Evaluation Board User Guide
UG-205

One Technology Way • P.O. Box 9106 • Norwood, MA 02062-9106, U.S.A. • Tel: 781.329.4700 • Fax: 781.461.3113 • www.analog.com

Evaluation Board for the ADP1850DP Step-Down DC-to-DC Controller

FEATURES

Input range: 10 V to 15 V
Output voltage: 1.09 V
Output current: 50 A
Switching frequency: 300 kHz
Operates in PWM
Compact, low cost, and efficient design

EVALUATION BOARD DESCRIPTION

This document describes the design, operation, and test results of the ADP1850DP-EVALZ operating in dual-phase mode. The input range for this evaluation board is 10 V to 15 V, and the regulated output voltage is 1.09 V with a maximum 50 A output current. A switching frequency (f_{SW}) of 300 kHz is chosen to achieve a good balance between efficiency and the sizes of the power components.

ADP1850 DEVICE DESCRIPTION

The ADP1850 is a dual-channel, step-down switching controller with integrated drivers for external N-channel synchronous power MOSFETs. The two PWM outputs are phase shifted 180°, which reduces the input RMS ripple current, thus minimizing required input capacitance. The two outputs can be combined for dual-phase PWM operation that can deliver more than 50 A output current. The internal parameters of the two channels are optimized for current sharing.

In addition, boost diodes are integrated into the ADP1850, thus lowering the overall system cost and component count. The ADP1850 can be set to operate in pulse skip, high efficiency mode under light load or in PWM continuous conduction mode.

The ADP1850 includes externally adjustable soft start, output overvoltage protection, externally adjustable current limit, power good, tracking function, and a programmable oscillator frequency that ranges from 200 kHz to 1.5 MHz. The ADP1850 provides an output voltage accuracy of ±0.85% from −40°C to +85°C and ±1.5% from −40°C to +125°C junction temperature. This controller may be powered from a 2.75 V to 20 V supply is available in a 32-lead 5 mm × 5 mm LFCSP package.

ADP1850DP EVALUATION BOARD

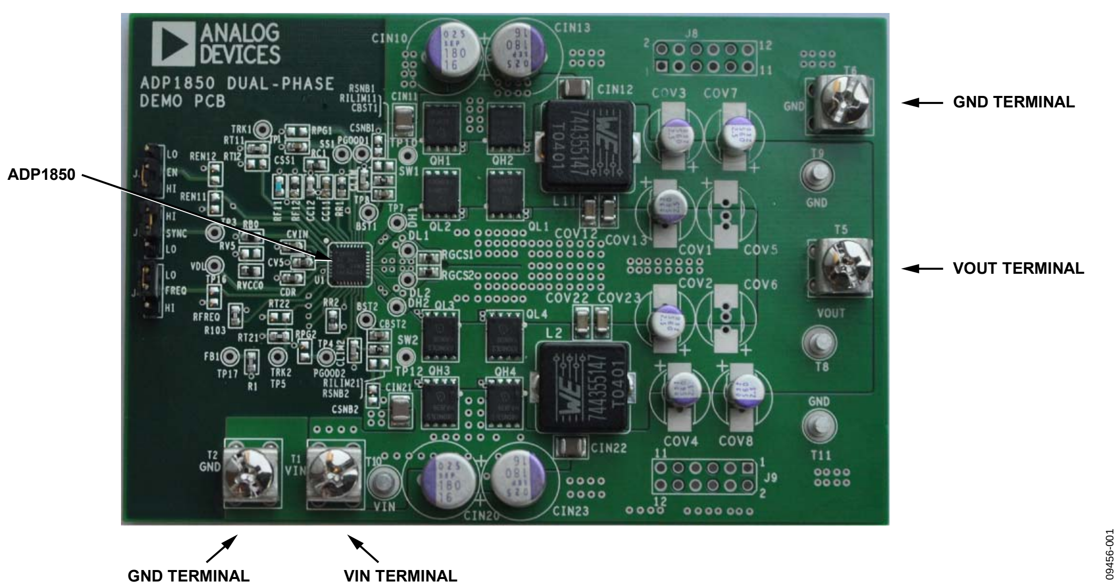

Figure 1.

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REVISION HISTORY

8/11—Rev. 0 to Rev. A

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11/10—Revision 0: Initial Version

COMPONENT DESIGN

For information about selecting power components and calculating component values, see the ADP1850 data sheet.

INDUCTOR SELECTION

A 0.47 μH inductor with a 50 A saturation current rating and a 30 A average current rating (744355147 from Würth Elektronik) is selected. This is a compact inductor with an iron alloy core, which offers high performance in terms of low R_{DC} and low core loss. An alternative to the 744355147 is the SER1408-301M (300 nH with about 40 A in saturation current and average current rating) from Coilcraft. If higher efficiency or lower DCR is desired, choose a physically larger inductor with approximately the same inductance value.

INPUT CAPACITORS

Because of the large input current ripple requirement, four 180 μF/16 V OS-CON™ capacitors have been selected for the input bulk capacitance. In addition, one MLCC decoupling capacitor (10 μF/25 V) is used at each of the high-side MOSFET.

OUTPUT CAPACITORS

A total of six 560 μF/2.5 V OS-CON™ capacitors is used at the output. These aluminum solid capacitors with conductive polymer have low ESR and high current ripple rating. In addition, four 47 μF MLCCs are added for filtering out the high frequency voltage ripples.

MOSFET SELECTION

For low output or low duty cycle, select a high-side MOSFET with fast rise and fall times and with low input capacitance to minimize charging and switching power loss. As for the synchronous rectifier (low-side MOSFET), select a MOSFET with low R_{DSON} because the switching speed is not critical and there is no switching power loss in the low-side MOSFET.

For the high-side MOSFETs of each channel, two BSC080N03LS connected in parallel from Infineon Technologies in the PG-TDSON-8 or Super-SO8 package are selected. This part has low input capacitance (1.2 nF) and fast transition time (3 ns). For the low-side MOSFET, two BSC030N03LS connected in parallel, with R_{DSON} of 4.7 mΩ at a V_{GS} of 4.5 V, are selected.

TEST RESULTS

$T_A = 25°C$.

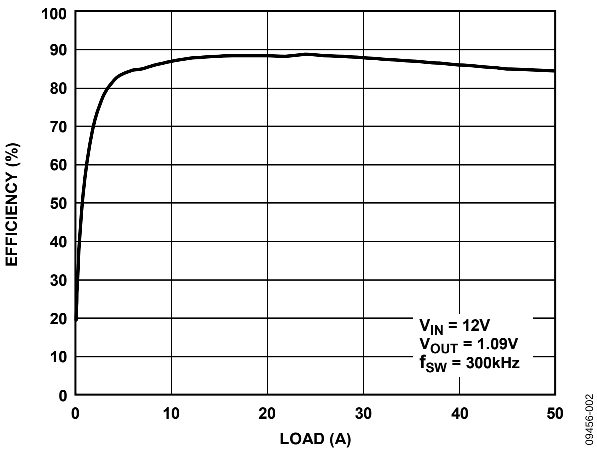


Figure 2. Efficiency

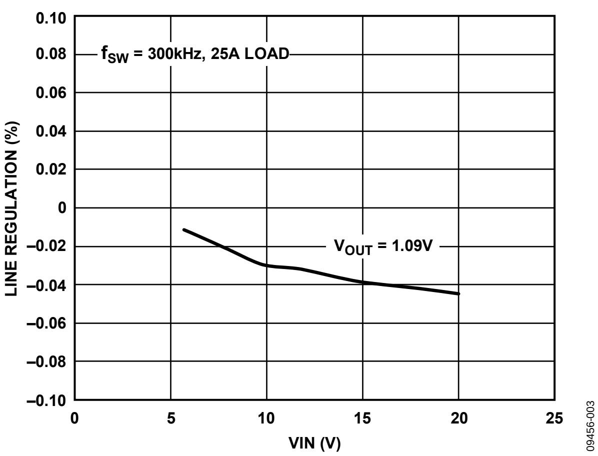


Figure 3. Line Regulation

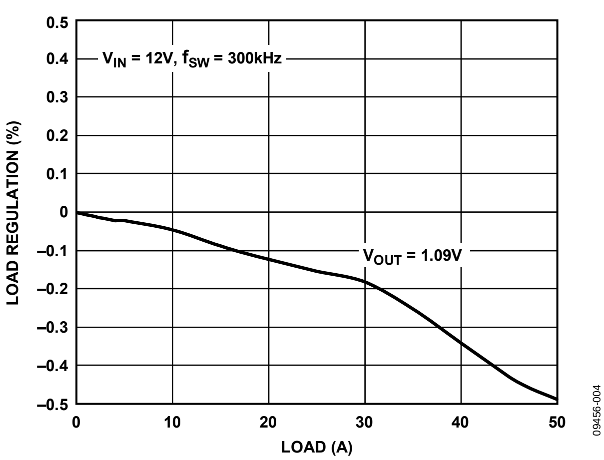


Figure 4. Load Regulation

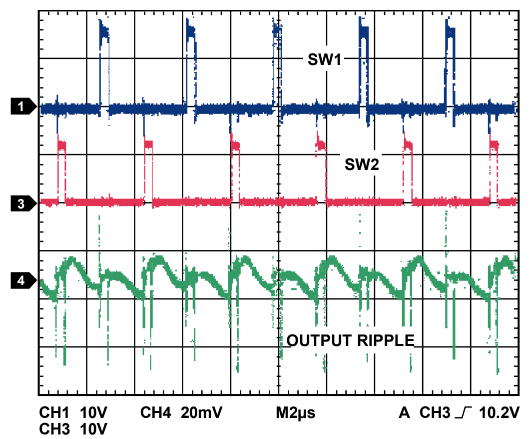


Figure 5. Output Ripple, 50 A Load

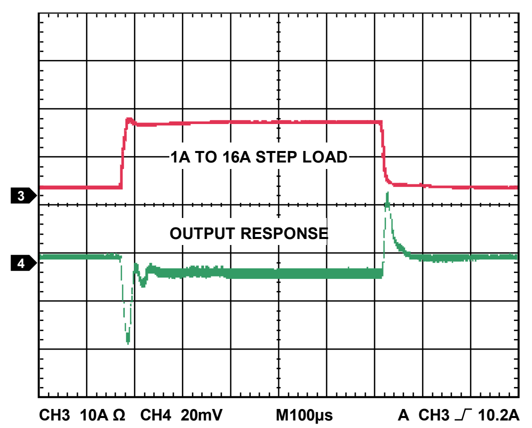


Figure 6. Step Load Transient, V_{OUT}

EVALUATION BOARD OPERATING INSTRUCTION

1. Connect Jumper J3 (EN) to the high position to enable Channel 1 and Channel 2 of the ADP1850. Jumper J3 is connected to both EN1 and EN2.
2. Connect Jumper J4 (FREQ) to the low position for 300 kHz operation.
3. Connect Jumper J1 (SYNC) to the high position for PWM operation.
4. Connect the positive terminal of the input power supply to the input terminal, T1. The input range is 10 V to 15 V.

Table 1. Jumper Description

Jumper	Description	Default Factory Setting	Function
J1	SYNC	High	Connect high for PWM. For synchronization to an external clock, run the external clock source to this pin.
J3	EN	High	Connect high to enable Channel 1 and Channel 2 of the ADP1850 or low to disable both channels.
J4	FREQ	Low	Connect low for 300 kHz or high for 600 kHz operation. This 50 A evaluation board is configured for operation at 300 kHz. Connect J4 low.

Table 2. Performance Summary (T_A = 25°C)

Parameter	Condition
V_{IN}	10 V to 15 V
f_{SW}	Switching frequency, 300 kHz
V_{OUT}	1.09 V
I_{OUT}	0 A to 50 A
V_{OUT} Ripple, DC Load	16 mV at 50 A load
V_{OUT} Deviation upon Step Load Release	3.3% with a 20 A step load

OTHER INFORMATION ABOUT THE EVALUATION BOARD PCB LAYOUT

As seen in Figure 1, the layout of this evaluation board is not optimized for the smallest PCB area. It is laid out in such a way that any of the components can be desoldered and replaced easily with different components with a hand soldering iron so that the user can modify the existing design without acquiring a new PCB layout. The physical size of the compensation components is 0603, which is selected for its ease of hand soldering when reworking the board is needed. The size of these components can be 0402 or even smaller in the final design. Note that there are extra place holders for input bulk capacitors, output filter capacitors, and MOSFETs. The user can remove, add, or change any of these power components to achieve a particular design objective. The track functions, where TRK1 and TRK2 are pulled up to VCCO through 0 Ω dummy resistors, are not used on this evaluation board. Also dummy 0 Ω resistors are placed at the driver gates, DHx and DLx, for evaluation purpose only and can be removed in the final design. Furthermore, many test points are placed on the evaluation board so that the user can easily evaluate the performances of the ADP1850 with an oscilloscope. See Figure 7, the evaluation board schematic, for more information.

EVALUATION BOARD SCHEMATICS AND ARTWORK

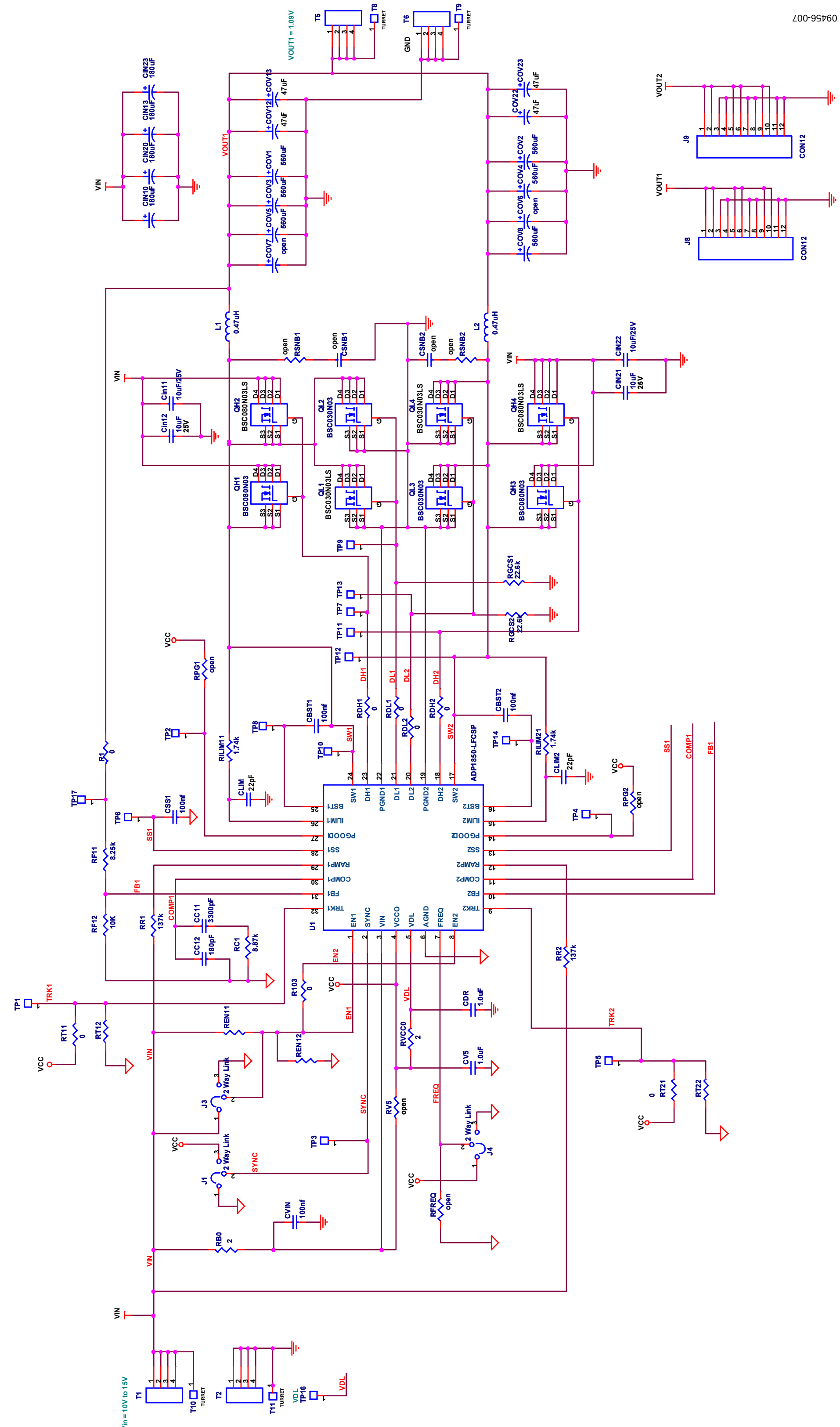
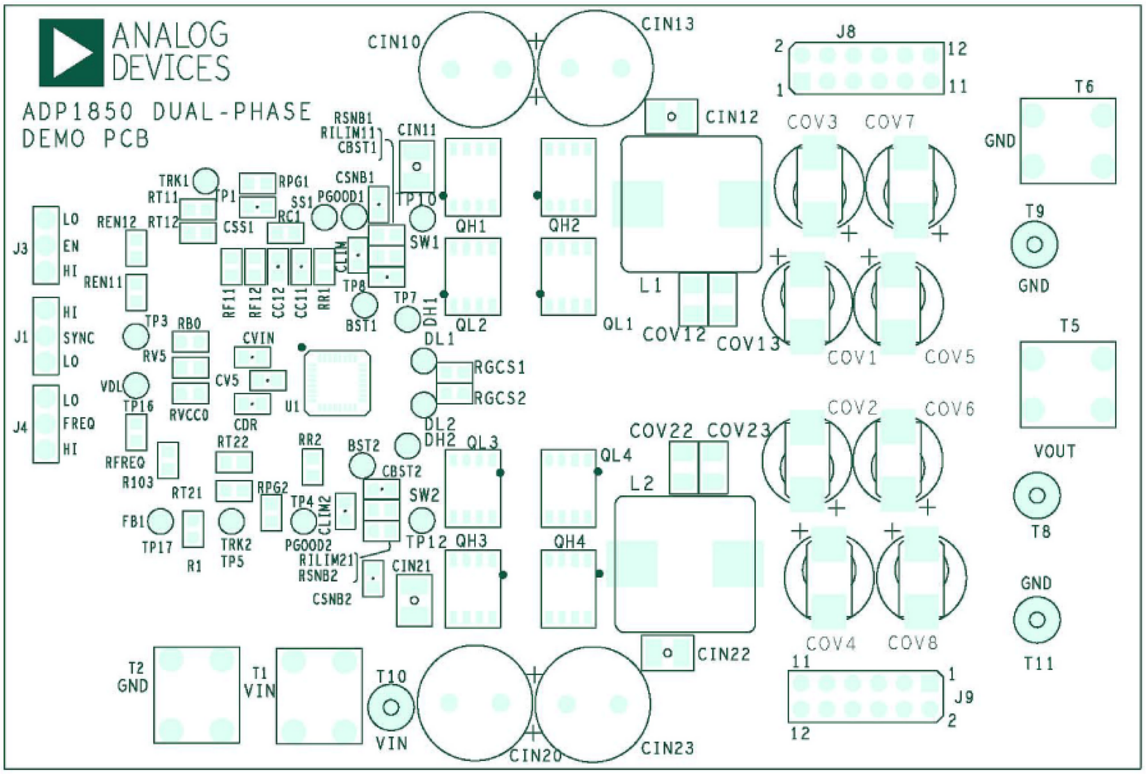
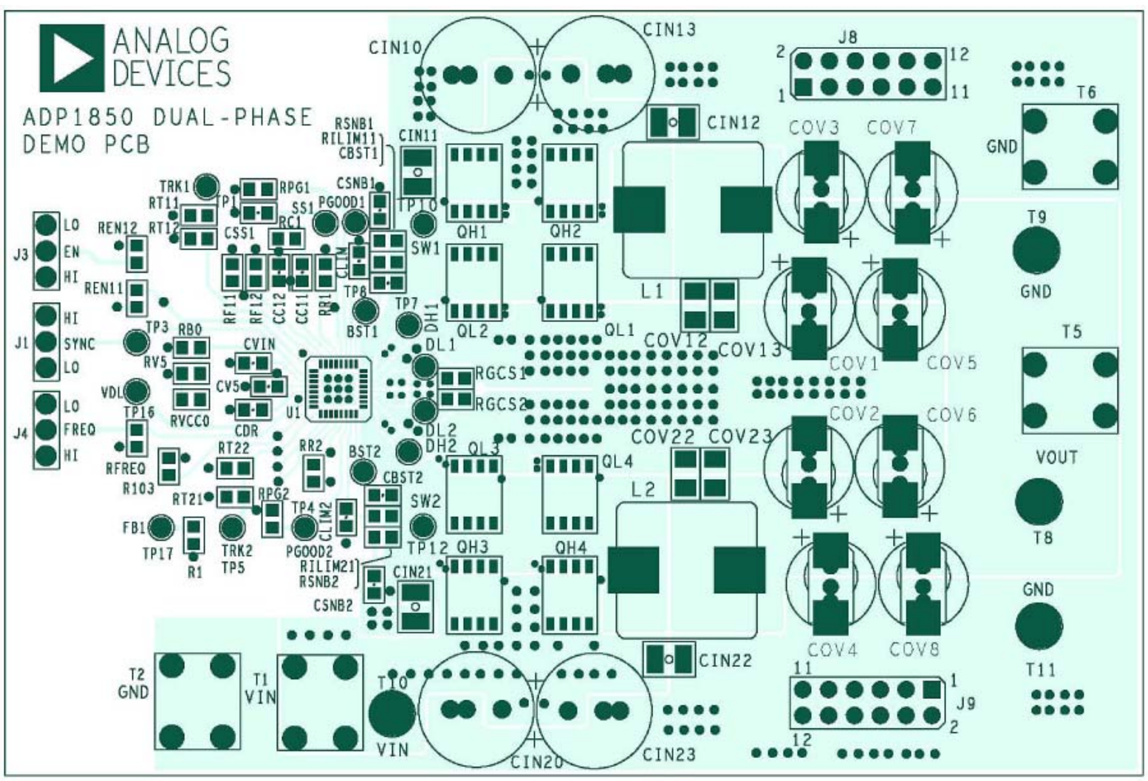


Figure 7. Evaluation Board Schematic



09456-008

Figure 8. Top Silkscreen



09456-009

Figure 9. Top Layer

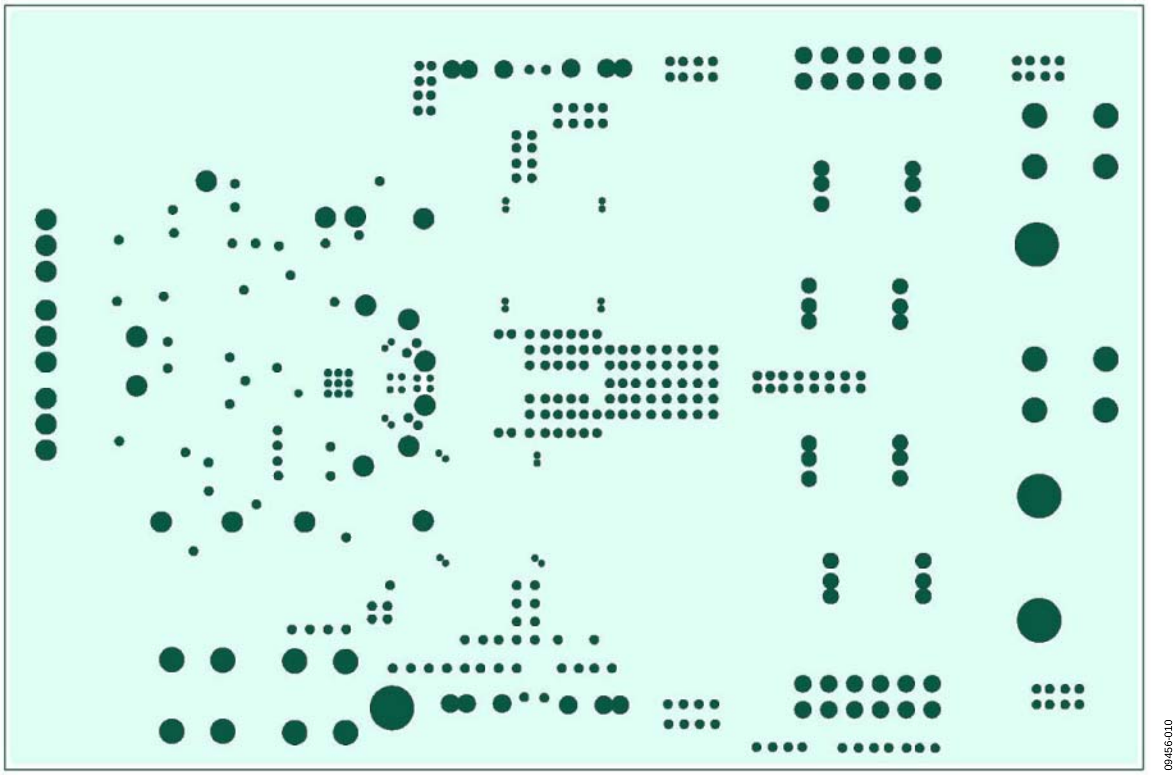


Figure 10. Second Layer (AGND Plane)

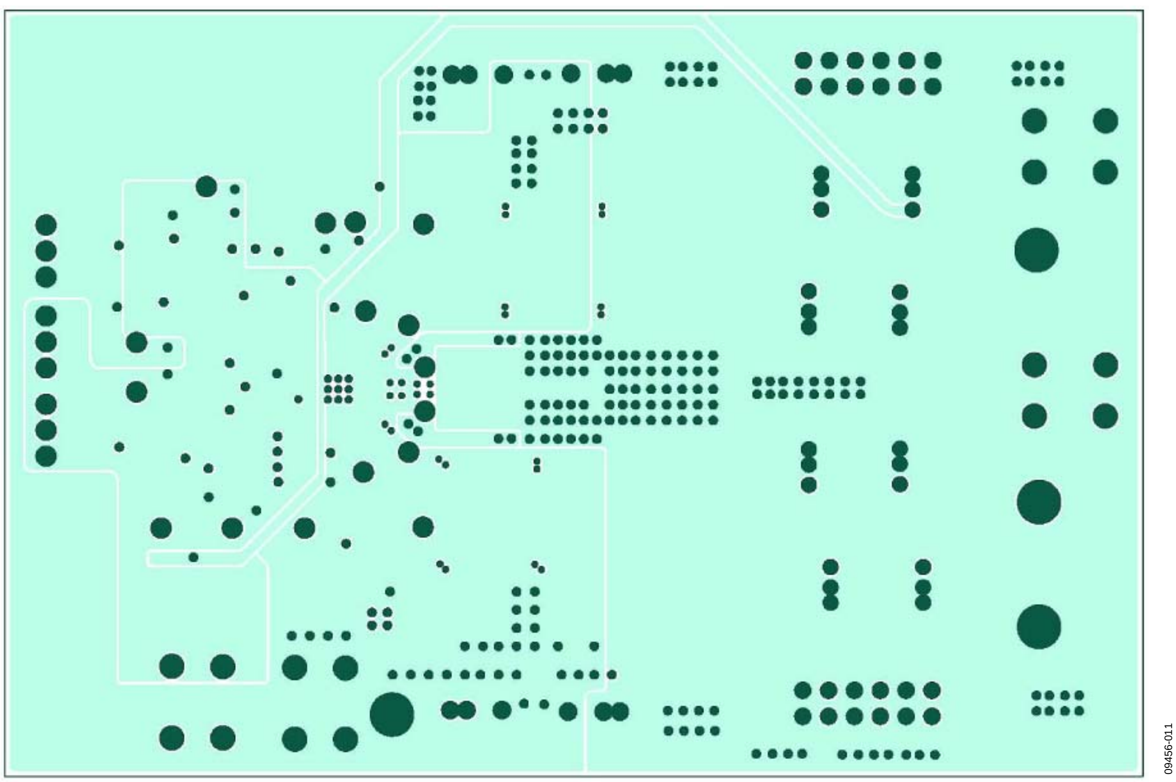


Figure 11. Third Layer (PGND Layer)

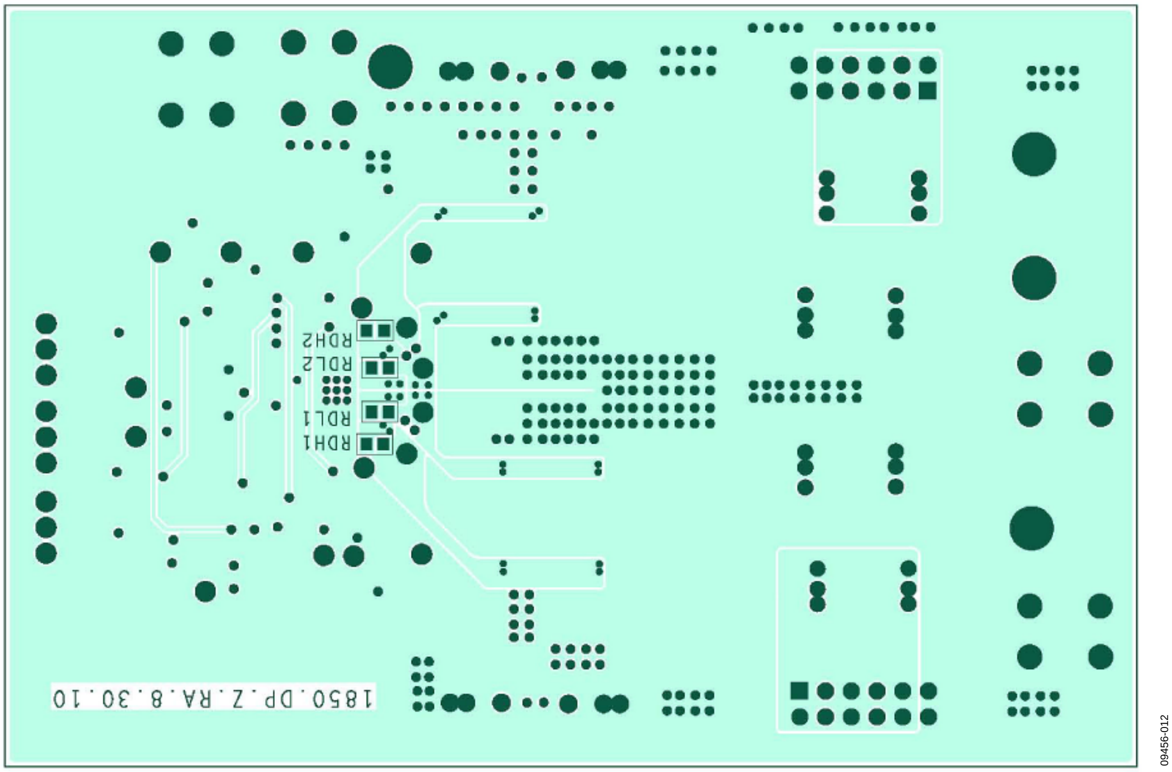


Figure 12. Bottom Layer (PGND Layer)

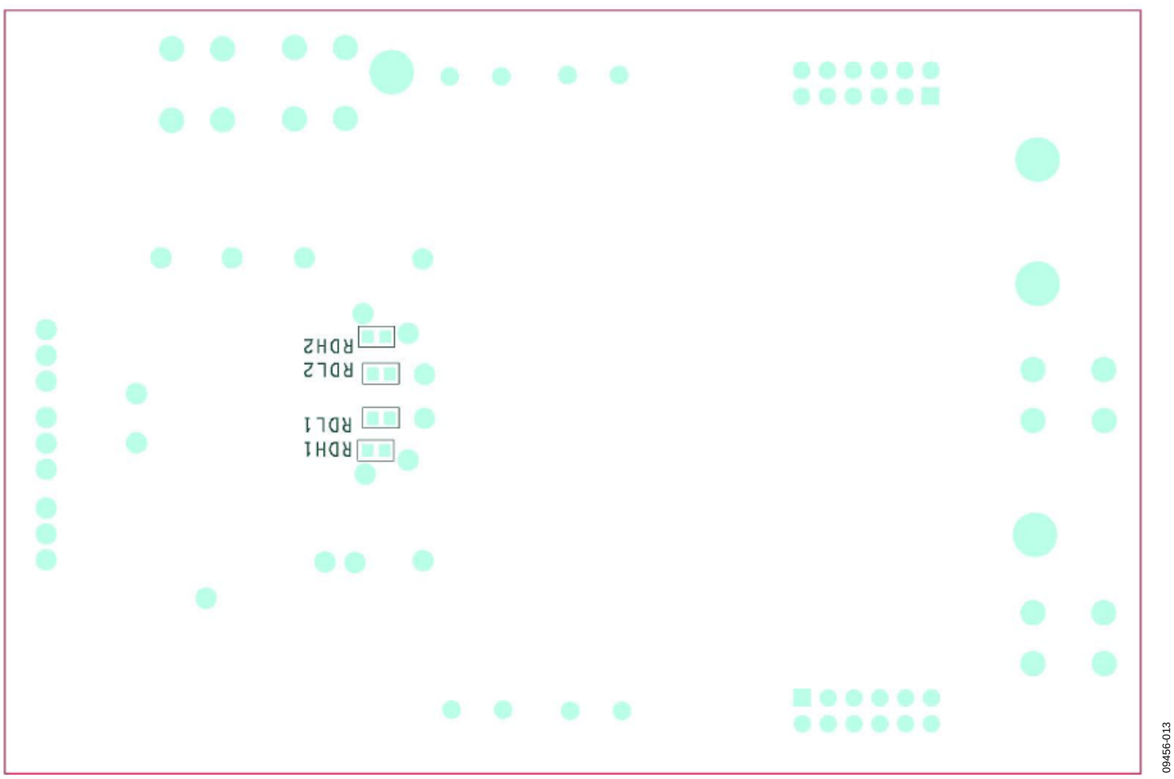


Figure 13. Bottom Silk Screen

ORDERING INFORMATION

BILL OF MATERIALS

Table 3.

Quantity	Reference Designator	Description	Manufacturer	Part No.
1	U1	DUT	Analog Devices, Inc.	ADP1850
4	CIN10, CIN13, CIN20, CIN23	OSCON, 180 µF, 16 V	Sanyo	16SEP180M
4	CIN11, CIN12, CIN21, CIN22	MLCC, 10 µF, X7R, 25 V	Murata	GRM32DR71E106KA12
4	CSS1, CBST1, CBST2, CVIN	MLCC, 100 nF, X7R, 25 V	Murata	GRM188R71E104KA01
2	CV5, CDR	MLCC, 1.0 µF, X5R, 6.3 V	Murata	GRM185R60J105KE21
2	RB0, RVCCO	Resistor, 2 Ω	Vishay	CRCW06032R00F
2	RGCS1, RGCS2	Resistor, 22.6 kΩ	Vishay	CRCW06032262F
2	RR1, RR2	Resistor, 137 kΩ	Vishay	CRCW06031373F
6	COV1, COV2, COV3, COV4, COV7, COV8	OSCON, 560 µF, 2.5V	Sanyo	2SEPC560MZ
4	COV12, COV13, COV22, COV23	MLCC, 47 µF, X5R, 1206	Murata	GRM31CR60J476ME19
2	L1, L2	Inductor, 0.47 µH	Wurth Elektronik	744355147
1	RF12	Resistor, 10 kΩ	Vishay	CRCW06031002F
1	RF11	Resistor, 8.25 kΩ	Vishay	CRCW06038251F
4	QH1, QH2, QH3, QH4	N MOSFET, 30 V, 9 mΩ	Infineon	BSC080N03LS
4	QL1, QL2, QL3, QL4	N MOSFET, 30 V, 4.5 mΩ	Infineon	BSC030N03LS
1	CC11	MLCC, 3300 pF	Vishay	VJ0603Y332KXAA
1	CC12	MLCC, 180 pF	Vishay	VJ0603Y181KXAA
1	RC1	Resistor, 8.87 kΩ	Vishay	CRCW06038871F
2	RLIM11, RLIM21	Resistor, 1.74 kΩ	Vishay	CRCW06031741F
2	CLIM1, CLIM2	MLCC, 22 pF	Vishay	VJ0603A220KXAA
4	J1, J2, J3, J4	3-terminal jumpers, 0.1" spacing		
9	R103, RT11, RT21, RDH1, RDH2, RDL1, RDL2, R1, R2	Resistor, 0 Ω	Vishay	CRCW06030R00F
4	T8, T9, T10, T11	Test points, turret, 110-mil through hole	Keystone Electronics Corp.	1502-1
4	T1, T2, T5, T6	Terminals, 20 A rated	Keystone Electronics Corp.	8191

NOTES

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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