



## ABSTRACT

The DEM-OPA-RGV-EVM is a generic, unpopulated printed circuit board (PCB) for dual operational amplifiers in VQFN-16 package. This evaluation module (EVM) is an evaluation and development kit for evaluating dual amplifiers as individual channels or as a differential line-driver with a current-feedback architecture that is targeted for use in broadband power line communications (PLC) line driver applications.

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## 1 Introduction

The DEM-OPA-RGV-EVM is an unpopulated evaluation module (EVM) for TI's dual, wideband operational amplifiers in the VQFN (RGV) package. This EVM is designed in accordance with high-speed performance specifications and Texas Instruments' PLC and Transmission Line Drivers. The EVM is designed to enable quick and efficient lab testing of TI High Speed dual amplifier using 50-Ω SMA connectors for use with lab equipment. The EVM can be easily configured for different gains and for single or split-supply operation. The two channels can be used as individual amplifiers or can be configured as a differential-input to differential-output driver. A transformer with appropriate resistors can be used at the output as a 50-Ω single-ended output.

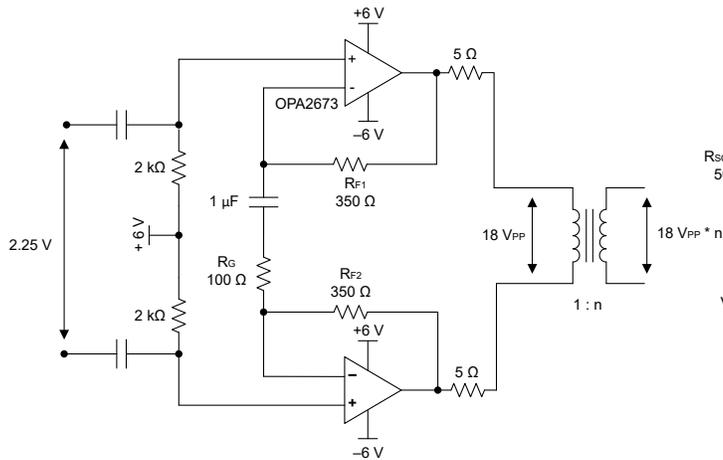


Figure 1-1. PLC Line Driver

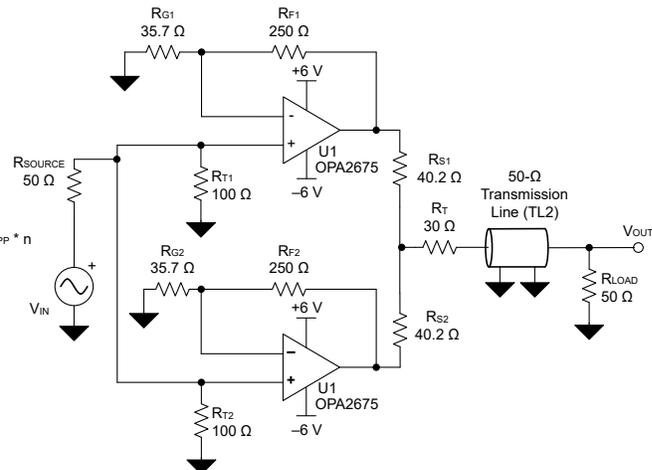


Figure 1-2. 50 Ω Transmission Line Driver

### 1.1 Features

- Configurable for single or split-supply operation
- Configurable gain and feedback networks for inverting and non-inverting configurations
- Supports single-ended or differential inputs and outputs
- Designed for easy connection to standard 50-Ω input and output impedance lab equipment

### 1.2 EVM Specifications

[Section 2](#) and [Section 3](#) provide a general description of the DEM-OPA-RGV-EVM specifications and configurations.

## 2 Power Connections

The DEM-OPA-RGV-EVM is equipped with standard banana jacks for easy connection to power. The positive supply input is labeled VCC, the negative supply input is labeled VEE, and the ground reference is labeled GND. There are additional ground reference points via testpoints TP1, TP2, and TP3.

### 2.1 Split-Supply Operation

To operate as a split supply, apply the positive supply voltage to VCC, the negative supply voltage to VEE, and the ground reference to GND.

When operating with equal (balanced) split-supplies in the differential input configuration, the input common mode can be held to GND by shorting C4.

If operating with uneven supplies in the differential input configuration, the input common mode can be referenced to midsupply,  $VCC/2$ . This can be modified by adding resistors R25 and R26 and adjusting the values to obtain a midpoint or other voltages between the supplies. A high-frequency 0.1  $\Omega$ F decoupling capacitor connected to VCM can be included as C4 on the board.

### 2.2 Single-Supply Operation

To operate as a single supply, apply the positive supply voltage to VCC and the ground reference to VEE.

The input common mode voltage is at the node between R25 and R26. To apply a voltage at this node, add resistors R25 and R26 and adjust the values to obtain a midpoint or other voltages between the supplies. A high-frequency 0.1  $\Omega$ F decoupling capacitor connected to VCM can be included as C4 on the board.

### 3 Input and Output Connections

The DEM-OPA-RGV-EVM is equipped with footprints for SMA input and output connectors for simple interface to signal generators and analysis equipment. Typically test equipment has 50- $\Omega$  termination, so footprints for matching resistors R1 and R2 at the input as well as R15 and R16 or R41 at the output are provided to create matched impedances in any configuration. For best results, signals must be routed to and from the EVM with cables with a characteristic impedance of the same value as the test equipment and board.

The board has two input SMA footprints for a dual channel amplifier. To set the amplifier in a non-inverting configuration, populate R4 and keep R3 and R20 unpopulated for channel A. For channel B, populate R9 and keep R10 and R36 unpopulated. The opposite can be modified to set the amplifier in an inverting configuration for both channels.

Both channels can be configured for either a differential input connection or as single-ended input individual channels. To use the device with a single-ended input, populate either R20 or R4 for Channel A and R36 or R9 for Channel B depending on amplifier configuration (inverting or non-inverting). If interfacing with a differential input, populate resistors R5 and R8 and apply a common-mode voltage, VCM, by following the steps detailed in [Section 2](#). Differential input components R7 and C14 will also need to be populated in this configuration.

The board can also be configured for either a differential output connection or as single-ended output individual channels. To use the device with a single-ended output, populate the transformer, T1, and keep C15 and C18 unpopulated. OUT\_A (J6) can be the connector to the equipment with R38 populated. If interfacing with a differential output, populate C15 and C18 with shorting resistors or DC-blocking capacitors. Both output SMAs should be populated and keep R35 and R38 unpopulated.

#### 3.1 Bias Mode Control Pins

The amplifier bias modes can be controlled by populating jumpers, J12 and J13, or by populating the SMAs, J4 and J5, to directly apply a signal. If using the jumpers, shorting terminals 1 and 2 pulls the pin high, while shorting terminals 2 and 3 pulls the pin low. J4 and J12 control the first bit selection, A0. J5 and J13 control the second bit selection, A1.

#### 3.2 Optional VCM Connection

The EVM includes an optional connection to set the common-mode voltage to the input of the device. Footprints of R25 and R26 are available to be used in a voltage divider with the positive supply voltage, VCC, as the input voltage. The resistor values will determine the output voltage or reference voltage that will set the input common-mode voltage.

## 4 Schematic and Layout

This section provides the schematic diagram and board layouts for the unpopulated DEM-OPA-RGV-EVM.

### 4.1 Schematic

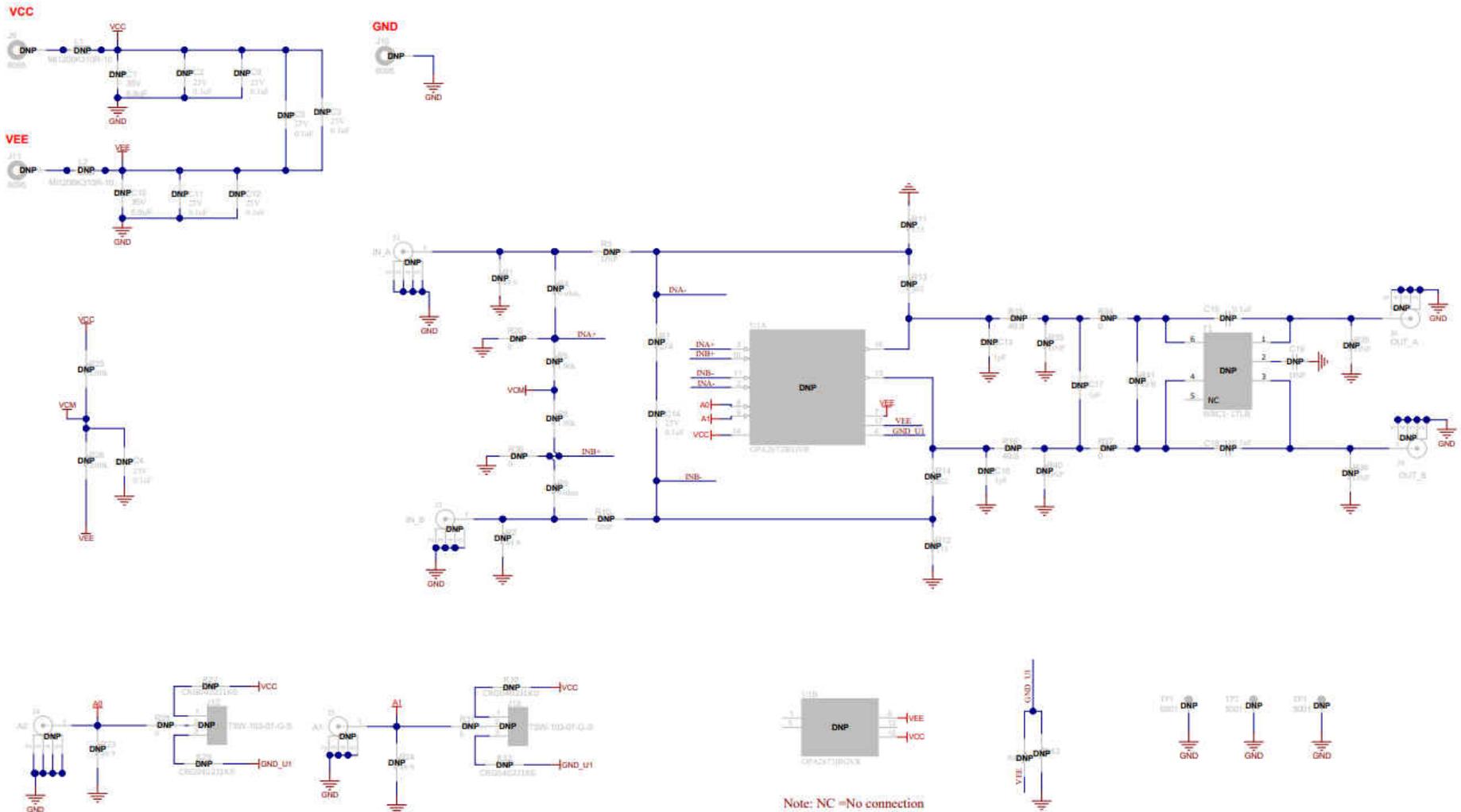


Figure 4-1. DEM-OPA-RGV-EVM Schematic

## 4.2 Layout

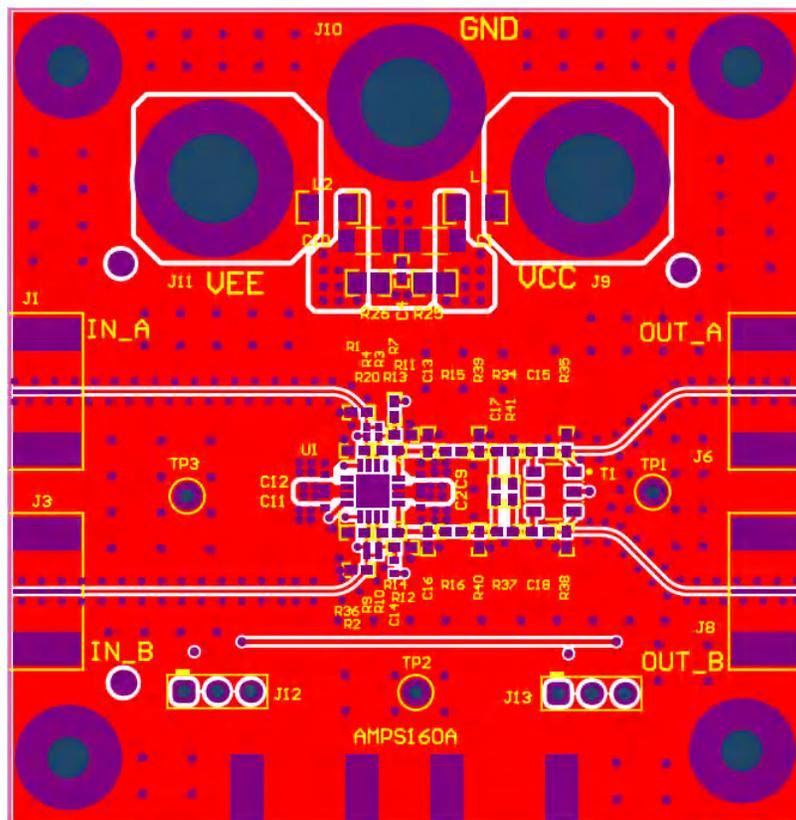


Figure 4-2. Top Layer

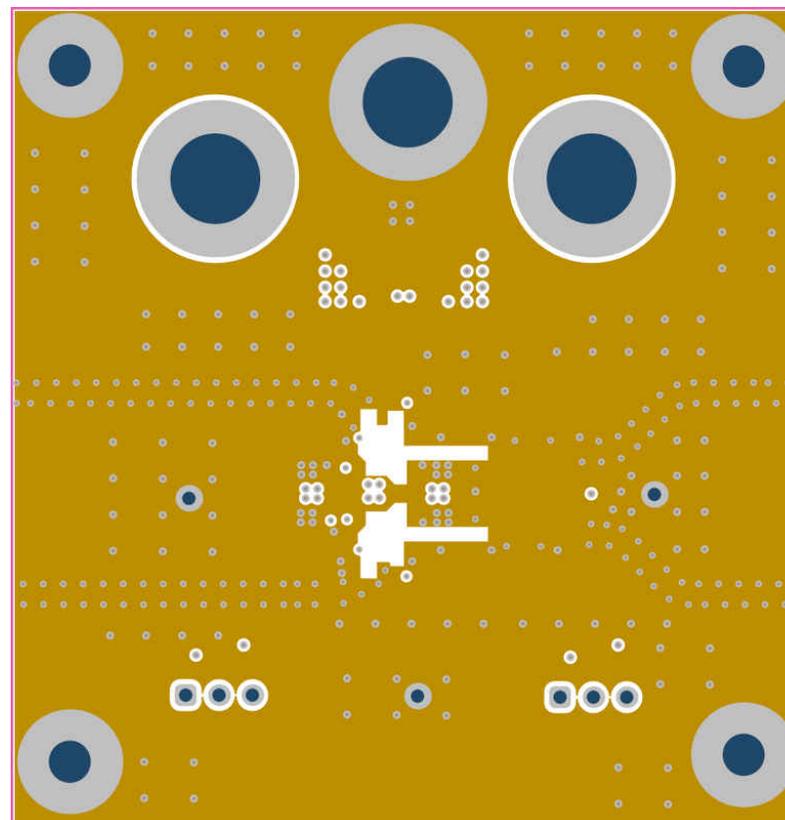


Figure 4-3. Second Layer (Ground)

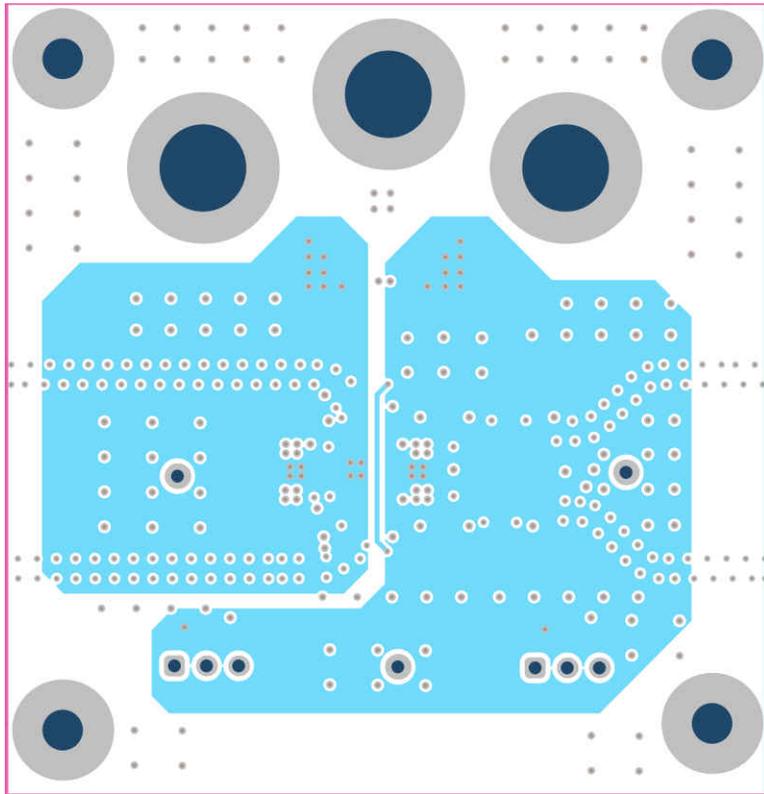


Figure 4-4. Third Layer (Power)

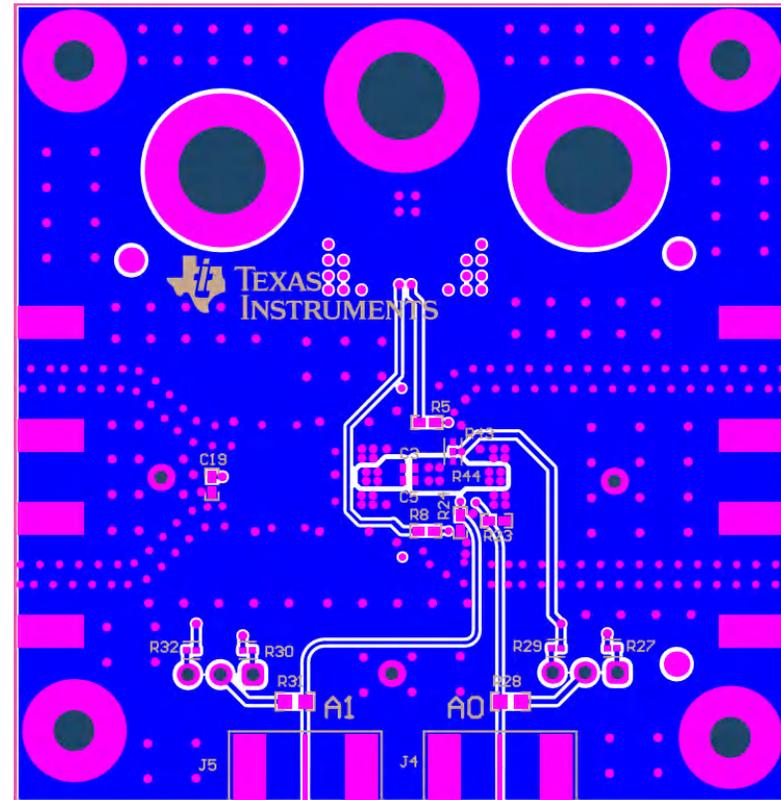


Figure 4-5. Bottom Layer

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