated-Amplifier with DUB 8 Package
Coupon B2	Single-Ended Output, Fixed Gain Isolated-Amplifier with DWV 8 Package
Coupon C2	Single-Ended Output, Fixed Gain Isolated-Amplifier with DJ 8 Package
Coupon D2	Single-Ended Output, Fixed Gain Isolated-Amplifier with DEN 8 Package
Coupon A3	Single-Ended Output, Ratiometric Gain Isolated-Amplifier with DUB 8 Package
Coupon B3	Single-Ended Output, Ratiometric Gain Isolated-Amplifier with DWV 8 Package
Coupon C3	Single-Ended Output, Ratiometric Gain Isolated-Amplifier with DJ 8 Package
Coupon D3	Single-Ended Output, Ratiometric Gain Isolated-Amplifier with DEN 8 Package
Coupon A4	Internal Clock Isolated-Modulator with DUB 8 Package
Coupon B4	Internal Clock Isolated-Modulator with DWV 8 Package
Coupon C4	Internal Clock Isolated-Modulator with DJ 8 Package
Coupon D4	Internal Clock Isolated-Modulator with DEN 8 Package
Coupon A5	External Clock Isolated-Modulator with DUB 8 Package
Coupon B5	External Clock Isolated-Modulator with DWV 8 Package
Coupon C5	External Clock Isolated-Modulator with DJ 8 Package
Coupon D5	External Clock Isolated-Modulator with DEN 8 Package

## 2.2 EVM Assembly Instructions

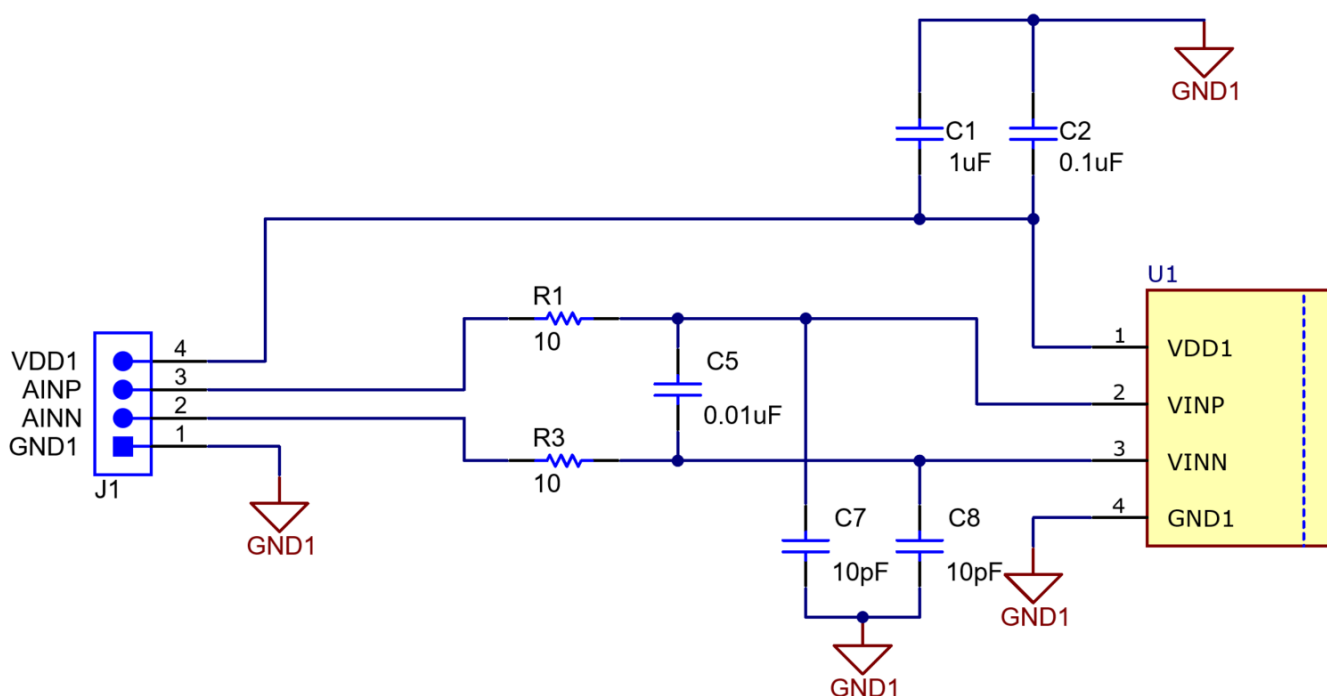
This section has step-by-step instructions on how to assemble a circuit configuration from the EVM.

- Step 1. Choose the desired coupon. See Section 2-1 for the location of each coupon.
- Step 2. Carefully flex the PCB panel at the score lines to separate the desired coupon from the EVM.
- Step 3. Solder device to the separated PCB.
- Step 4. Solder header pins to the separated PCB.
- Step 5. Insert into breadboard if desired for easy evaluation.

## 2.3 Interfaces

The DIYAMC-0-EVM features one input design and five output configurations. The analog input to any coupon on the EVM is routed from a four-position header strip. This provides access to the input terminals of any device. The output configuration varies by row. Each output configuration is offered in four packages: DEN, D, DWV, and DUB.

### 2.3.1 Analog Input



**Figure 2-2. Analog Input Circuit**

Figure 2-2 shows the example analog input circuit for the DIYAMC-0-EVM.

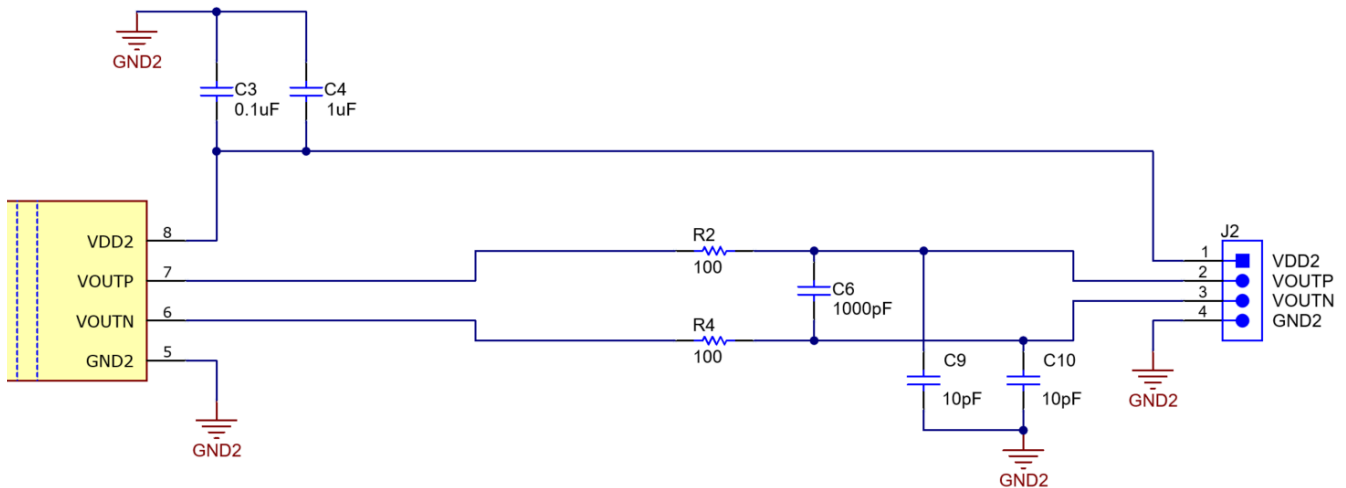
The input amongst all twenty coupons is identical. Using Coupon A1 as an example, the input is accessible to the user by connector J1. The passive components of the input include R1, R3, & C5 to make a differential anti-aliasing filter with a cutoff frequency of 796kHz, and C7 and C8 to help attenuate common-mode signals. C1 and C2 serve as decoupling capacitors for noise reduction and high-side supply (VDD1) stability.

Using a signal generator or other voltage source, the user can apply an input signal directly to J1.3 (AINP) and J1.2 (AINN). The linear input voltage range of the EVM varies by device selected for the configuration of the user. Reference the device data sheet for more information. Establish the common-mode input voltage if necessary, commonly done by shorting J1.2 (AINN) to J1.1(GND).

### 2.3.2 Amplifier Output

Rows 1, 2, and 3 of the DIYAMC-0-EVM are amplifier output configurations.

### 2.3.2.1 Differential Output



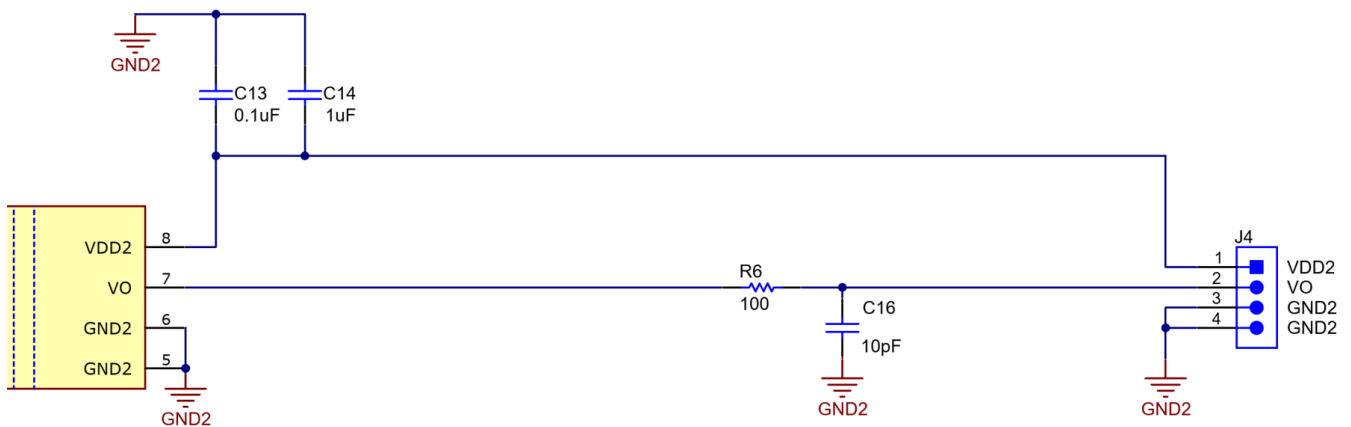
**Figure 2-3. Differential Output Circuit**

Figure 2-3 shows the example differential output circuit for the DIYAMC-0-EVM.

Row 1 of the EVM provides a differential analog output. Using Coupon A1 as an example, the output is accessible to the user by connector J2. The passive components of the input include R2, R4, and C6 to make a differential anti-aliasing filter with a cutoff frequency of 796kHz, and C9 and C10 to help attenuate common-mode signals. C3 and C4 serve as decoupling capacitors for noise reduction and low-side supply (VDD2) stability.

Using an oscilloscope, the user can observe the differential output signal between J2.2 (VOUTP) and J2.3 (VOUTN) or single-ended with respect to J2.4 (GND2).

### 2.3.2.2 Single-Ended Output, Fixed Gain



**Figure 2-4. Single-Ended Output, Fixed Gain Circuit**

Figure 2-4 shows the example single-ended output with fixed gain output circuit for the DIYAMC-0-EVM.

Row 2 of the EVM provides a single-ended analog output with fixed gain. Using Coupon A2 as an example, the output is accessible to the user by connector J4. The passive components of the output are comprised of R6 and C16 that form an RC filter from pin 7 of the device with a cutoff frequency of 159MHz. The VOUTN pin is tied to ground in this configuration since the pin does not have an output. C13 and C14 serve as decoupling capacitors for noise reduction and low-side supply (VDD2) stability.

Using an oscilloscope, the user can observe the output signal at J4.2 (VO).

### 2.3.2.3 Single-Ended Output, Ratiometric Gain

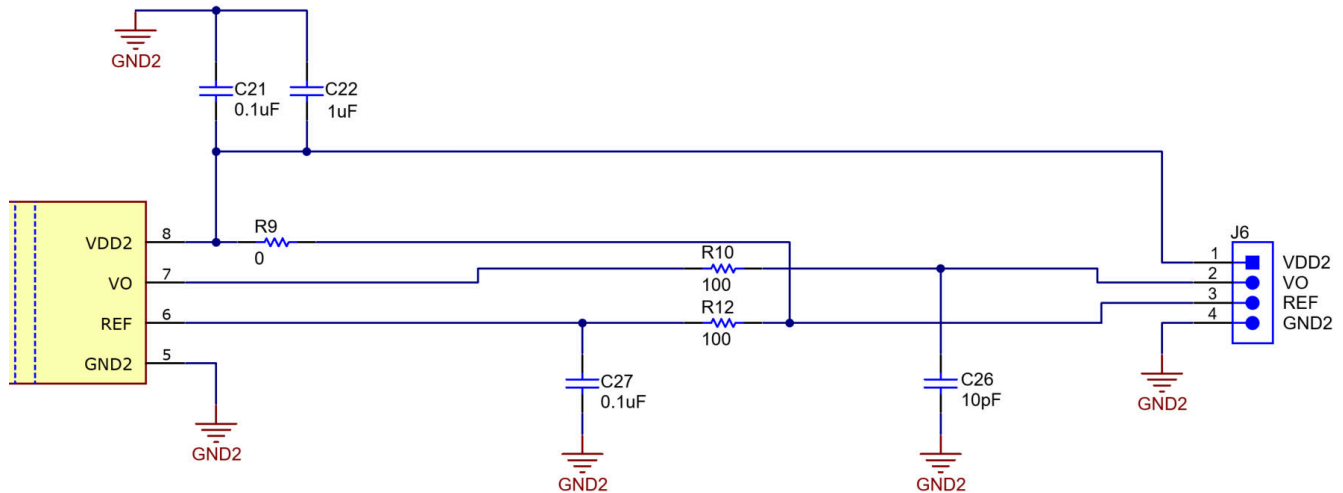


Figure 2-5. Single-Ended Output, Ratiometric Gain Circuit

Figure 2-5 shows the example single-ended output with ratiometric gain output circuit for the DIYAMC-0-EVM.

Row 3 of the EVM provides a single-ended analog output with ratiometric gain. Using Coupon A3 as an example, the output is accessible to the user by connector J6. The passive components of the output are comprised of R10, R12, C26, and C27 to form two RC filters. The output filter from pin 6 of the device has a cutoff frequency of 159MHz. C21 and C22 serve as decoupling capacitors for noise reduction and low-side supply (VDD2) stability.

Using an oscilloscope, the user can observe the output signal at J6.2 (VO). This trace includes a 0 Ohm resistor, R9, which can be removed to apply an external reference to J6.3 (REF). When a reference voltage is applied, the output ranges from 0 to REF centered at REF/2. This is filtered through R12 and C27. VDD2 is extended to pin 6 of the device to J6.3 (REF). Pin 7 of the device functions as the device's output. This is filtered through R10 and C26.

### 2.3.3 Modulator Output

Rows 4 and 5 of the DIYAMC-0-EVM are modulator output configurations.

#### 2.3.3.1 Internal Clock

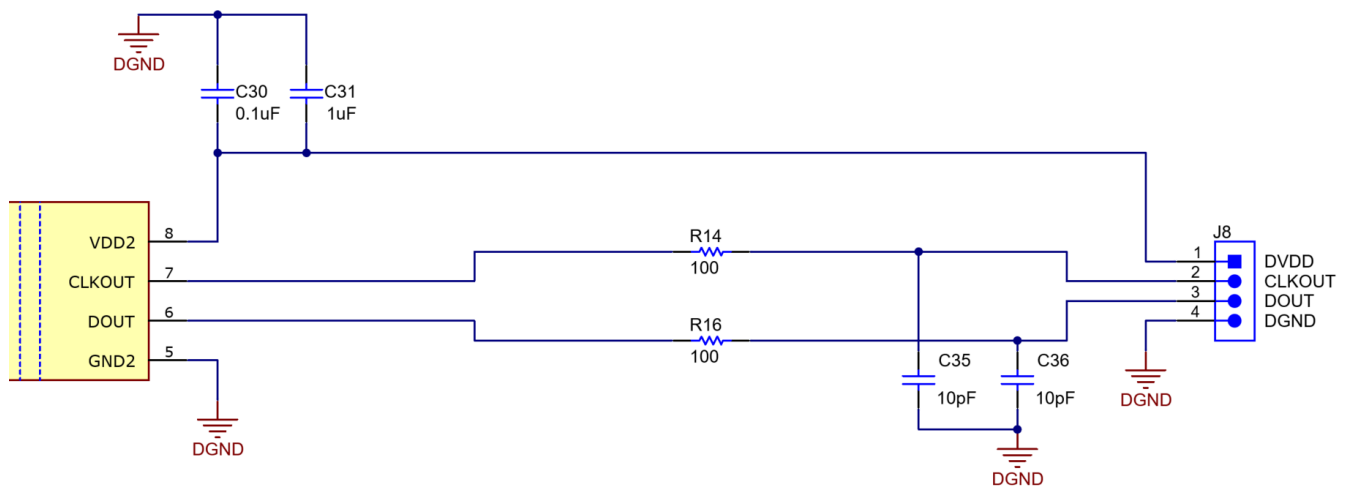


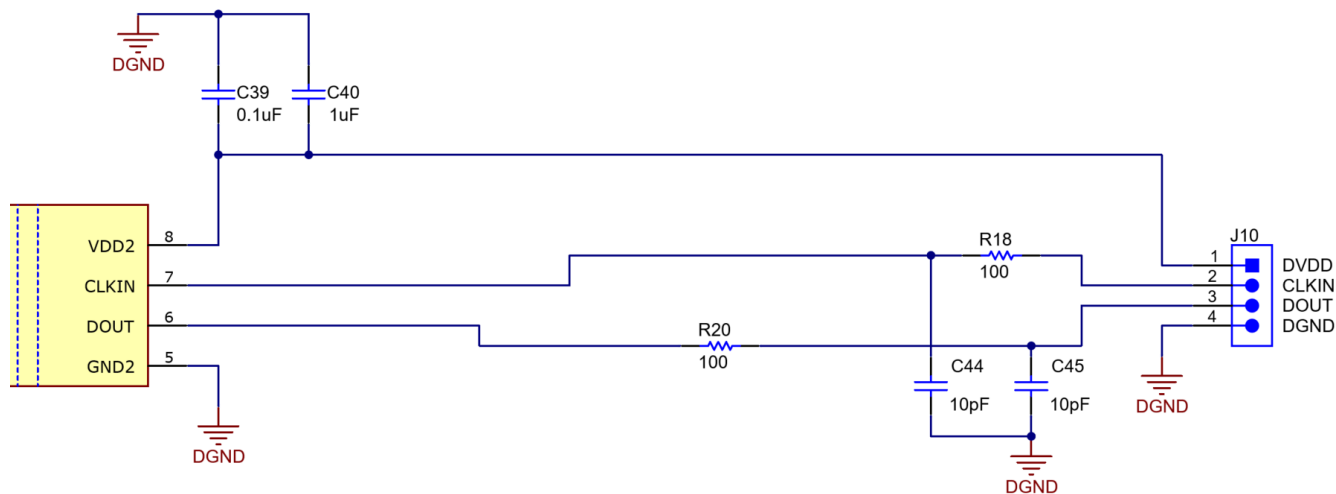
Figure 2-6. Internal Clock Circuit

Figure 2-6 shows the example internal clock modulator output circuit for the DIYAMC-0-EVM.

Row 4 of the EVM provides a digital output with internal clock configurations. Using Coupon A4 as an example, the output is accessible to the user by connector J8. The passive components of the output are comprised of R14, R16, C35, and C36 to form two RC filters. The output filter from pin 6 of the device has a cutoff frequency of 159MHz. C30 and C31 serve as decoupling capacitors for noise reduction and low-side supply (DVDD) stability.

Using an oscilloscope, the user can observe the output signal at J8.3 (DOUT). R14 and C35 filter the internal clock output of the device to connection J8.2 (CLKOUT) while R16 and C36 filter the digital output of the device to connection J8.3.

### 2.3.3.2 External Clock



**Figure 2-7. External Clock Circuit**

Figure 2-7 shows the example internal clock modulator output circuit for the DIYAMC-0-EVM.

Row 5 of the EVM provides a digital output for external clock configurations. Using Coupon A5 as an example, the output is accessible to the user by connector J10. The passive components of the output are comprised of R20 and C45 to form two RC filters. The output filter from pin 6 of the device has a cutoff frequency of 159MHz. C39 and C40 serve as decoupling capacitors for noise reduction and low-side supply (DVDD) stability.

Using an oscilloscope, the user can observe the output signal at J10.3 (DOUT). R18 and C44 filter the external clock into the device, typically 5-21MHz, from connection J10.2 (CLKIN) while R20 and C45 filter the digital output of the device to connection J10.3.

## 2.4 Power Supplies

The EVM requires two separate power rails, VDD1 & VDD2 or AVDD & DVDD. VDD1 is on the high-voltage side of the amplifier coupons and VDD2 is on the low-voltage side of the amplifier coupons. Similarly, AVDD is on the high-voltage side of the modulator coupons and DVDD is on the low-voltage side of the modulator coupons. Effectively, the high-voltage power rails (VDD1 and AVDD) function alike and the low-voltage power rails (VDD2 and DVDD) function alike.

### 2.4.1 VDD1/AVDD Input

The EVM provides access to VDD1/AVDD by a coupon's respective connection pin 4. The power supply must be between the devices recommended operating conditions with respect to ground. Typically 3.3-5V for both power supplies.

### 2.4.2 VDD2/DVDD Input

The EVM provides access to VDD2/DVDD by a coupon's respective connection pin 1. The power supply must be between the devices recommended operating conditions with respect to ground.

## 2.5 EVM Operation

The following section describes how to verify correct soldering of your devices and components as well as general operation of the EVM.

### 2.5.1 Analog Input and VDD1/AVDD Power

The analog supply voltage can be applied directly to pin 4 with respect to pin 1 of the input connection header. The analog input can be applied to pin 3 with respect to pin 2. External connection of the negative input pin, AINN, to GND1/AGND is often necessary to make sure the input voltage remains within the common-mode input voltage range.

Table 2-2 lists the details of an input connection.

<b>CAUTION</b>		
Carefully review the selected device data sheet for limitations of the analog input range and make sure the appropriate analog and digital voltages are applied prior to connecting any analog input to the EVM. The board is not certified for high-voltage operation		

**Table 2-2. Analog Input**

Pin Number	Signal	Description
4	VDD1/AVDD	Connection to the installed VDD1/AVDD of the device.
3	AINP	Analog positive input to the installed device.
2	AINN	Analog negative input to the installed device.
1	GND1/AGND	Connection to the installed GND1/AGND terminal of the device.

### 2.5.2 Outputs and VDD2/DVDD Power

The analog supply voltage can be applied directly to pin 1 with respect to pin 4 of the output connection header. The analog output can be observed at pins 2 and pin 3.

**Table 2-3. Differential Output**

Pin Number	Signal	Description
1	VDD2	Connection to the VDD2 of the installed device.
2	VOU TP	Noninverting analog output from the installed device.
3	VOU TN	Inverting analog output from the installed device.
4	GND2	Connection to the GND2 terminal of the installed device.

**Table 2-4. Single-Ended Output, Fixed Gain**

Pin Number	Signal	Description
1	VDD2	Connection to the VDD2 of the installed device.
2	VO	Analog output from the installed device.
3	GND2	Connection to the GND2 terminal of the installed device.
4	GND2	Connection to the GND2 terminal of the installed device.

**Table 2-5. Single-Ended Output, Ratiometric Gain**

Pin Number	Signal	Description
1	VDD2	Connection to the VDD2 of the installed device.
2	VO	Analog output from the installed device.
3	REF	Connection to reference input, tied to VDD by default.
4	GND2	Connection to the installed device's GND2 terminal.



**Table 2-6. Internal Clock**

Pin Number	Signal	Description
1	DVDD	Connection to the DVDD of the installed device.
2	CO	Clock out from the installed device.
3	DO	Data out from the installed device.
4	DGND	Connection to the DGND terminal of the installed device.

**Table 2-7. External Clock**

Pin Number	Signal	Description
1	DVDD	Connection to the DVDD of the installed device.
2	CI	Clock in into the installed device.
3	DO	Data out from the installed device.
4	DGND	Connection to the DGND terminal of the installed device.

### 2.5.3 Test Procedure

To verify the connections of the assembled EVM coupon, TI recommends to run a test procedure.

#### 2.5.3.1 Equipment Setup

1. Two five-volt sources for high-side and low-side power supply.
2. The 5V sources needs to be limited to 50mA.
3. Oscilloscope *or* digital multimeter (DMM) with at least 6.5 digits of resolution.
4. Signal generator.

#### 2.5.3.2 Procedure

1. Set the first 5V (+/-10%) source and limit the current to 50mA as noted above. Connect the EVM voltage source to the connectors VDD2/DVDD pin referenced to GND2/DGND. Turn on the power source and make sure there is no more than the specified current limit in the device data sheet drawn.
2. Set the second 5V (+/-10%) source and limit the current to 50mA as noted above. Connect the EVM voltage source to the connectors VDD1/AVDD pin referenced to GND1/AGND. Turn on the power source and make sure there is no more than the specified current limit in the device data sheet drawn.
3. Tie inputs together and to ground. Use the oscilloscope or the DMM to verify that isolated power is present on both supplies. Measure the output of the device referenced to GND2/DGND and verify:
  - a. For amplifiers using either the oscilloscope or the DMM: the isolated voltage is within the common-mode output voltage (typ. 1.44V).
  - b. For modulators using the oscilloscope: the digital output is a stream of ones and zeros that are high 50% of the time and low 50% of the time.
  - c. For modulators using the DMM: the DMM is about 50% magnitude of DVDD.
4. Depending on the mounted device, apply the appropriate full-scale linear input signal. Typically:  $\pm 50\text{mV}$ ,  $\pm 250\text{mV}$ ,  $\pm 1\text{V}$ , or 0-2V.
5. Measure the output with the oscilloscope or the DMM.
  - a. For amplifiers using either the oscilloscope or the DMM: Verify that the output voltage swings between the specified range in the device data sheet. Typical input frequency is 10kHz.
    - i.  $\pm 2.05\text{V}$  FSR for differential amplifiers.
    - ii. 0-2.25 FSR for single-ended amplifiers.
  - b. For modulators using the oscilloscope: Verify that the digital output is proportional to the expected conversion. Apply a DC input signal.
    - i. For a positive full scale linear input, the digital output needs to be high about 90% of the time.
    - ii. For a negative full scale linear input, the digital output needs to be high about 10% of the time.
  - c. For modulators using the DMM: Verify that the digital output is proportional to the expected conversion. Apply a DC input signal.
    - i. For a positive full scale linear input, the digital output needs to be about 90% magnitude of DVDD.
    - ii. For a negative full scale linear input, the digital output needs to be about 10% magnitude of DVDD.

### 3 Hardware Design Files

#### 3.1 Schematics

Figure 3-1 shows an example row 1 schematic for differential output.

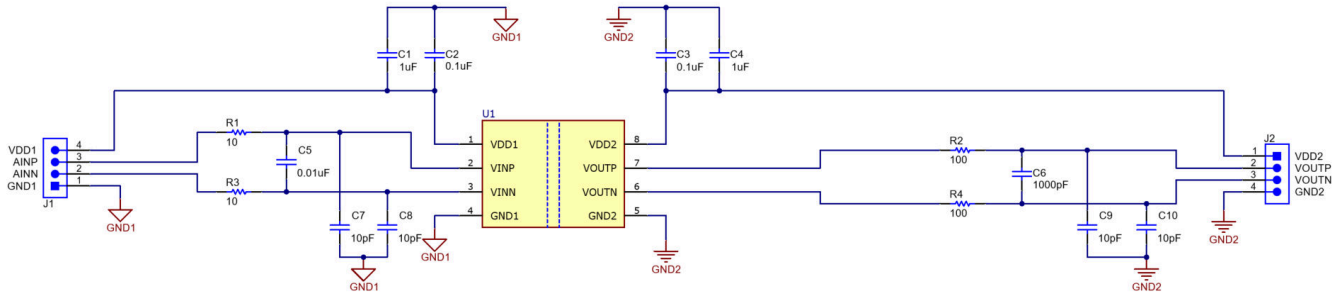


Figure 3-1. Coupon A1 Schematic

Figure 3-2 shows an example row 2 schematic for single-ended output with fixed gain.

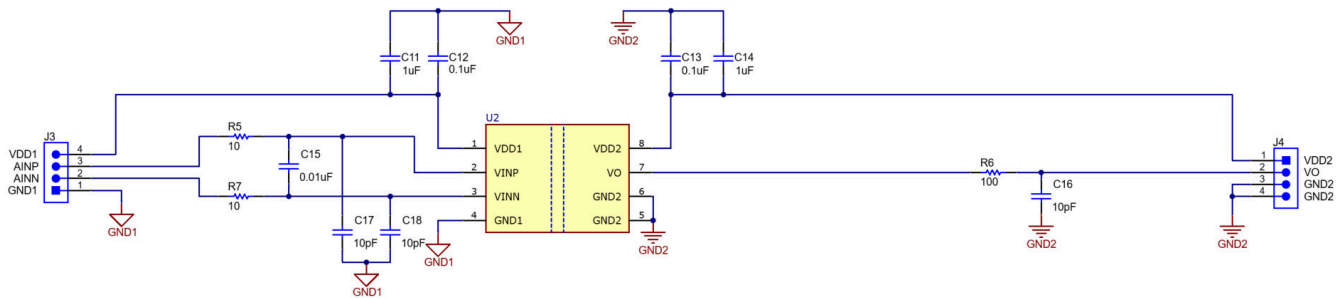


Figure 3-2. Coupon A2 Schematic

Figure 3-3 shows an example row 3 schematic for single-ended output with ratiometric gain.

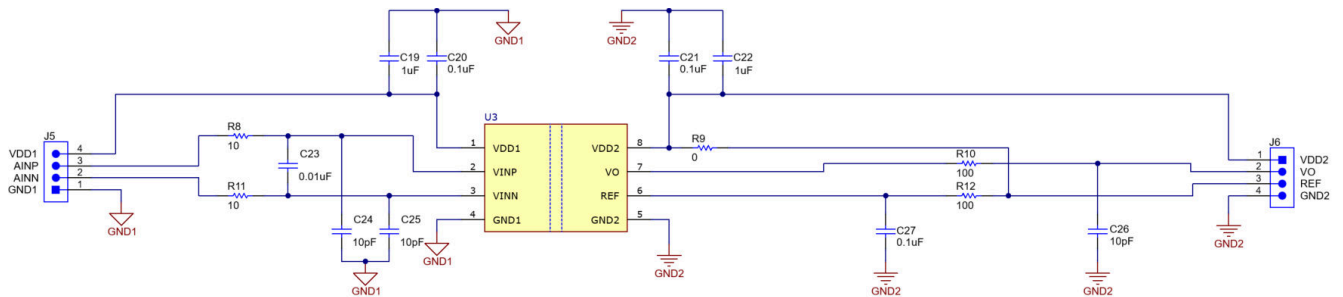


Figure 3-3. Coupon A3 Schematic

Figure 3-4 shows an example row 4 schematic for internal clock configurations.

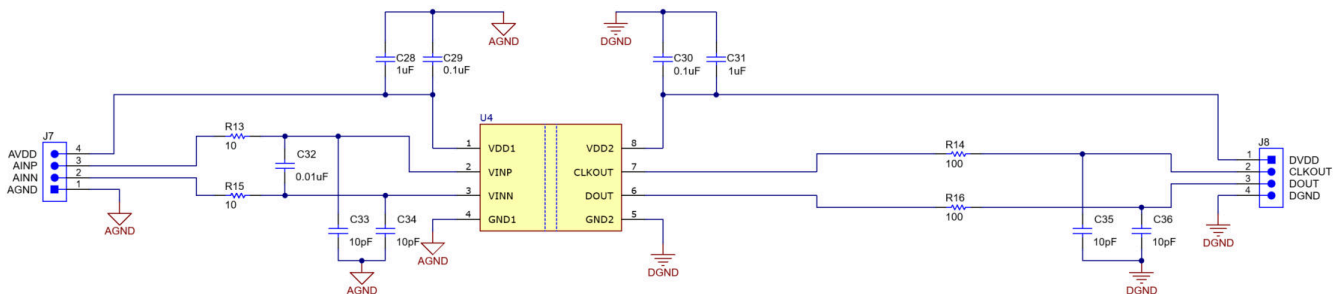
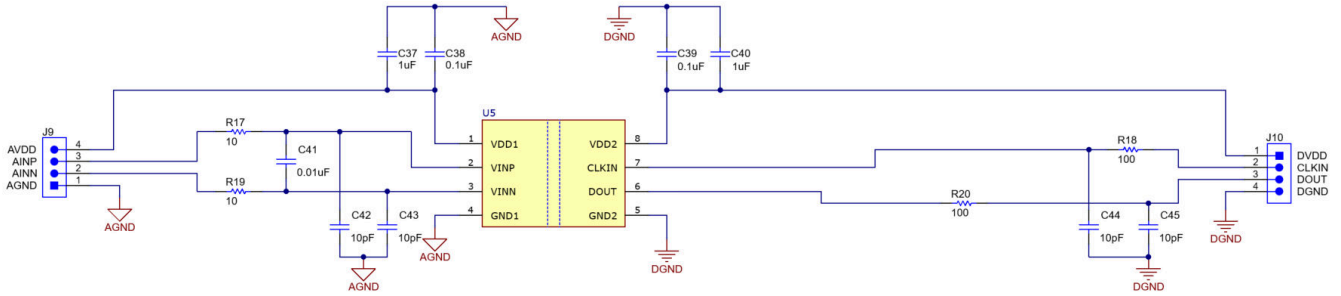


Figure 3-4. Coupon A4 Schematic

Figure 3-5 shows an example row 5 schematic for external clock configurations.



**Figure 3-5. Coupon A5 Schematic**

### 3.2 PCB Layout

Figure 3-6 and Figure 3-7 show the top and bottom printed circuit board (PCB) drawings of the DIYAMC-0-EVM, respectively.

#### Note

Board layouts are not to scale. These layouts are intended to show how the board is laid out, and are not intended to be used for manufacturing the DIYAMC-0-EVM PCB.

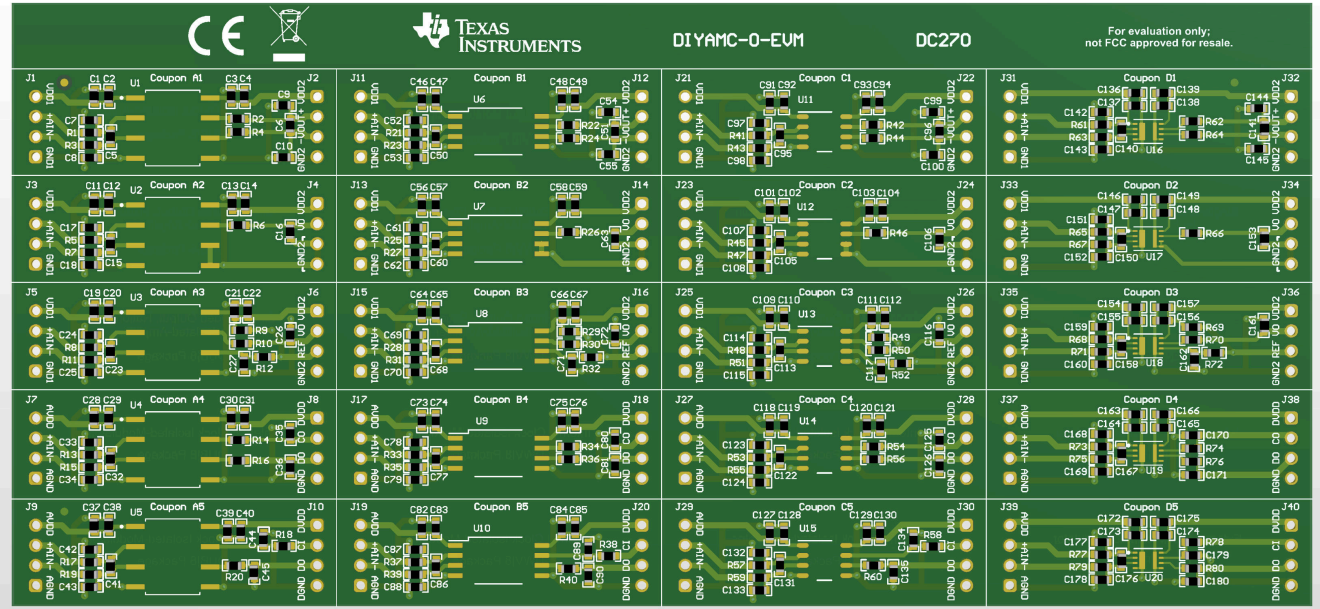


Figure 3-6. DIYAMC-0-EVM Top PCB Drawing

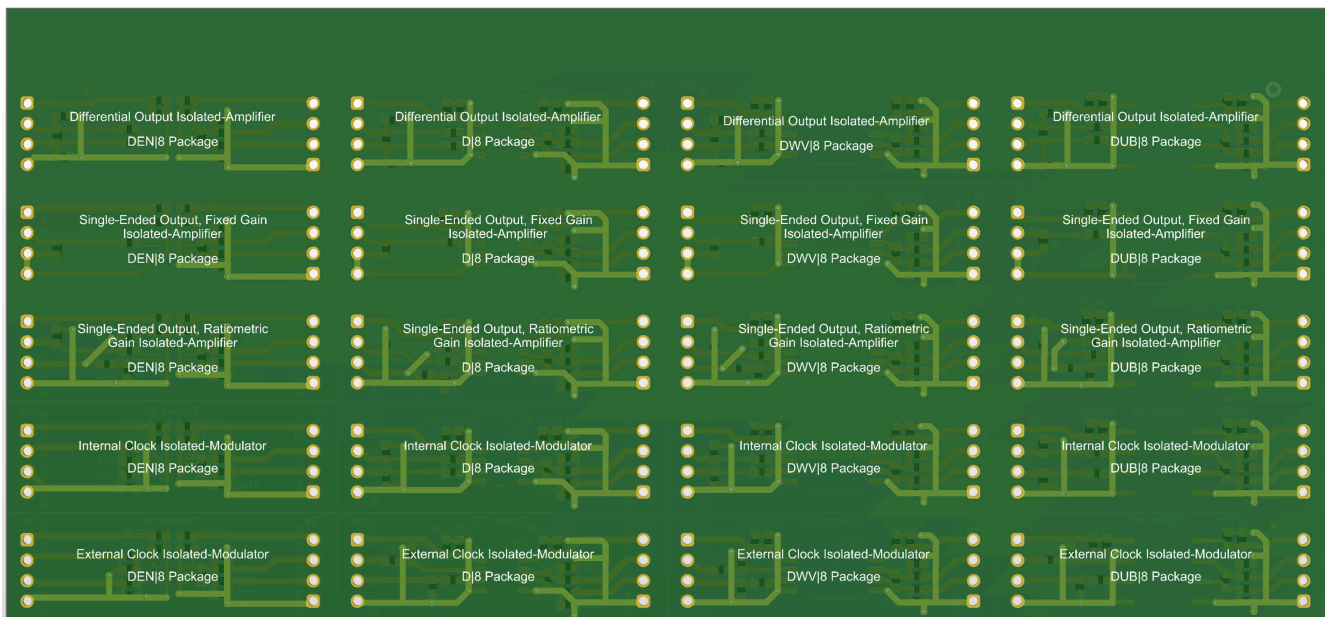


Figure 3-7. DIYAMC-0-EVM Bottom PCB Drawing

### 3.3 Bill of Materials

Table 3-1 shows the complete DIYAMC-0-EVM bill of materials (BOM).

**Table 3-1. Bill of Materials**

Designator	Description	Manufacturer	Mfg. Part Number
C1, C4, C11, C14, C19, C22, C28, C31, C37, C40, C46, C49, C56, C59, C64, C67, C73, C76, C82, C85, C91, C94, C101, C104, C109, C112, C118, C121, C127, C130, C136, C139, C146, C149, C154, C157, C163, C166, C172, C175	CAP, CERM, 1uF, 16V, +/- 20%, X5R, 0603	Wurth Elektronik	8.85012E+11
C2, C3, C12, C13, C20, C21, C27, C29, C30, C38, C39, C47, C48, C57, C58, C65, C66, C71, C74, C75, C83, C84, C92, C93, C102, C103, C110, C111, C117, C119, C120, C128, C129, C137, C138, C147, C148, C155, C156, C162, C164, C165, C173, C174	CAP, CERM, 0.1uF, 25V, +/- 10%, X7R, 0603	AVX	06033C104KAT2A
C5, C15, C23, C32, C41, C50, C60, C68, C77, C86, C95, C105, C113, C122, C131, C140, C150, C158, C167, C176	CAP, CERM, 0.01uF, 50V, +/- 5%, C0G/NP0, 0603	TDK	C1608NP01H103J080AA
C6, C51, C96, C141	CAP, CERM, 1000pF, 25V, +/- 1%, C0G/NP0, 0603	Kemet	C0603C102F3GACTU
C7, C8, C9, C10, C16, C17, C18, C24, C25, C26, C33, C34, C35, C36, C42, C43, C44, C45, C52, C53, C54, C55, C61, C62, C63, C69, C70, C72, C78, C79, C80, C81, C87, C88, C89, C90, C97, C98, C99, C100, C106, C107, C108, C114, C115, C116, C123, C124, C125, C126, C132, C133, C134, C135, C142, C143, C144, C145, C151, C152, C153, C159, C160, C161, C168, C169, C170, C171, C177, C178, C179, C180	CAP, CERM, 10pF, 50V, +/- 5%, C0G/NP0, 0603	AVX	06035A100JAT2A
R1, R3, R5, R7, R8, R11, R13, R15, R17, R19, R21, R23, R25, R27, R28, R31, R33, R35, R37, R39, R41, R43, R45, R47, R48, R51, R53, R55, R57, R59, R61, R63, R65, R67, R68, R71, R73, R75, R77, R79	RES, 10, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060310R0JNEA
R2, R4, R6, R10, R14, R16, R18, R20, R22, R24, R26, R30, R34, R36, R38, R40, R42, R44, R46, R50, R54, R56, R58, R60, R62, R64, R66, R70, R74, R76, R78, R80	RES, 100, 5%, 0.1 W, 0603	Vishay-Dale	CRCW0603100RJNEA
R9, R29, R49, R69	RES, 0, 5%, 0.1 W, 0603	Yageo	RC0603JR-070RL
R12, R32, R52, R72	RES, 100, 1%, 0.1 W, 0603	Yageo	RC0603FR-07100RL

## 4 Additional Information

### 4.1 Trademarks

All trademarks are the property of their respective owners.

## 5 Related Documentation

To obtain a copy of any of the following TI documents, call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center (PIC) at (972) 644-5580. When ordering, please identify this document by the title and literature number. Updated documents can also be obtained through our website at [www.ti.com](http://www.ti.com).

- [Comparing Isolated Amplifiers and Isolated Modulators](#)
- [Isolated Amplifiers](#)
- [Isolated ADCs](#)

## STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
  - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductor products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
  - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
  - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
  - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
  - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

### **WARNING**

**Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.**

**User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.**

**NOTE:**

**EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGRADATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.**

### 3 Regulatory Notices:

#### 3.1 United States

##### 3.1.1 Notice applicable to EVMs not FCC-Approved:

**FCC NOTICE:** This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

##### 3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

#### **CAUTION**

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

#### **FCC Interference Statement for Class A EVM devices**

*NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

#### **FCC Interference Statement for Class B EVM devices**

*NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

#### 3.2 Canada

##### 3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

#### **Concerning EVMs Including Radio Transmitters:**

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

#### **Concernant les EVMs avec appareils radio:**

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

#### **Concerning EVMs Including Detachable Antennas:**

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.



### Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

#### 3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないものご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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ンスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_02.page)

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#### 3.4 European Union

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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4. *EVM Use Restrictions and Warnings:*
    - 4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
    - 4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
    - 4.3 *Safety-Related Warnings and Restrictions:*
      - 4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
      - 4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
    - 4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.
  5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.
  6. *Disclaimers:*
    - 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
    - 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.
  7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.
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8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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