ANALOG DEVICES

EVAL-ADuM5411EBZ User Guide
UG-1007

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Using the EVAL-ADuM5411EBZ Evaluation Board with *i*Coupler Quad-Channel Isolators and Integrated DC-to-DC Converters

FEATURES

Access to 4 data channels and data output enable control pins
Easily configurable *iso*Power dc-to-dc converter controls
Split primary and secondary power planes for independent operation of data channels and *iso*Power integrated dc-to-dc converters
Multiple connection options for data and power
Support for printed circuit board (PCB) edge mounted coaxial connectors
Support for active probes
Layout for electromagnetic interference (EMI) evaluation

DOCUMENTS NEEDED

ADuM5410/ADuM5411/ADuM5412 data sheet
ADuM6410/ADuM6411/ADuM6412 data sheet
AN-1349 Application Note
AN-1109 Application Note
AN-0971 Application Note

EVALUATION KIT CONTENTS

EVAL-ADuM5411EBZ, populated with the ADuM5411
EVAL-ADuM5411UEBZ, DUT unpopulated (must be ordered separately)

ADDITIONAL EQUIPMENT NEEDED

One to three 3.3 V to 5.0 V power supplies
Edge mounted SMA

GENERAL DESCRIPTION

The EVAL-ADuM5411EBZ supports quad-channel *i*Coupler® data isolators, including the ADuM5410/ADuM5411/ADuM5412 and ADuM6410/ADuM6411/ADuM6412, with an *iso*Power integrated dc-to-dc converter in 24-lead SSOP packages. The EVAL-ADuM5411EBZ supports signal distribution, loopback, and loads referenced to the power and ground planes. The evaluation board also has EMI evaluation and bypass and bulk capacitors. Signal sources can be conducted to the board through header pins or through edge mounted SMA connectors (SMA connectors must be ordered separately). Screw terminal blocks on the evaluation board provide power connections. The board includes 0.2 inch header positions for compatibility with active probes (probe header pins must be ordered separately).

The evaluation board follows best PCB design practices for 4-layer boards, including a full power plane and ground plane on each side of the isolation barrier. No other EMI or noise mitigation design features are included on the evaluation board. In cases of high speed operation, or when ultralow emissions are required, refer to the AN-1349 Application Note, AN-1109 Application Note, and AN-0971 Application Note for additional evaluation board layout techniques.

The EVAL-ADuM5411EBZ is supplied with the ADuM5411 installed. Other supported *i*Coupler digital isolators with an integrated dc-to-dc converters must be ordered separately to use with the EVAL-ADuM5411UEBZ, including the ADuM5410, ADuM5412, ADuM6410, ADuM6411, and ADuM6412

Complete specifications for the ADuM5410/ADuM5411/ADuM5412 and the ADuM6410/ADuM6411/ADuM6412 are available in the ADuM5410/ADuM5411/ADuM5412 data sheet and ADuM6410/ADuM6411/ADuM6412 data sheet, respectively, available from Analog Devices, Inc., and should be consulted in conjunction with this data sheet when using the evaluation board.

PLEASE SEE THE LAST PAGE FOR AN IMPORTANT WARNING AND LEGAL TERMS AND CONDITIONS.

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REVISION HISTORY

7/2016—Revision 0: Initial Version

PHOTOGRAPH OF THE EVAL-ADuM5411EBZ EVALUATION BOARD

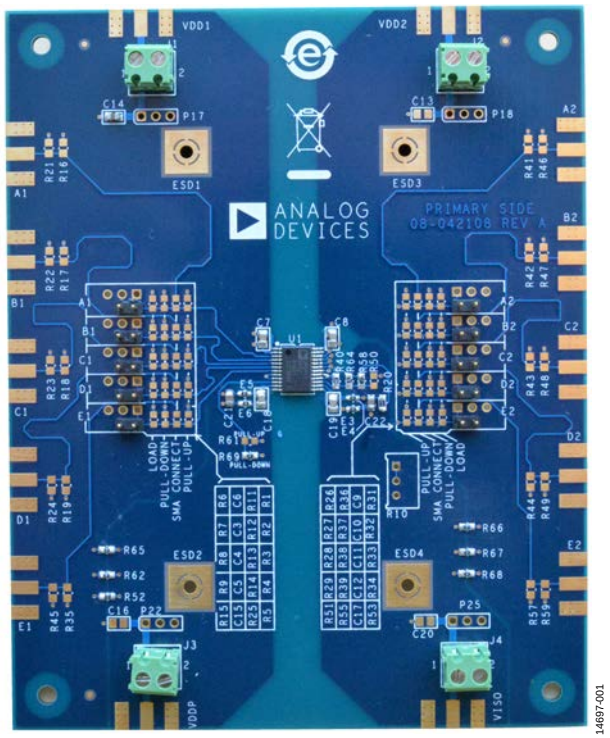

Figure 1.

EVALUATION BOARD CIRCUITRY

PCB EVALUATION GOALS

The EVAL-ADuM5411EBZ evaluation board is intended to achieve the following goals:

- Evaluate the full range of *i*Coupler data transfer functions.
- Evaluate the capabilities of the integrated *iso*Power dc-to-dc converter.
- Allow quick setup of isolated power voltage levels.
- Allow easy connection to power supplies, data channels, and instrumentation.
- Provide simple off-board routing for isolated power.
- Allow high differential voltage applied between the two sides of an *i*Coupler isolator. Note that the EVAL-ADuM5411EBZ is intended for evaluation of the ADuM5411, but has not been safety certified for high voltage operation. If differential voltages above 60 V are applied, external safety measures appropriate for the voltage must be in place.

The EVAL-ADuM5411UEBZ is available as an alternative to desoldering the ADuM5411 from the EVAL-ADuM5411EBZ evaluation board for evaluation of the ADuM5410, ADuM5412 and the ADuM6410/ADuM6411/ADuM6412. The EVAL-ADuM5411UEBZ leaves the 24-lead SSOP pad of the *i*Coupler isolator unpopulated. A pin-compatible *i*Coupler digital isolator with an integrated dc-to-dc converter must be ordered separately and installed on the EVAL-ADuM5411UEBZ evaluation board. Both the EVAL-ADuM5411EBZ and EVAL-ADuM5411UEBZ evaluation boards come populated with the same power terminals, bypass capacitors, header pins, and resistors required for typical operation.

The evaluation board is compatible with 24-lead SSOP *i*Coupler quad-channel data isolators with an integrated dc-to-dc converter, such as the ADuM5410/ADuM5411/ADuM5412 and the ADuM6410/ADuM6411/ADuM6412 devices.

CONNECTORS

The PCB provides support for three types of interconnections:

- SMA edge mounted connectors
- Through-hole signal ground pairs
- Terminal blocks for power connections

With these three options, both temporary and permanent connections to the EVAL-ADuM5411EBZ can be made.

When coaxial connections are required, SMA connector positions are available for digital input/output data signals and the VDD1/VDD2/VDDP/VISO power supply planes. The SMA connector positions are unpopulated as shipped and must be ordered from a distributor separately. The PCB also supports optional 50 Ω on-board termination with optional 100 Ω parallel resistors.

The EVAL-ADuM5411EBZ is configured with the *iso*Power dc-to-dc converter enabled and setup for a nominal 3.3 V isolated power provided to the data channels. The isolated device is fully operational with power to the J1 screw terminal block or optional VDD1 SMA connectors. Other power schemes can be constructed with the J1, J2, J3, and J4 screw terminal blocks or matching optional SMA connectors. Signals can be routed in or out with the provided header pins or the optional SMA connectors. The pin spacing of each through-hole connector is 0.1 inch between the centers. There are additional signal test points with 0.2 inch spacing provided for active scope probes. These header pins must be added separately. Optional components are shown installed in Figure 2.

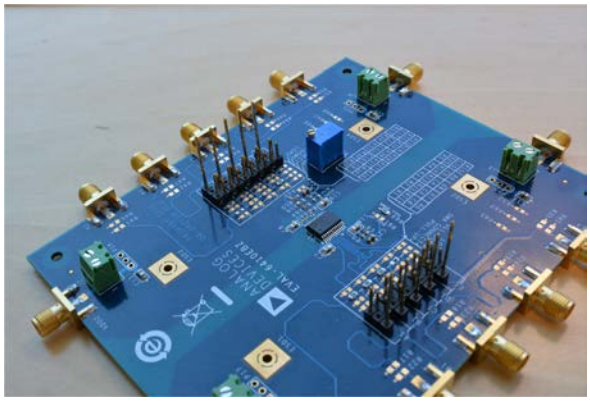

Figure 2. Optional Components for the EVAL-ADuM5411EBZ

INPUT POWER/ISOLATED POWER

The PCB is configured by default for full device operation with an external power connected only to the VDD1 plane. In this specific configuration, the VDD1 and VDDP power planes are connected together by 0 Ω resistors to supply power to the integrated *iso*Power dc-to-dc converter. The dc-to-dc converter is enabled by the R69 pull-down resistor. The V_{ISO} output voltage level is set to a nominal 3.3 V by the voltage divider on the V_{SEL} pin. The VISO and VDD2 planes are connected together by 0 Ω resistors to provide isolated power to the *i*Coupler data channels.

The evaluation board provides easily divisible power planes to independently power the data channel inputs and/or outputs. The R52, R62, and R65 0 Ω resistors can be removed to separate the VDD1 and VDDP planes. Separating the planes allows the data channels and dc-to-dc converter of the ADuM5410/ADuM5411/ADuM5412 and ADuM6410/ADuM6411/ADuM6412 devices to be powered by independent supplies or mixed voltage levels.

The V_{ISO} output voltage level is set by the evaluation board to a nominal 3.3 V. This can be adjusted to 5.0 V by removing the 0 Ω R64 resistor. For adjustable V_{ISO} output voltage levels, remove the R20 resistor and add the R10 potentiometer, and the R50 10 kΩ resistor, to the evaluation board.

The parallel 0 Ω resistors R66, R67, and R68 can be removed to separate the VDD2 and VISO planes. Isolated power from the dc-to-dc converter can be routed off-board with the J4 screw terminal or optional VISO SMA connector. The *i*Coupler data channels can be powered independently by the J2 screw terminal block or optional VDD2 SMA connector. The C8 capacitor location is available if bulk capacitance is required for the VDD2 supply.

To disable the integrated dc-to-dc converter, the 0 Ω pull-down resistor in the R69 position must be moved to the R61 position to act as a pull-up to the VDDP plane on the PDIS pin.

Divided power and ground planes are present on Layer 2 and Layer 3 of the PCB on each side of the isolation barrier. This configuration is shown in Figure 6 and Figure 7, respectively.

See the ADuM5410/ADuM5411/ADuM5412 and ADuM6410/ADuM6411/ADuM6412 data sheets for additional operation specifics.

DATA INPUT/OUTPUT STRUCTURES

Each data channel has a variety of structures to help configure, load, and monitor both the input and output signals of the device. Figure 3 shows an example of the routing from an external connection to each data channel pin of the device under test (DUT). Each data channel has similar connections.

Starting at the external connection, the signal path is constructed in the following order (see Figure 3 for the locations of these components):

1. A pad layout for a PCB edge mounted SMA connector.
2. Two 0805 pads are provided to install 100 Ω resistors to ground. The combined resistance is 50 Ω to provide termination for a standard coaxial cable.
3. A standard 0805 pad layout that allows the coaxial and termination structures to connect to the rest of the signal path.
4. A 0603 pad layout between the signal path and VDD1/VDD2 power plane for a pull-up resistor.
5. A populated 2-pin header to provide a signal ground pair for use with clip leads or for temporarily shorting a channel to ground.
6. Groupings of three open through holes, consisting of a signal and two ground connections. These holes can hardwire signal wires into the PCB, installing a header to accept an active probe, or installing a 2-pin header to allow adjacent channels to temporarily be shorted together.
7. A 0805 pad layout between the signal and GND1/GND2 planes where a load capacitor or pull-down resistor can be installed.

CAPACITORS AND FERRITE BEADS ON THE PCB

Several positions and structures are provided to allow optimal bypass capacitance for the DUT on the evaluation board. Provisions are made for optional surface-mount bulk capacitors (C13, C16, and C20) to be installed near the power connectors to compensate for long cables to the power supply. Bypass capacitors are installed near the V_{DD1}, V_{DDP}, V_{DD2}, and V_{ISO} power supply pins of the *i*Coupler device.

The PCB also implements a distributed capacitive bypass. This bypass consists of power and ground planes closely spaced on the inner layers of the PCB, which reduces noise and the transmission of EMI without using complex design features.

Ferrite beads can replace the 0603 sized 0 Ω resistors in the E3 and E4 positions. See the ADuM5410/ADuM5411/ADuM5412 and ADuM6410/ADuM6411/ADuM6412 data sheets for further information ferrite selection placed in series with the V_{ISO} and GND_{ISO} pins.

HIGH VOLTAGE CAPABILITY

This PCB is designed in adherence to 2500 V basic insulation practices. High voltage testing beyond 2500 V is not recommended. Do not rely on the EVAL-ADuM5411EBZ for safety functions.

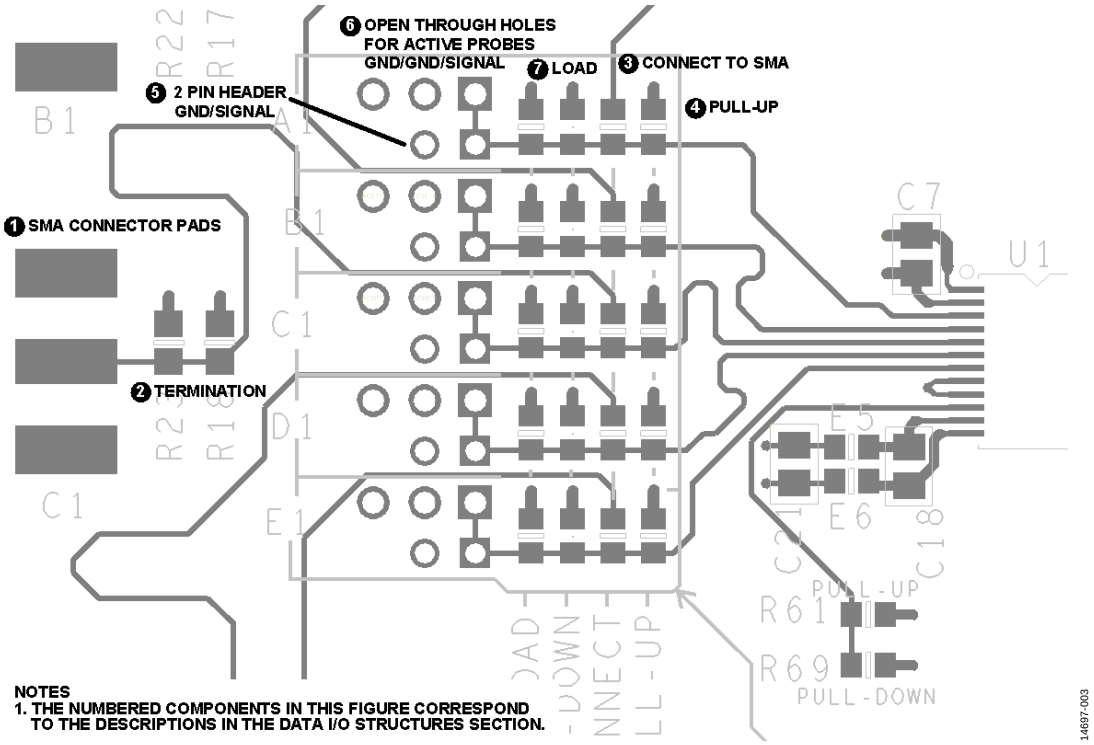

Figure 3. Configuration and Monitoring Structures

EVALUATION BOARD SCHEMATIC AND ARTWORK

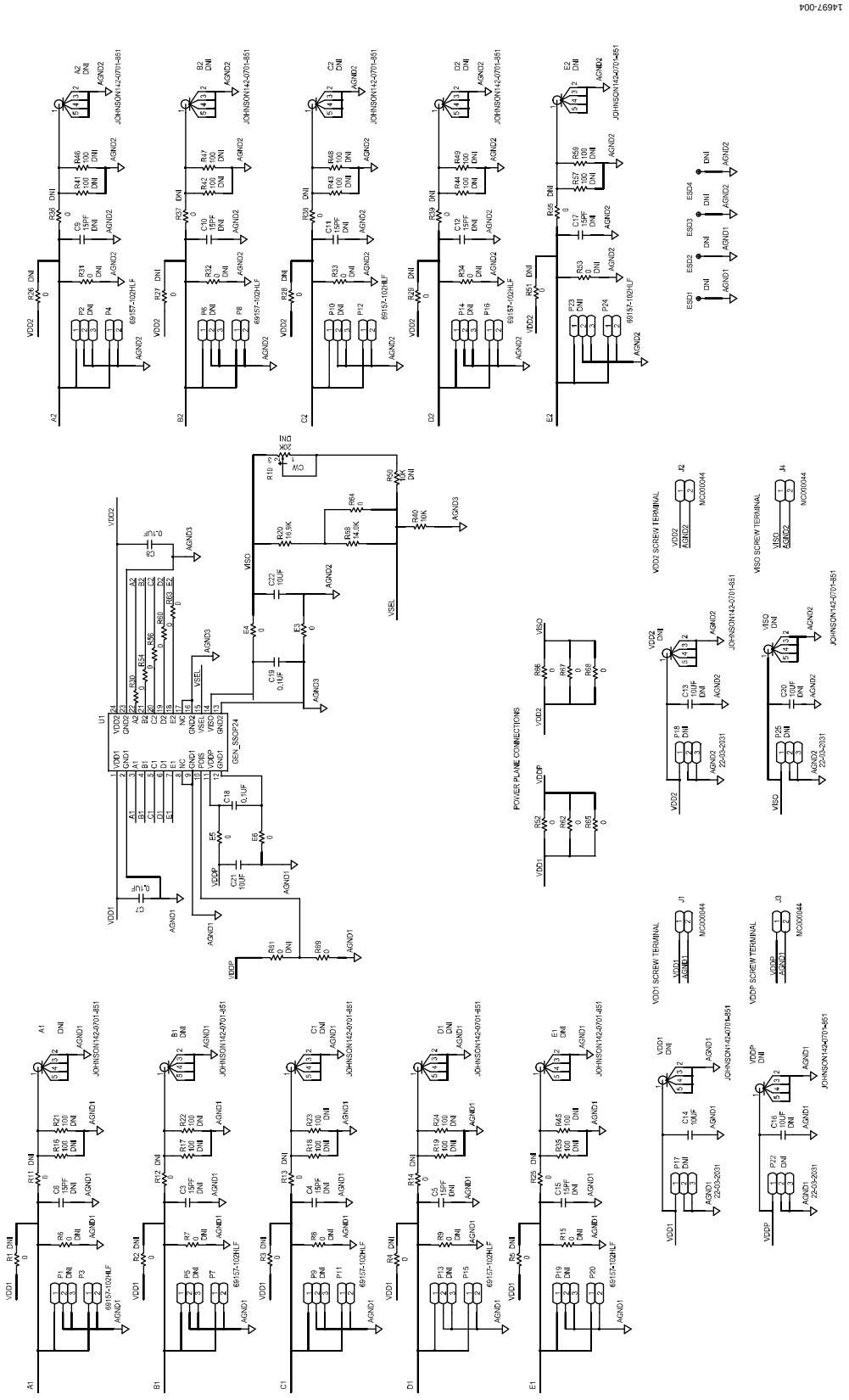

Figure 4. EVAL-ADuM5411EBZ Schematic

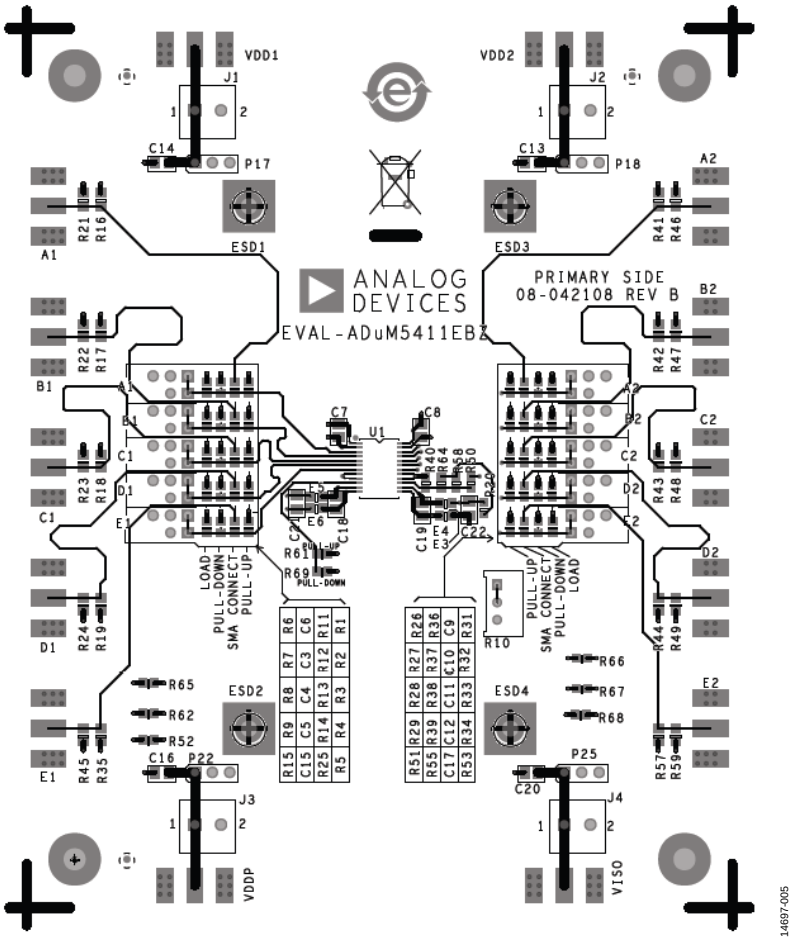

Figure 5. Top Level Signal Routing and Assembly (Layer 1)

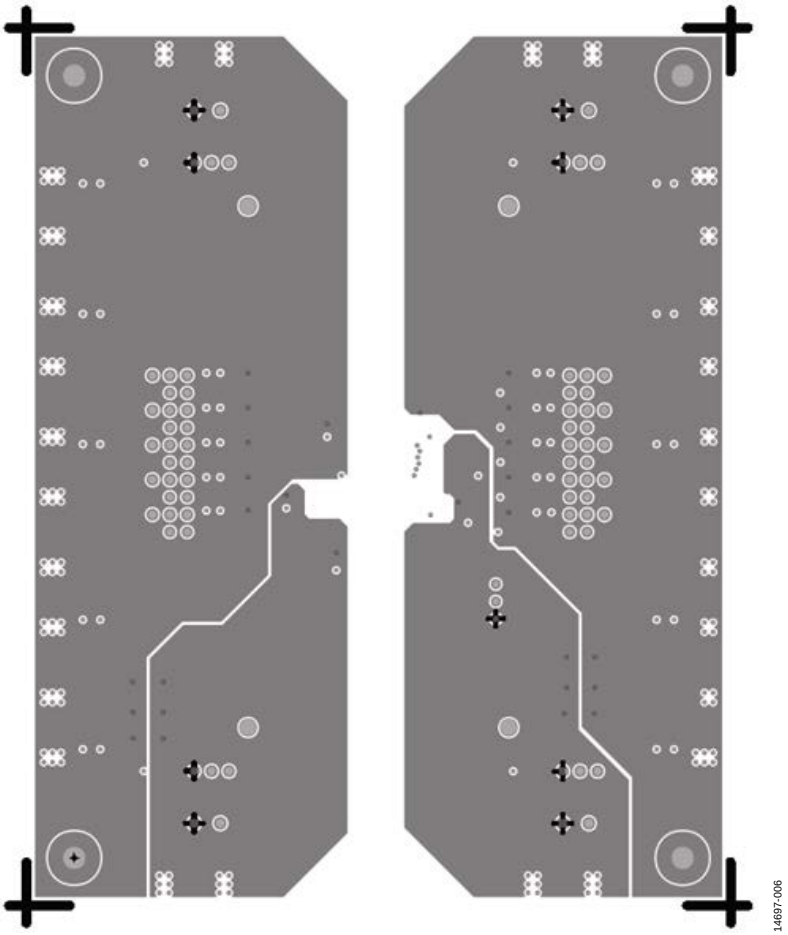

Figure 6. VDD1/VDDP/VDD2/VISO Power Planes (Layer 2)

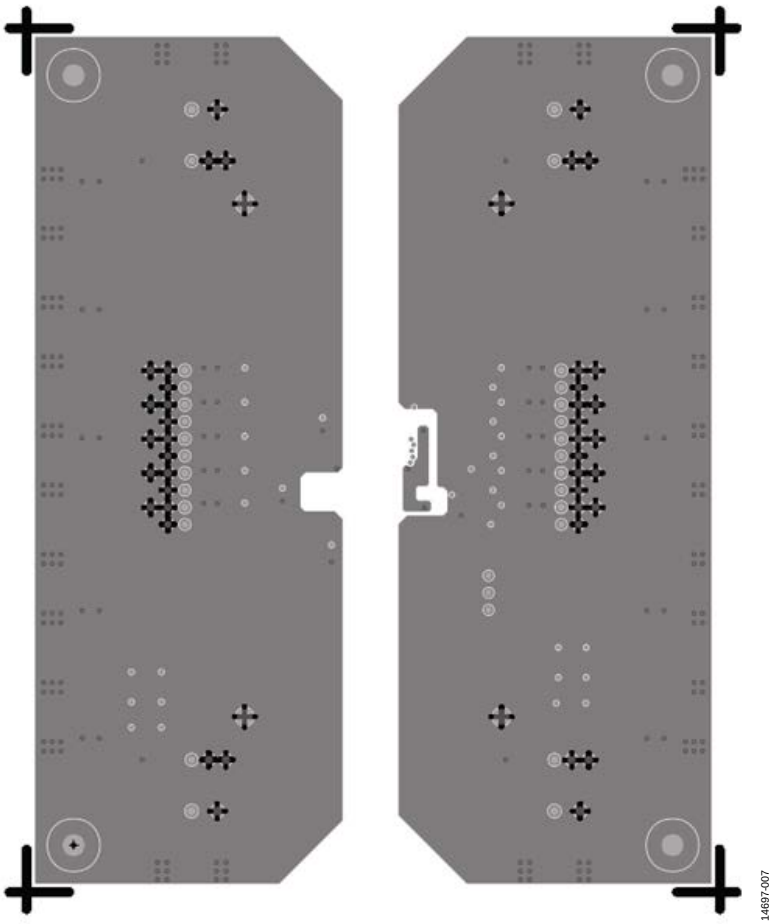

Figure 7. GND1 and GND2 Planes (Layer 3)

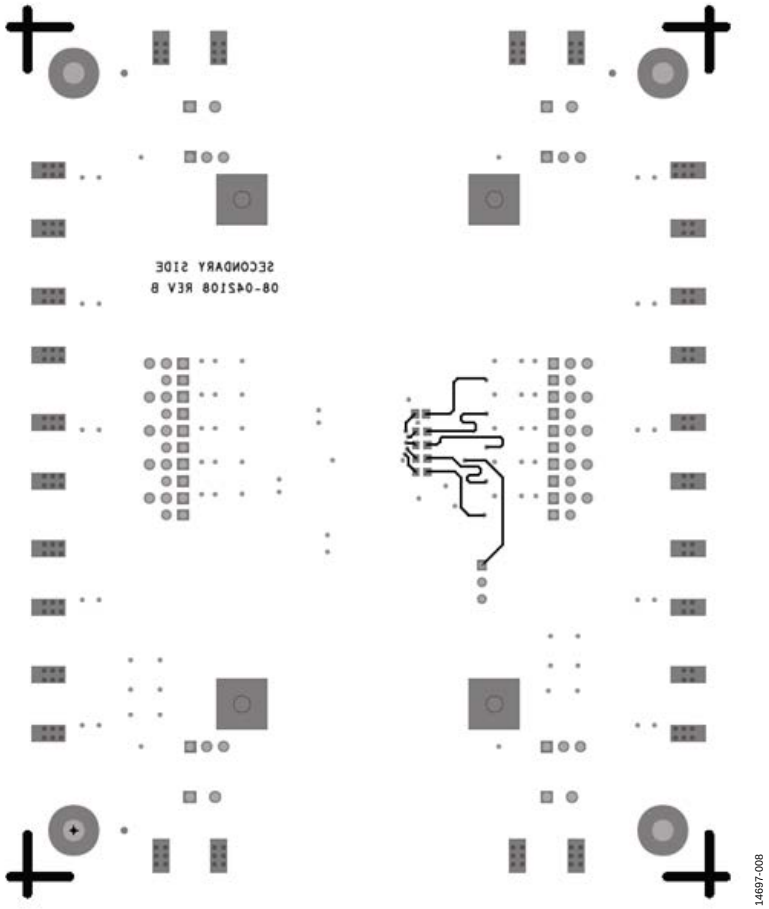

Figure 8. Bottom Layer Assembly and Routing (Layer4)

ORDERING INFORMATION

BILL OF MATERIALS

Table 1.

Reference Designator	Description	Manufacturer/Part Number
U1	ADuM5411 quad-channel isolator with integrated dc-to-dc converter	ADuM5411BRSZ
C14, C21, C22	0805, 10 µF capacitors, CER monolithic	Not applicable
C7, C8, C18, C19	0805, 0.1 µF bypass capacitors, X7R	Not applicable
E3 to E6, R30, R52, R54, R56, R60, R62 to R69	0603, 0 Ω resistors	MULTICOMP
J1 to J4	PCB screw terminal blocks	MULTICOMP/MC000044
P3, P4, P7, P8, P11, P12, P15, P16, P20, P24	2-pin headers, 100 mil spacing	FCI/69157-102HLF
R20	0603, 16.9 kΩ resistor	Not applicable
R40	0603, 10 kΩ resistor	Not applicable
R58	0603, 14 kΩ resistor	Not applicable
A1, A2, B1, B2, C1, C2, D1, D2, E1, E2, VDD1, VDD2, VDDP, VISO	SMA edge connectors (not installed)	Johnson/142-0701-851
C3 to C6, C9 to C12, C15, C17	0603, signal loads (not installed)	Not applicable
C13, C16, C20	0805, 10 µF capacitors, CER monolithic (not installed)	Not applicable
P1, P2, P5, P6, P9, P10, P13, P14, P17 to P19, P22, P23, P25	2-pin headers, 200 mil spacing (not installed)	Not applicable
R1 to R9, R11 to R15, R25 to R29, R31 to R34, R36 to R39, R51, R53, R55, R61	0603, 0 Ω resistors (not installed)	MULTICOMP
R10	3/8 inch, 20 kΩ potentiometer (not installed)	BOURNS/3299W-1-203LF
R16 to R19, R21 to R24, R35, R41 to R49, R57, R59	0805, 100 Ω resistors (not installed)	Not applicable
R50	0603, 10 kΩ resistor (not installed)	Not applicable

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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