Evaluation Board User Guide

# EVAL-ADPL26001-AZ

Evaluates: ADPL26001 in both a 48V and -12V Output-Voltage Applications

## General Description

The EVAL-ADPL26001-AZ evaluation board features ADPL26001, a low-$I_Q$ boost/SEPIC/inverting converter with a 1A, 60V switch.

The ADPL26001 allows higher input and output voltages than comparable converters and also significantly reduces input current at light loads and no load. The ADPL26001 regulates either positive or negative outputs and has an internally programmed switching frequency of 2MHz.

The EVAL-ADPL26001-AZ evaluation board consists of two circuits: one circuit is a boost converter with 48V output voltage operating from input voltage range of 10V to 36V. The second circuit is an inverting converter with -12V output voltage operating from input voltage range of 4V to 36V.

Low input current at light loads, a high voltage rating and negative output capability make the ADPL26001 attractive for battery-powered and extended voltage range regulator circuits. The *ADPL26001* data sheet must be read in conjunction with this user guide to properly use or modify the EVAL-ADPL26001-AZ evaluation board.

## Features and Benefits

- Boost Circuit, $V_{OUT}$ = 48V, $V_{IN}$ Range = 10V to 36V:
  - $I_{OUT}$ = 110mA at $V_{IN}$ = 10V
  - $I_{OUT}$ = 135mA at $V_{IN}$ = 12V
  - $I_{OUT}$ = 210mA at $V_{IN}$ = 24V
  - $I_{OUT}$ = 400mA at $V_{IN}$ = 36V
  - Efficiency = 89% at $V_{IN}$ = 12V and $I_{OUT}$ = 135mA
- Inverting Circuit, $V_{OUT}$ = -12V, $V_{IN}$ Range = 4V to 36V:
  - $I_{OUT}$ = 170mA at $V_{IN}$ = 4V
  - $I_{OUT}$ = 270mA at $V_{IN}$ = 12V
  - $I_{OUT}$ = 280mA at $V_{IN}$ = 24V
  - $I_{OUT}$ = 280mA at $V_{IN}$ = 36V
  - Efficiency = 87% at $V_{IN}$ = 12V and $I_{OUT}$ = 270mA
- Enable/UVLO Input, Resistor Programmable UVLO Threshold
- Positive or Negative Output Voltage Programming with a Single Feedback Pin
- Fixed 2MHz Switching Frequency
- Internal Compensation and Soft-Start
- Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested

## Quick Start

### Required Equipment

- One 36V, 1A DC Power Supply
- Digital Multimeters (DMM)
- Load Resistors Capable of Sinking up to 400mA at 48V output and 300mA at -12V output

## Procedure

To evaluate the performance of the ADPL26001 using either the boost or inverting circuits of EVAL-ADPAL26001-AZ, do the following procedures:

**Note: Do not turn on power supply until all connections are completed.**

1. Make sure that the EN/UVLO CONTROL jumper JP1 or JP2 is in the ON position.
2. Connect the power supply (with power off), load, and meters as shown in *Figure 1*.
3. After all connections are made, turn on the input power and verify that the input voltage is between 10V and 36V for the boost or between 4V and 36V for the inverting circuit.
4. Verify that the output voltage is 48V for the boost or -12V for the inverting circuit.

**Note: If the output voltage is low, temporarily disconnect the load to make sure that it is not set too high.**

Once the proper output voltage is established, adjust the input voltage and load within the operating ranges and observe the output voltage regulation, ripple voltage, efficiency, and other parameters.

***Ordering Information* appears at end of data sheet.**



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## EVAL-ADPL26001-AZ Evaluation Board Configuration

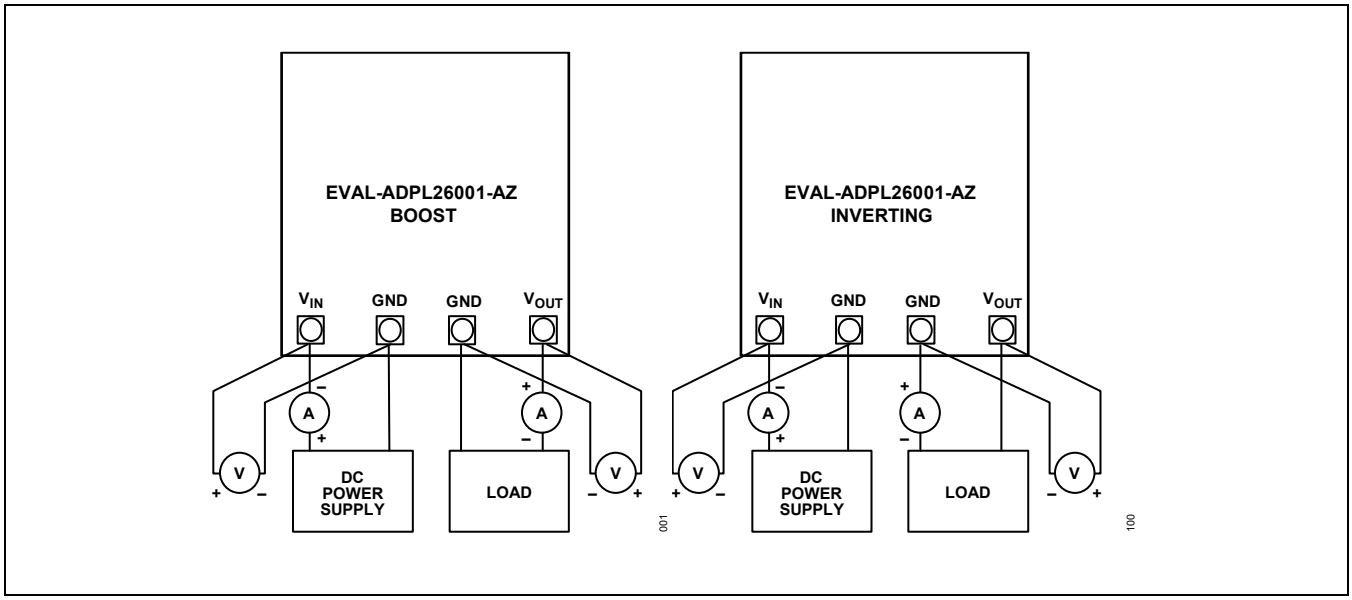



*Figure 1. EVAL-ADPL26001-AZ Evaluation Board Connections*

## Typical Performance Characteristics

$T_A$ = 25°C, all measurements are in reference to *EVAL-ADPL26001-AZ Evaluation Board Schematic* (48V Boost), unless otherwise noted.

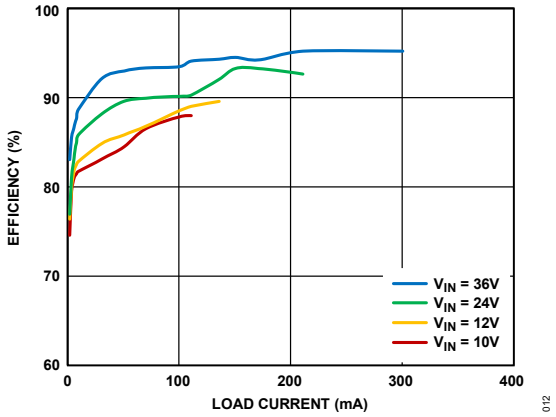



*Figure 2. Efficiency vs. Load Current*

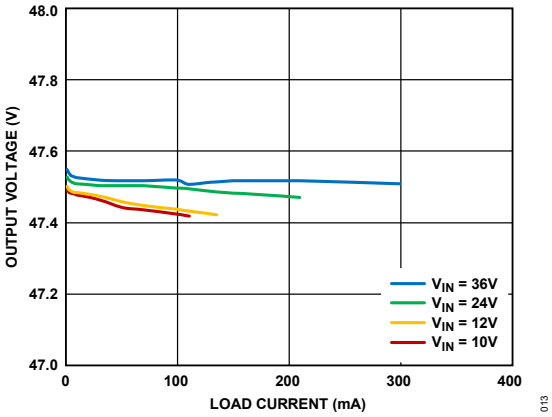



*Figure 3. Load and Line Regulation*

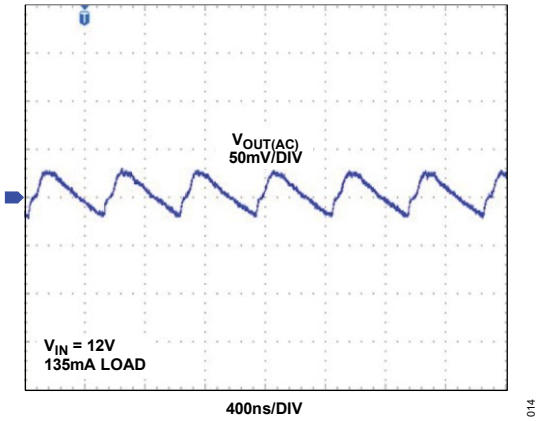



*Figure 4. Output Voltage Ripple*

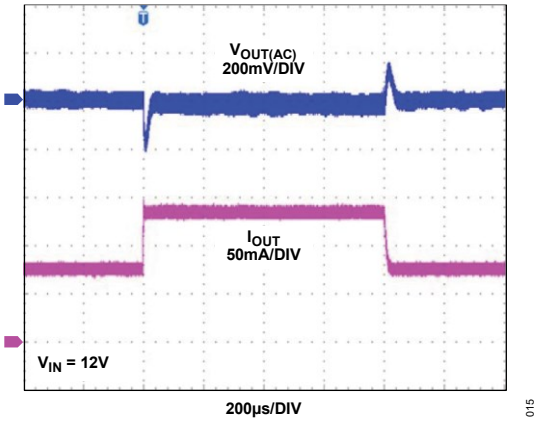



*Figure 5. Load Transient Between 75mA and 135mA*

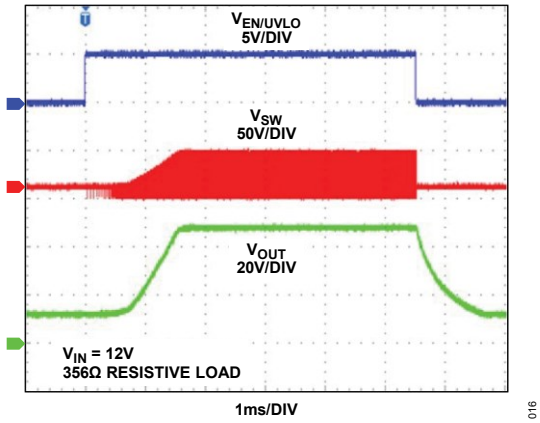



*Figure 6. Soft-Start and Shutdown Through EN/UVLO*

## Typical Performance Characteristics

$T_A$ = 25°C, all measurements are in reference to *EVAL-ADPL26001-AZ Evaluation Board Schematic* (-12V Inverting), unless otherwise noted.

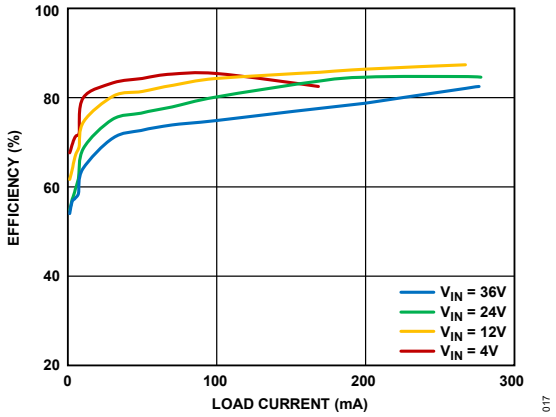



*Figure 7. Efficiency vs. Load Current*

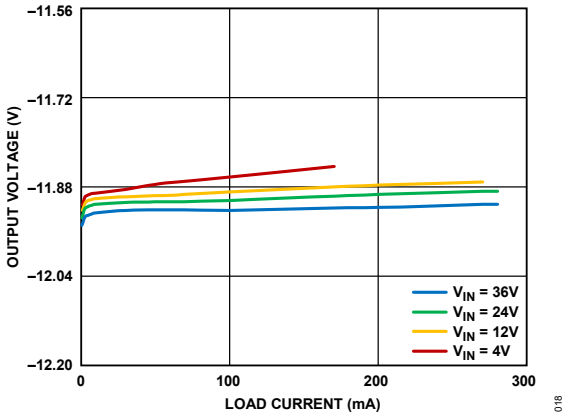



*Figure 8. Load and Line Regulation*

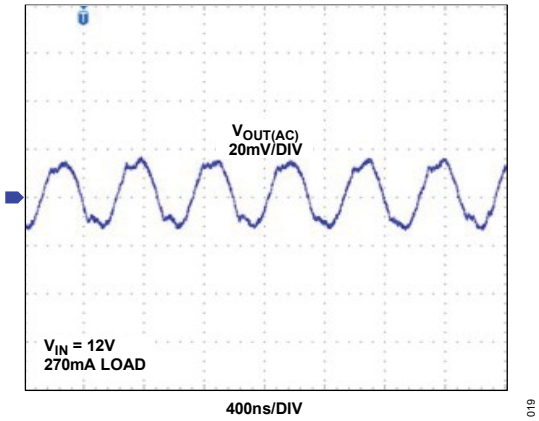



*Figure 9. Output Voltage Ripple*

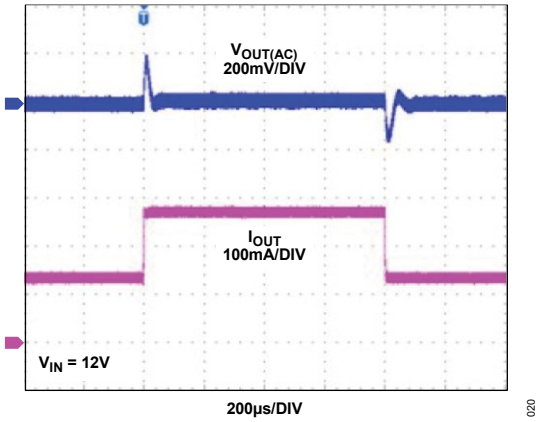



*Figure 10. Load Transient Between 135mA and 270mA*

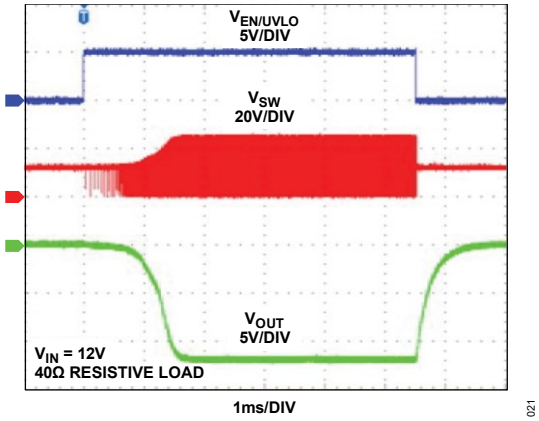



*Figure 11. Soft-Start and Shutdown Through EN/UVLO*

## Detailed Description

The EVAL-ADPL26001-AZ evaluation board consists of two circuits: one circuit is a boost converter with an operating input voltage range from 10V to 36V and an output voltage of 48V. With a 12V input, the maximum output current for the boost is 135mA and the efficiency is 89%. The second circuit is an inverting converter, which shows a negative output voltage. The operating input voltage range of the inverting converter is from 4V to 36V, and the output voltage is -12V. With a 12V input, the maximum output current for the inverting converter is 270mA and the efficiency is 87%.

### Enable/Undervoltage Lockout (EN/UVLO) Programming

A resistor-divider from the input to the EN/UVLO pin programs the boost to turn off when the input falls below 9V and the inverting converter to turn off when the input falls below 3.6V. The position of the EN/UVLO CONTROL jumper either connects the EN/UVLO pin to the input supply through a resistor-divider, shorts EN/UVLO to ground, or allows the EN/UVLO pin to be driven directly by a signal applied to the EN/UVLO terminal.

## Table 1. Jumper Connection Guide (JP1, JP2)

| SHUNT POSITION | EN/UVLO PIN | OUTPUT |
|---|---|---|
| 1-2* | Connected to the center node of respective resistor-dividers (R5 and R6, R7 and R8) | Enabled, UVLO level set through resistor-divider between VIN an GND |
| 2-3 | Connected to ground | Disabled |
| 3-4 | Connected to EN/UVLO | Externally driven |

**Default position.*

### Adjusting Output Voltage

The *ADPL26001* supports adjustable output voltage up to 60V. The EVAL-ADPL26001-AZ evaluation board has two circuits: a boost converter with 48V output and an inverting converter with -12V output. The output voltage is programmed using the resistor divider R1 and R2, R3 and R4. The voltage divider uses high resistance values that minimize current leakage, and the feedback network also includes a 4.7pF feed-forward capacitor. For more information, refer to the *Setting the Output Voltage* section in the ADPL26001 data sheet.

### Input Capacitor Selection

The input capacitors C1 and C4 serve to reduce current peaks drawn from the input-power supply and reduce the switching frequency ripple at the input. For more information on how to choose the input capacitance, refer to the *Input Capacitor* section in the ADPL26001 data sheet. Choose the input capacitors as 4.7µF/50V/X7R.

### Output Capacitor Selection

Choose the output capacitors C2 and C6 as 4.7µF/50V/X7R. For more information on how to choose the output capacitance, refer to the *Output Capacitor and Output Ripple* section in the ADPL26001 data sheet.

### Diode Selection

Each EVAL-26001-AZ evaluation board circuit uses a low-leakage rectifier diode to further minimize input current at light loads and no load. For more information, refer to the *Diode Selection* section in the ADPL26001 data sheet.

### Hot Plug-In and Long input cables

The EVAL-ADPL26001-AZ evaluation board provides optional tantalum polymer capacitor to dampen input voltage peaks and oscillations that can arise during hot-plug-in and/or due to long input cables. These capacitors limit the peak voltage at the input of the DC-DC converters when the evaluation board is powered directly from a precharged capacitive source or an industrial backplane PCB. Long input cables between an input-power source and the evaluation board circuit can cause input-voltage oscillations due to the inductance of the cables. The equivalent series resistance (ESR) of the electrolytic capacitor helps damp out the oscillations caused by long input cables.

## Ordering Information

| PART | TYPE |
|---|---|
| EVAL-ADPL26001-AZ | Evaluation Board |

*Z = RoHS-compliant part.*

## Component Suppliers

| SUPPLIER | WEBSITE |
|---|---|
| Murata Americas | www.murata.com |
| Coilcraft | www.coilcraft.com |
| Wurth Elektronik | www.we-online.com |
| Taiyo Yuden | www.ty-top.com |
| AVX | www.kyocera-avx.com |
| Nexperia | www.nexperia.com |

*Note: When contacting these component suppliers, indicate that the ADPL26001 is used.*

## EVAL-ADPL26001-AZ Evaluation Board Bill of Materials

### Boost Circuit

| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER, PART NUMBER |
|---|---|---|---|---|
| 1 | 2 | C1, C2 | Ceramic Capacitors, 4.7µF, 50V, 10%, X7R, 1206 | Murata, GRM31CR71H475KA12L |
| 2 | 1 | C11 | Tantalum Capacitor, 10µF, 50V, 20% | Kyocera-AVX, TCJD106M050R0090 |
| 3 | 1 | C12 | Ceramic Capacitor, 0.1µF, 50V, 10%, X7R, 0603 | Kyocera-AVX, 06035C104KAT2A |
| 4 | 1 | C3 | Ceramic Capacitor, 1µF, 6.3V, 10%, X7R, 0402 | Murata, GRM155R70J105KA12D |
| 5 | 1 | C8 | Ceramic Capacitor, 4.7pF, 50V, C0G, 0603 | Kyocera-AVX, 06035A4R7BAT2A |
| 6 | 1 | D1 | Schottky Rectifier, 60V, 1A | Nexperia, PMEG6010CEJ |
| 7 | 1 | L1 | Inductor, 6.8µH | Wurth Elektronik, 74438335068 |
| 8 | 2 | R1, R5 | Resistors, 1MΩ, 1%, 1/10W, 0603 | N/A |
| 9 | 1 | R2 | Resistor, 34.8kΩ, 1%, 1/10W, 0603 | N/A |
| 10 | 1 | R6 | Resistor, 215kΩ, 1%, 1/10W, 0603 | N/A |
| 11 | 1 | U1 | IC, Regulator | Analog Devices, Inc., ADPL26001ES6 |

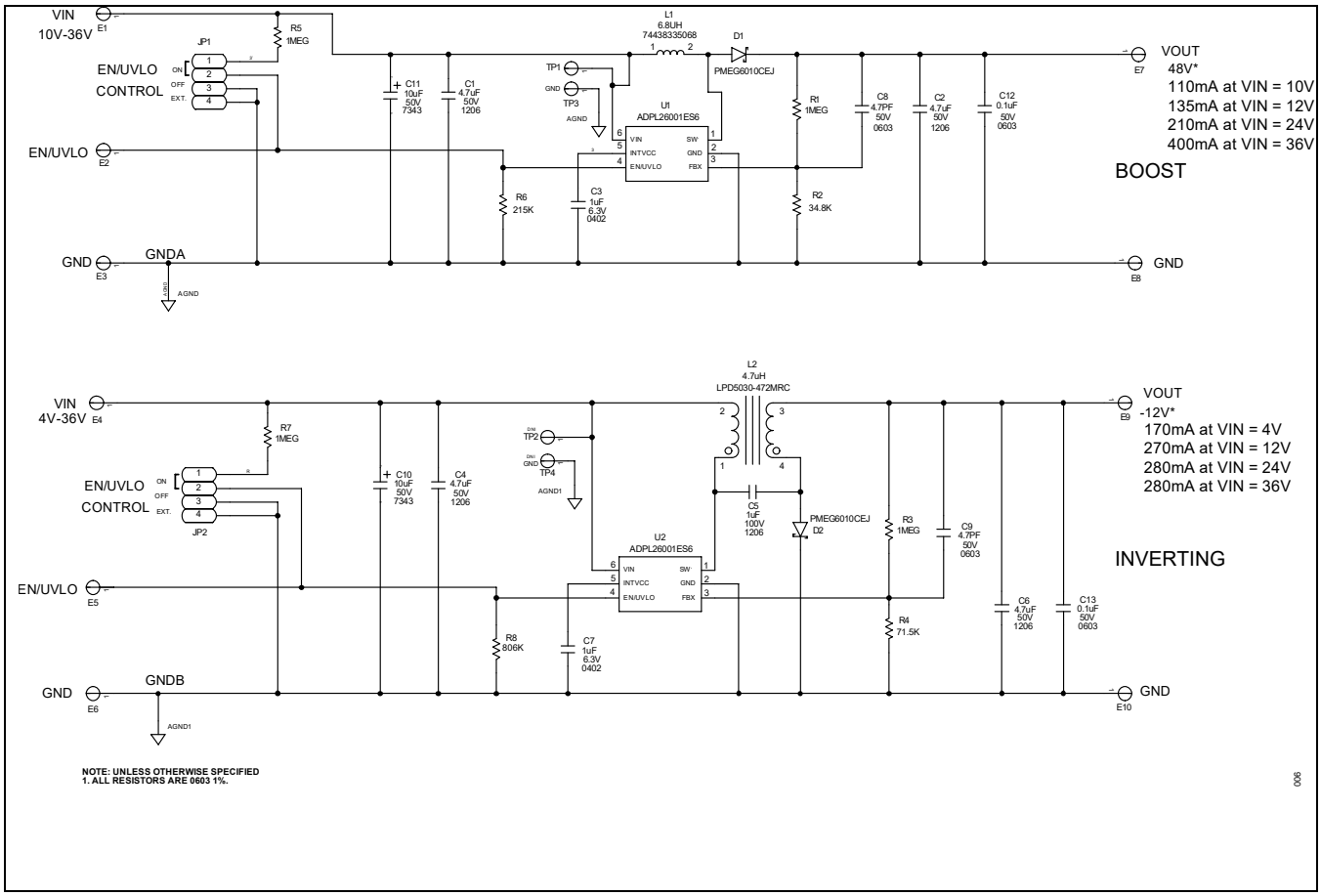
*Note: N/A means not applicable.*

### Inverting Circuit

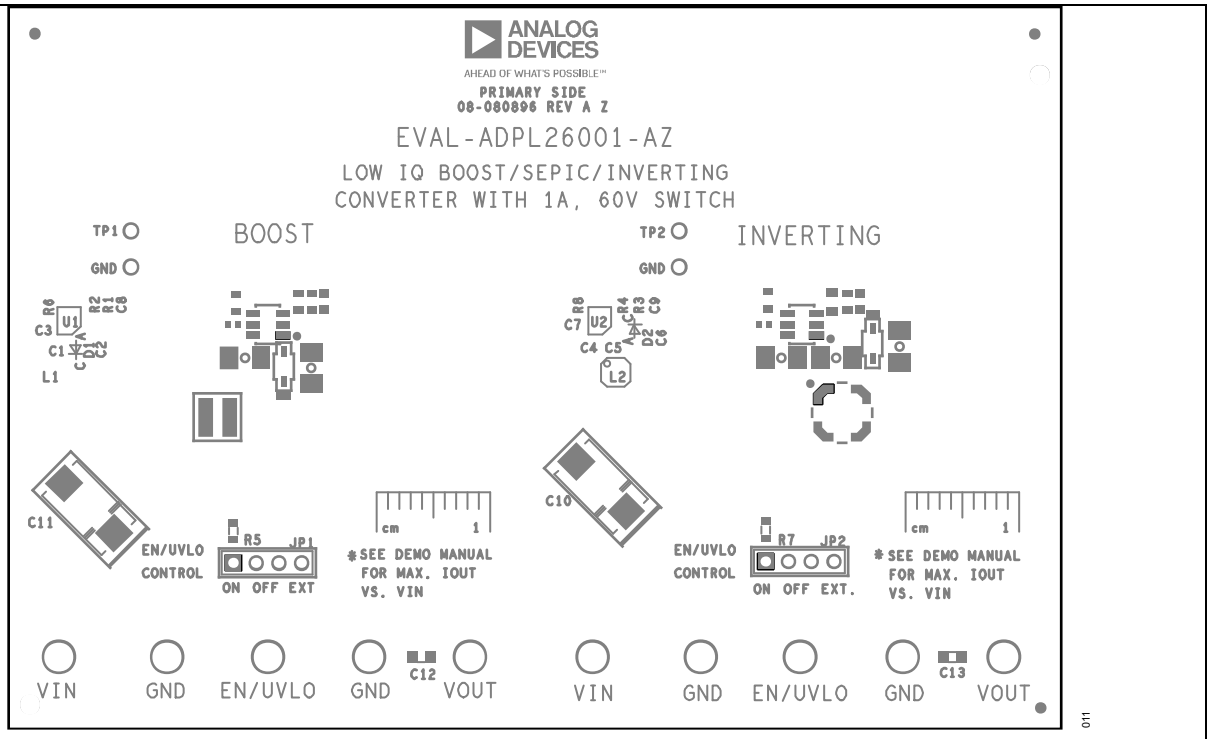
| ITEM | QTY | REFERENCE | PART DESCRIPTION | MANUFACTURER, PART NUMBER |
|---|---|---|---|---|
| 1 | 2 | C4, C6 | Ceramic Capacitors, 4.7µF, 50V, 10%, X7R, 1206 | Murata, GRM31CR71H475KA12L |
| 2 | 1 | C10 | Tantalum Capacitor, 10µF, 50V, 20% | Kyocera-AVX, TCJD106M050R0090 |
| 3 | 1 | C13 | Ceramic Capacitor, 0.1µF, 50V, 10%, X7R, 0603 | Kyocera-AVX, 06035C104KAT2A |
| 4 | 1 | C7 | Ceramic Capacitor, 1µF, 6.3V, 10%, X7R, 0402 | Murata, GRM155R70J105KA12D |
| 5 | 1 | C5 | Ceramic Capacitor, 1µF, 100V, 10%, X7R, 1206 | Taiyo Yuden, HMK316B7105KL-T |
| 6 | 1 | C9 | Ceramic Capacitor, 4.7pF, 50V, C0G, 0603 | Kyocera-AVX, 06035A4R7BAT2A |
| 7 | 1 | D2 | Schottky Rectifier, 60V, 1A | Nexperia, PMEG6010CEJ |
| 8 | 1 | L2 | Inductor Coupled, 4.7µH | Coilcraft, LPD5030-472MRC |
| 9 | 2 | R3, R7 | Resistors, 1MΩ, 1%, 1/10W, 0603 | N/A |
| 10 | 1 | R4 | Resistor, 71.5kΩ, 1%, 1/10W, 0603 | N/A |
| 11 | 1 | R8 | Resistor, 806kΩ, 1%, 1/10W, 0603 | N/A |
| 12 | 1 | U2 | IC, Regulator | Analog Devices, Inc., ADPL26001ES6 |

*Note: N/A means not applicable.*

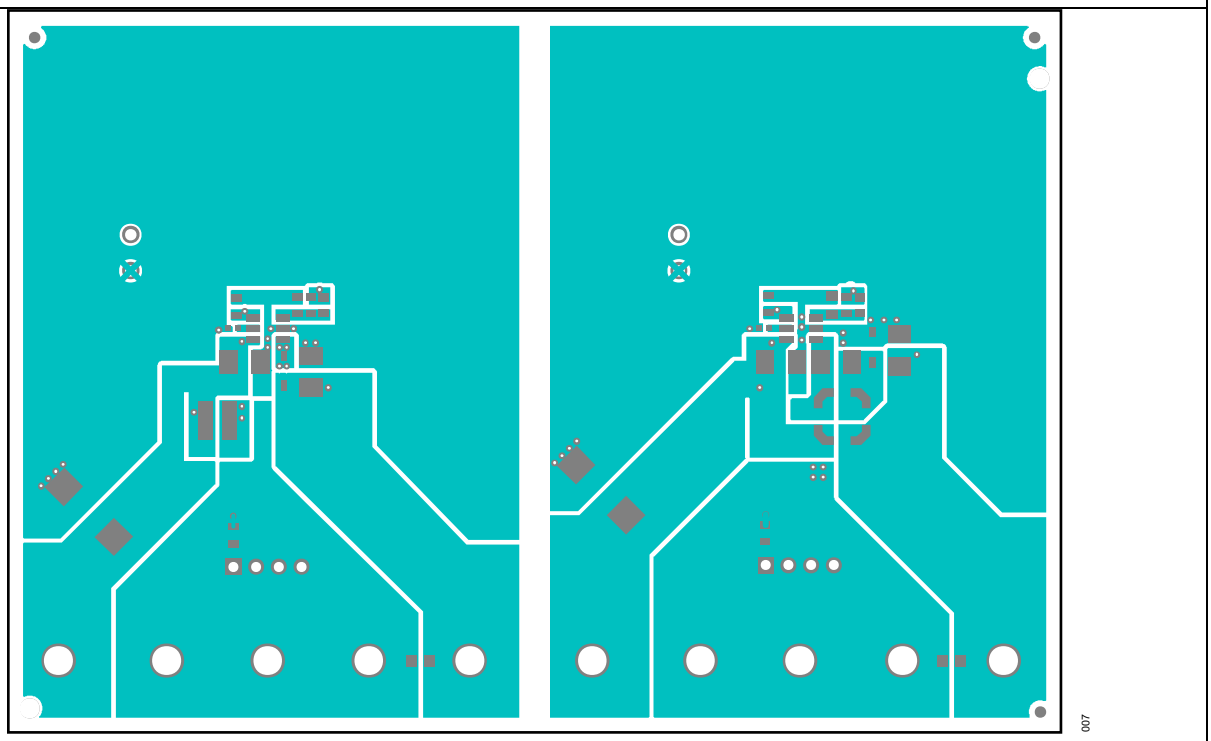
## EVAL-ADPL26001-AZ Evaluation Board Schematic



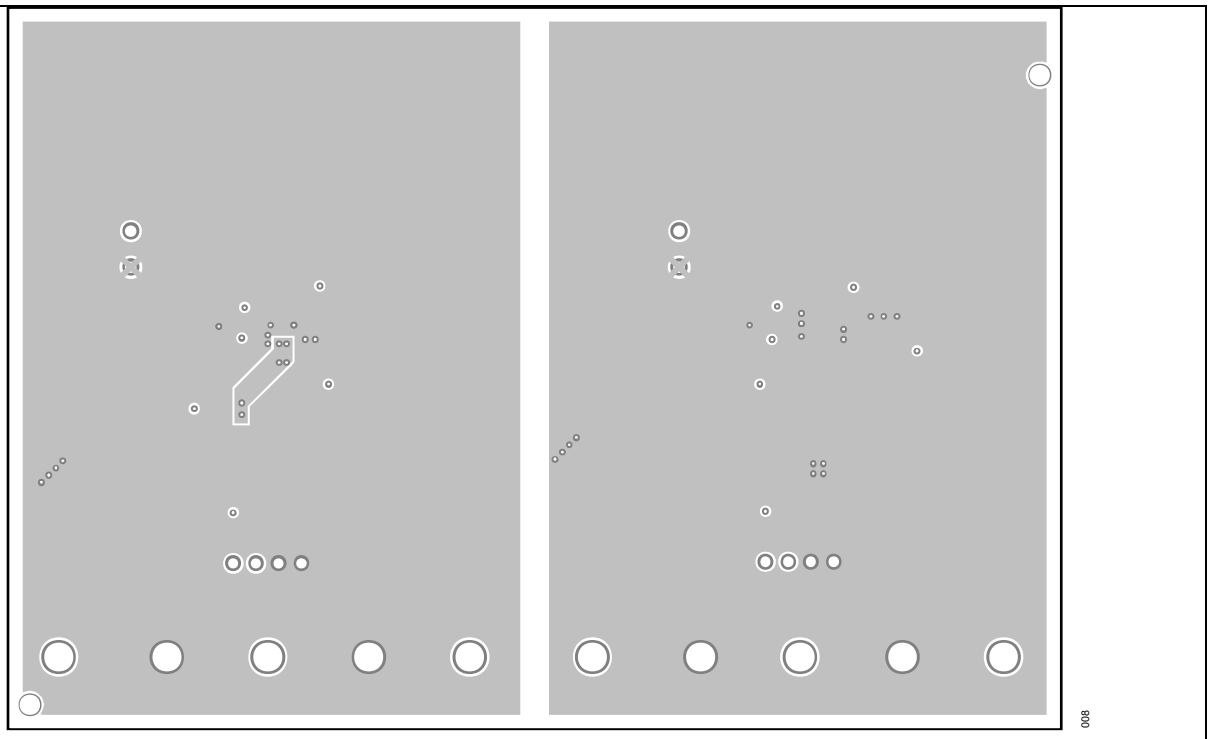
## EVAL-ADPL26001-AZ Evaluation Board PCB Layout



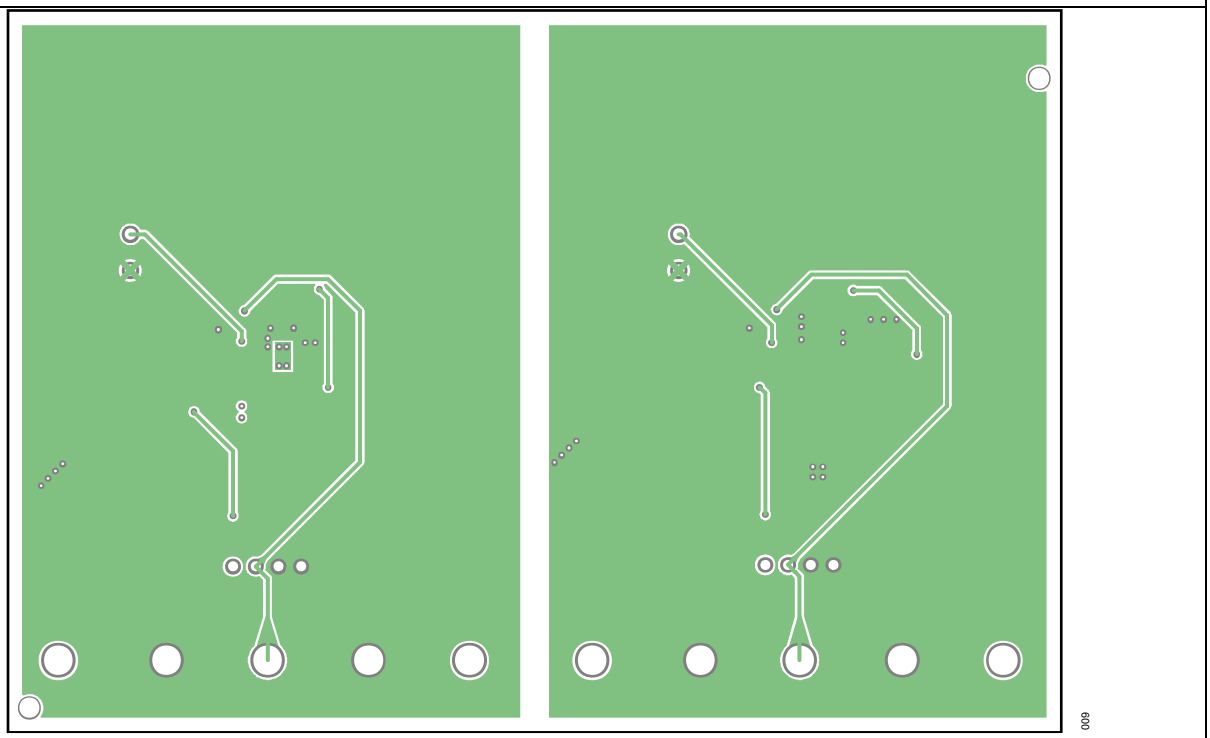

*EVAL-ADPL26001-AZ Evaluation Board—Top Silkscreen*



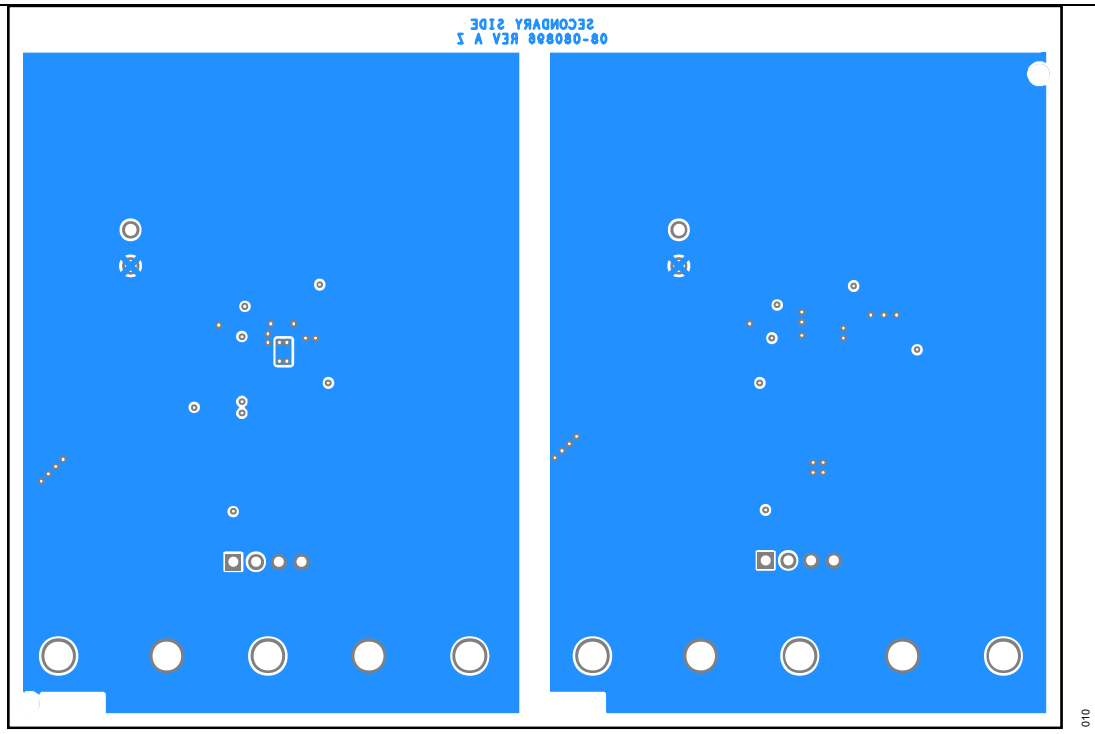

*EVAL-ADPL26001-AZ Evaluation Board Layout—Layer 1*



EVAL-ADPL26001-AZ Evaluation Board Layout—Layer 2



EVAL-ADPL26001-AZ Evaluation Board Layout—Layer 3




*EVAL-ADPL26001-AZ Evaluation Board Layout—Layer 4*

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|---|---|---|---|
| 0 | 1/24 | Initial release | — |