

ISL85005EVAL1Z, ISL85005AEVAL1Z

Evaluation Boards User Guide

UG100  
Rev.0.00  
Jan 11, 2017

**Description**

The [ISL85005](#) and [ISL85005A](#) are 4.5V to 18V input, 5A synchronous buck regulators for applications with input voltage from multicell batteries or regulated 5V and 12V power rails. These devices also provide an integrated bootstrap diode for the high-side gate driver to reduce the external parts count. The ISL85005EVAL1Z and ISL85005AEVAL1Z platforms allow quick evaluation of the high-performance features of the ISL85005 and ISL85005A buck regulators.

**Specifications**

These boards have been configured and optimized for the following operating conditions:

- Input voltage ranges from 7V to 15V
- 5V nominal output voltage
- Up to 5A output current capability
- Default internally set to 500kHz switching frequency
- Default internally set to 2.3ms soft-start
- Operating temperature range: -40 °C to +85 °C

**Key Features**

- Switch selectable EN (enabled/disabled)
- Jumper selectable MODE (DEM/Forced CCM) (ISL85005EVAL1Z)
- Internal and external compensation options
- Frequency synchronization option (ISL85005EVAL1Z)
- Adjustable soft-start option (ISL85005AEVAL1Z)
- Connectors and test points for easy probing

**Related Literature**

- For a full list of related documents, visit our website - [ISL85005](#) and [ISL85005A](#) product pages

**Ordering Information**

PART NUMBER	DESCRIPTION
ISL85005EVAL1Z	Evaluation Board for ISL85005FRZ
ISL85005AEVAL1Z	Evaluation Board for ISL85005AFRZ

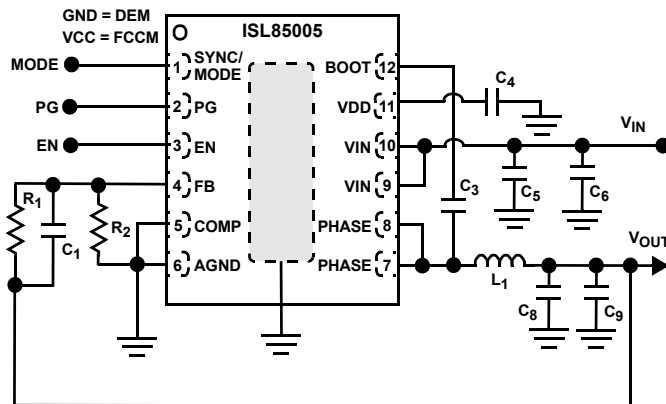


FIGURE 1A. ISL85005EVAL1Z

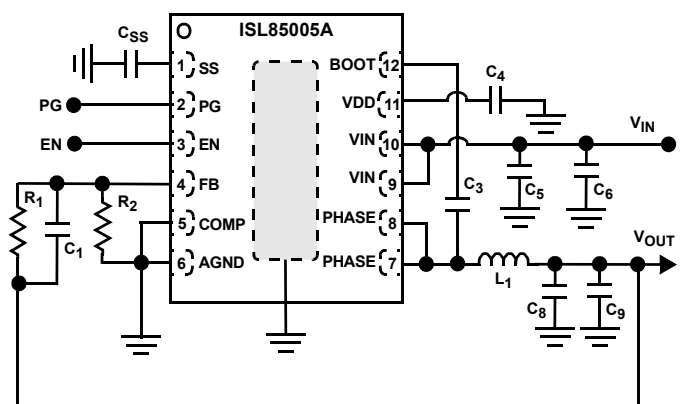


FIGURE 1B. ISL85005AEVAL1Z

FIGURE 1. BLOCK DIAGRAM

## Connector and Test Point Descriptions

The ISL85005EVAL1Z and ISL85005AEVAL1Z evaluation boards include I/O connectors and test points as shown in [Table 1](#).

TABLE 1. CONNECTORS AND TEST POINTS

REF DES	DESCRIPTION
J1	2-position socket connector for PHASE to GND test
J2	2-position socket connector for VOUT to GND test
J3	Input voltage positive connection
J4	Input voltage return connection
J5	Output voltage positive connection
J6	Output voltage return connection
P1 (PGOOD)	Power-good output
P2(SS)	Soft-start test point (ISL85005AEVAL1Z)
P2 (SYNC/MODE)	External synchronization clock connection (ISL85005EVAL1Z)
P4 (VIN)	Input voltage positive test point
P5 (GND)	Input voltage return test point
P6 (EN)	Enable test point
P7 (VDD)	Internal LDO output test point
P8 (VOUT)	Output voltage positive test point
P9 (GND)	Output voltage return test point

## Selection Switch and Jumper Descriptions

- Switch SW1 (Enable)  
The switch enables and disables ISL85005/ISL85005A:
  - Switch in position ON (EN tied to VIN through R<sub>7</sub>), ISL85005 and ISL85005A enabled
  - Switch in position OFF (EN tied to GND), ISL85005 and ISL85005A disabled
- Jumper J7 (MODE) (ISL85005EVAL1Z)  
The jumper provides selection of different operation modes detailed as following:
  - Switch in position FCCM (SYNC/MODE tied to VDD through R<sub>6</sub>), the ISL85005 operates in forced CCM.
  - Switch in position DEM (SYNC/MODE tied to GND), the ISL85005 operates in Diode Emulation mode and enables automatic transition from CCM to DCM at light-load conditions.

## Quick Setup Guide

Refer to the following Quick Setup Guide to configure and power-up the board for proper operation.

1. Set the power supply voltage to 12V and turn off the power supply. Connect the positive output of power supply to J3 (VIN) and the negative output to J4 (GND).
2. Connect an electronic load to J5 (VOUT) for the positive connection and J6 (GND) for the negative connection.
3. Measure the output voltage (test points P8 and P9) with the voltmeter.
4. Place scope probes on VOUT test point (J2) and other test points of interest.
5. Toggle selection switch SW1 to ON position.
6. Set the load current to be 0.1A and turn on the power supply. The output voltage should be in regulation with a nominal 5V output.
7. Slowly increase the load up to 5A while monitoring the output voltage, which should remain in regulation with a nominal 5V output.
8. Slowly sweep VIN from 7V to 15V. The output voltage should remain in regulation with a nominal 5V output.
9. Decrease the input voltage to 0V to shut down the regulator.

## Frequency Synchronization (ISL85005EVAL1Z)

The ISL85005 can be synchronized to an external clock with frequency ranges from 300kHz to 2MHz by applying the external clock to test point P2 on the ISL85005EVAL1Z evaluation board. The external clock should meet the specifications of pulse width and voltage level described in the [ISL85005](#) datasheet.

## Adjusting Soft-Start Time (ISL85005AEVAL1Z)

With SS pin floating, the ISL85005A features an internally set 2.3ms of soft-start time. The soft-start time can be set to a desired value by connecting an external capacitor (C<sub>SS</sub> on the ISL85005AEVAL1Z evaluation board) between the SS pin and AGND. The capacitance can be calculated by [Equation 1](#):

$$C_{SS}[\text{nF}] = 3.5 \cdot t_{SS}[\text{ms}] - 1.6\text{nF} \quad (\text{EQ. 1})$$

## Evaluating Other Output Voltages

Both ISL85005EVAL1Z and ISL85005AEVAL1Z have a nominal 5V output voltage. The output voltages are programmable by an external resistor divider formed by R<sub>1</sub> and R<sub>2</sub> as shown in [Figure 1](#). R<sub>1</sub> is usually chosen first, then the value for R<sub>2</sub> can be calculated based on R<sub>1</sub> and the desired output voltage using [Equation 2](#).

$$R_2 = \frac{R_1 \cdot 0.8V}{V_{OUT} - 0.8V} \quad (\text{EQ. 2})$$

## PCB Layout Considerations

The PCB layout is critical for proper operation of the ISL85005 and ISL85005A. The following guidelines should be followed to achieve good performance.

1. Use a multilayer PCB structure to achieve optimized performance. A four-layer PCB is recommended for this design.
2. Use a combination of bulk capacitors and smaller ceramic capacitors with lower ESL for the input capacitors and place them as close to the IC as possible.
3. Place the VDD decoupling capacitor close to the IC between VDD and GND. A 1 $\mu$ F ceramic capacitor is typically used.
4. Place a bootstrap capacitor close to the IC between BOOT and PHASE pins. A 0.1 $\mu$ F ceramic capacitor is typically used.
5. Connect the feedback resistor divider between the output capacitor positive terminal and AGND pin of the IC, and place the resistors close to the FB pin of the IC.
6. Connect the EPAD of the IC to the GND planes underneath using multiple thermal vias to improve thermal performance.

## ISL85005EVAL1Z Evaluation Board

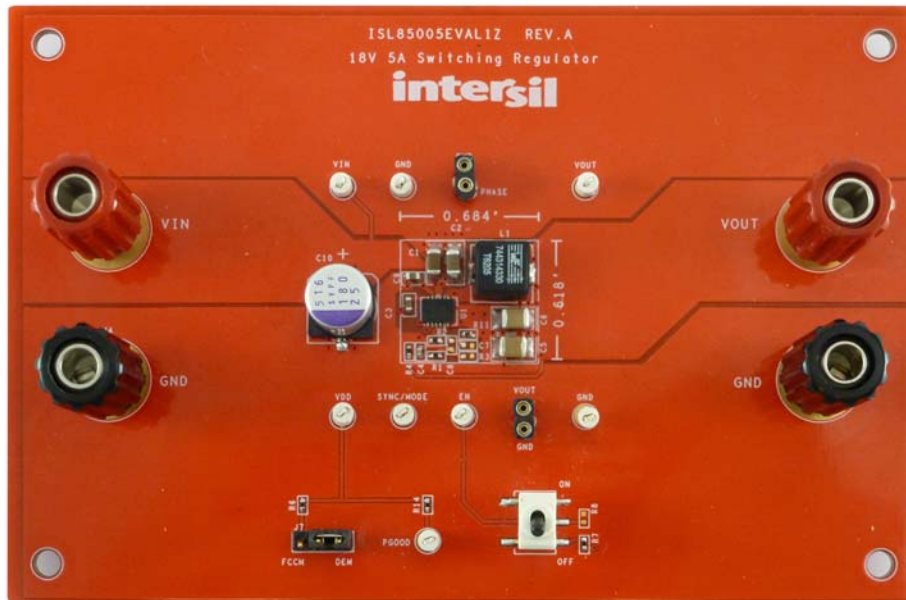


FIGURE 2. TOP VIEW

## ISL85005AEVAL1Z Evaluation Board

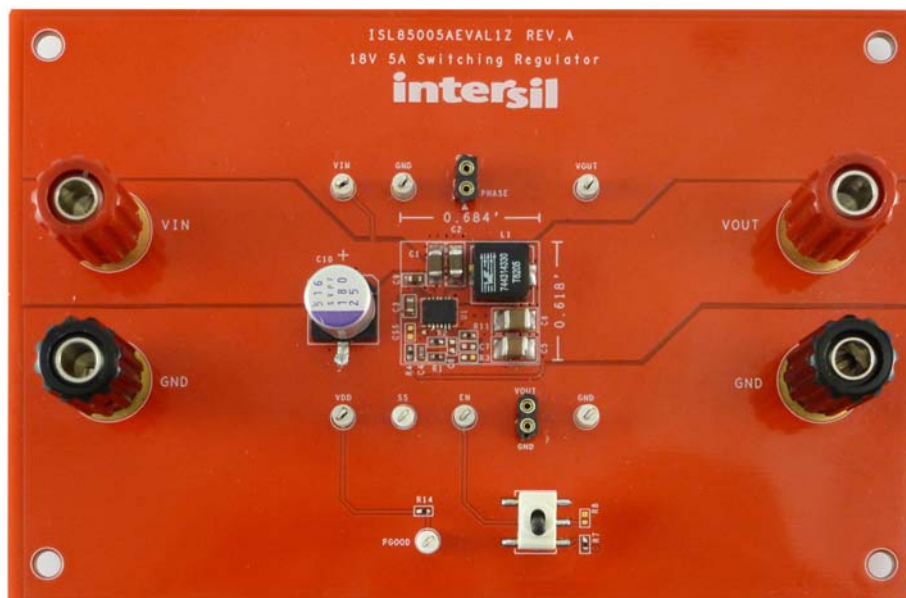


FIGURE 3. TOP VIEW

## ISL85005EVAL1Z Schematic

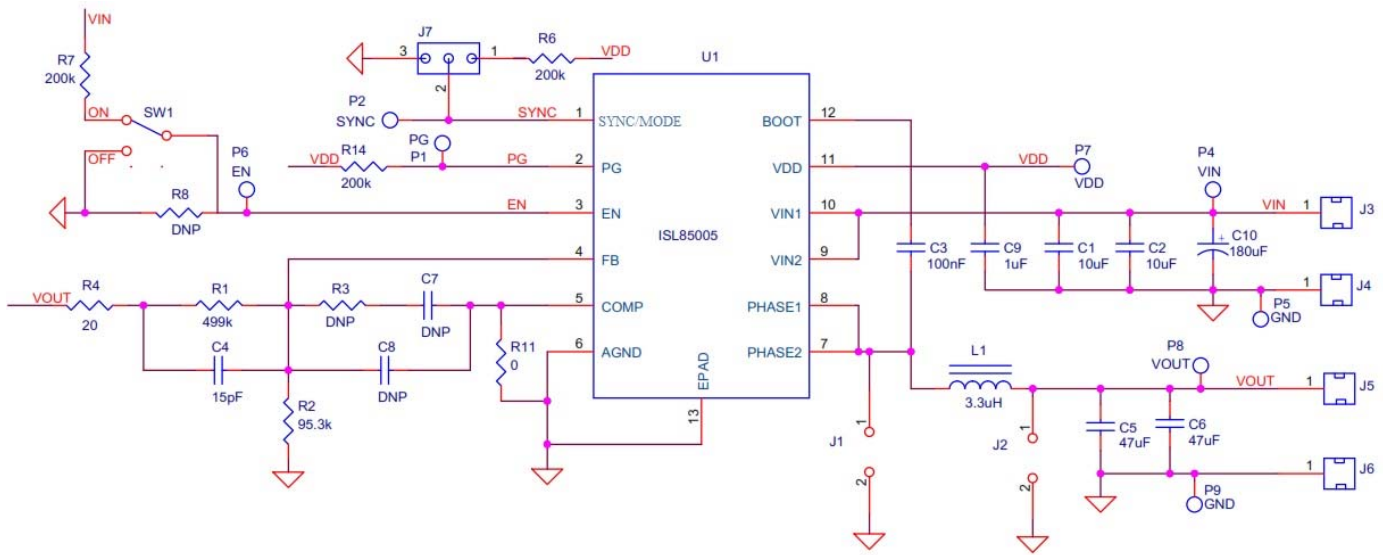


FIGURE 4. ISL85005EVAL1Z SCHEMATIC

## ISL85005AEVAL1Z Schematic

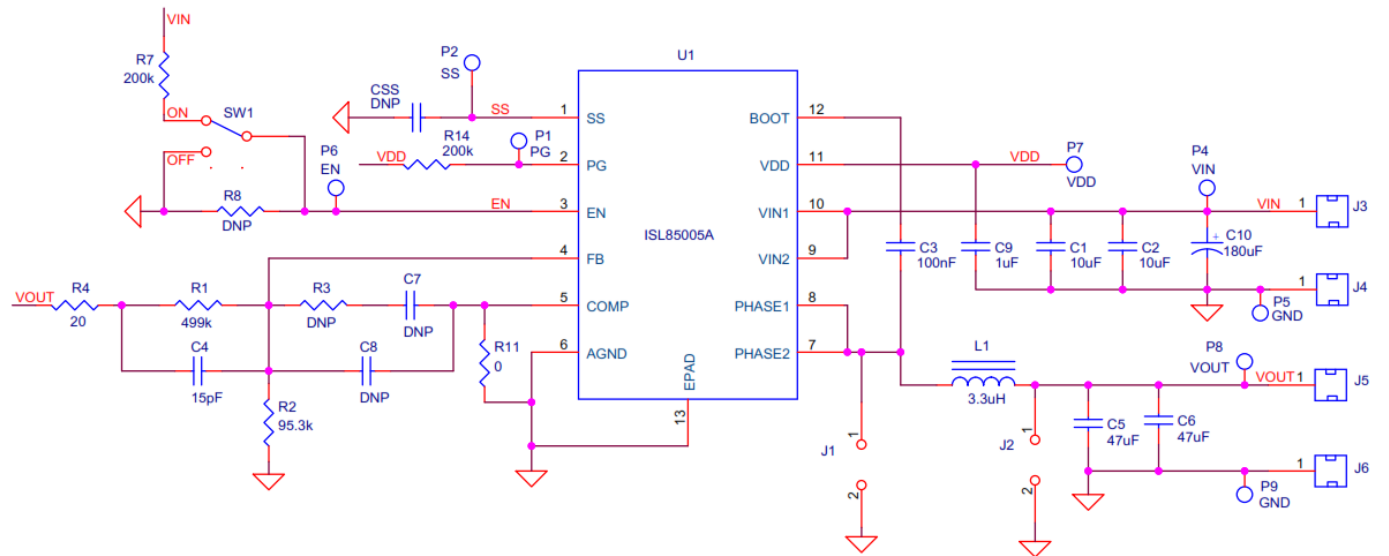


FIGURE 5. ISL85005AEVAL1Z SCHEMATIC

**ISL85005EVAL1Z Bill of Materials**

REFERENCE DESIGNATOR	QTY	DESCRIPTION	PART NUMBER	MANUFACTURER
U1	1	IC-BUCK REGULATOR W/ SYNC PIN, 12P, DFN, 3x4, ROHS	ISL85005FRZ	INTERSIL
C10	1	CAP-OSCON, SMD, 8.3X9, 180µF, 25V, 20%, 16mΩ, ROHS	25SVPF180M	SANYO
C4	1	CAP, SMD, 0402, 15pF, 50V, 5%, NPO, ROHS	GRM36COG150J050AQ	MURATA
C7, C8	0	CAP, SMD, 0402, DNP-PLACE HOLDER, ROHS		
C3	1	CAP, SMD, 0603, 0.1µF, 25V, 10%, X7R, ROHS	GRM188R71E104KA01D	MURATA
C9	1	CAP, SMD, 0603, 1µF, 25V, 10%, X5R, ROHS	GRM188R61E105KA12D	MURATA
C1, C2	2	CAP, SMD, 1206, 10µF, 25V, 10%, X7R, ROHS	C1206X7R250-106KNE	VENKEL
C5, C6	2	CAP, SMD, 1210, 47µF, 16V, 10%, X5R, ROHS	CL32A476KOJNNE	SAMSUNG
L1	1	COIL-PWR INDUCTOR, SMD, 6.9mmSQ, 3.3µH, 9A, 9mΩ, WW, ROHS	744314330	WURTH ELEKTRONIK
J3, J5	2	CONN-GEN, BIND.POST, INSUL-RED, THMBNUT-GND	111-0702-001	JOHNSON COMPONENTS
J4, J6	2	CONN-GEN, BIND.POST, INSUL-BLK, THMBNUT-GND	111-0703-001	JOHNSON COMPONENTS
P1, P2, P4, P5, P6, P7, P8, P9	8	CONN-MINI TEST POINT, VERTICAL, WHITE, ROHS	5002	KEYSTONE
J7	1	CONN-HEADER, 1x3, BREAKAWY 1x36, 2.54mm, ROHS	68000-236HLF	BERG/FCI
Jumper	1	CONN-JUMPER, SHORTING, 2PIN, BLK, OPEN TOP, 2.54mmPITCH, ROHS	929950-00	3M
R4	1	RES, SMD, 0402, 20Ω, 1/16W, 1%, TF, ROHS	ERJ2RKF20R0	PANASONIC
R11	1	RES, SMD, 0402, 0Ω, 1/16W, 5%, TF, ROHS	CR0402-16W-00T	VENKEL
R6, R7, R14	3	RES, SMD, 0402, 200k, 1/16W, 1%, TF, ROHS	MCR01MZPF2003	ROHM
R1	1	RES, SMD, 0402, 499k, 1/16W, 1%, TF, ROHS	CR0402-16W-4993FT	VENKEL
R2	1	RES, SMD, 0402, 95.3k, 1/16W, 1%, TF, ROHS	RC0402FR-0795K3L	YAGEO
R3, R8	0	RES, SMD, 0402, DNP, DNP, DNP, TF, ROHS		
SW1	1	SWITCH-TOGGLE, SMD, 6PIN, SPDT, 2POS, ON-NONE-ON, ROHS	GT11MSCBE	ITT INDUSTRIES/ C&K DIVISION
J1, J2	2	CONN-SOCKET STRIP, TH, 2P, 2.54mmPITCH, ROHS	310-87-102-41-001101	PRECI-DIP
PCB	1	PWB-PCB, ISL85005EVAL1Z, REVA, ROHS	ISL85005EVAL1Z	Any

**ISL85005AEVAL1Z Bill of Materials**

REFERENCE DESIGNATOR	QTY	DESCRIPTION	PART NUMBER	MANUFACTURER
U1	1	IC-BUCK REGULATOR W/ SYNC PIN, 12P, DFN, 3x4, ROHS	ISL85005AFRZ	INTERSIL
C10	1	CAP-OSCON, SMD, 8.3x9, 180µF, 25V, 20%, 16mΩ, ROHS	25SVPF180M	SANYO
C4	1	CAP, SMD, 0402, 15pF, 50V, 5%, NPO, ROHS	GRM36COG150J050AQ	MURATA
C7, C8, C <sub>SS</sub>	0	CAP, SMD, 0402, DNP-PLACE HOLDER, ROHS		
C3	1	CAP, SMD, 0603, 0.1µF, 25V, 10%, X7R, ROHS	GRM188R71E104KA01D	MURATA
C9	1	CAP, SMD, 0603, 1µF, 25V, 10%, X5R, ROHS	GRM188R61E105KA12D	MURATA
C1, C2	2	CAP, SMD, 1206, 10µF, 25V, 10%, X7R, ROHS	C1206X7R250-106KNE	VENKEL
C5, C6	2	CAP, SMD, 1210, 47µF, 16V, 10%, X5R, ROHS	CL32A476KOJNNE	SAMSUNG
L1	1	COIL-PWR INDUCTOR, SMD, 6.9mmSQ, 3.3µH, 9A 9mΩ, WW, ROHS	744314330	WURTH ELEKTRONIK
J3, J5	2	CONN-GEN, BIND.POST, INSUL-RED, THMBNUT-GND	111-0702-001	JOHNSON COMPONENTS

**ISL85005AEVAL1Z Bill of Materials (Continued)**

REFERENCE DESIGNATOR	QTY	DESCRIPTION	PART NUMBER	MANUFACTURER
J4, J6	2	CONN-GEN, BIND.POST, INSUL-BLK, THMBNUT-GND	111-0703-001	JOHNSON COMPONENTS
P1, P2, P4, P5, P6, P7, P8, P9	8	CONN-MINI TEST POINT, VERTICAL, WHITE, ROHS	5002	KEystone
R4	1	RES, SMD, 0402, 20 $\Omega$ , 1/16W, 1%, TF, ROHS	ERJ2RKF20R0	PANASONIC
R11	1	RES, SMD, 0402, 0 $\Omega$ , 1/16W, 5%, TF, ROHS	CR0402-16W-00T	VENKEL
R7, R14	2	RES, SMD, 0402, 200k, 1/16W, 1%, TF, ROHS	MCR01MZPF2003	ROHM
R1	1	RES, SMD, 0402, 499k, 1/16W, 1%, TF, ROHS	CR0402-16W-4993FT	VENKEL
R2	1	RES, SMD, 0402, 95.3k, 1/16W, 1%, TF, ROHS	RC0402FR-0795K3L	YAGEO
R3, R8	0	RES, SMD, 0402, DNP, DNP, DNP, TF, ROHS		
SW1	1	SWITCH-TOGGLE, SMD, 6PIN, SPDT, 2POS, ON-NONE-ON, ROHS	GT11MSCBE	ITT INDUSTRIES/ C&K DIVISION
J1, J2	2	CONN-SOCKET STRIP, TH, 2P, 2.54mmPITCH, ROHS	310-87-102-41-001101	PRECI-DIP
PCB	1	PWB-PCB, ISL85005AEVAL1Z, REVA, ROHS	ISL85005AEVAL1Z	Any

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## ISL85005EVAL1Z PCB Layout

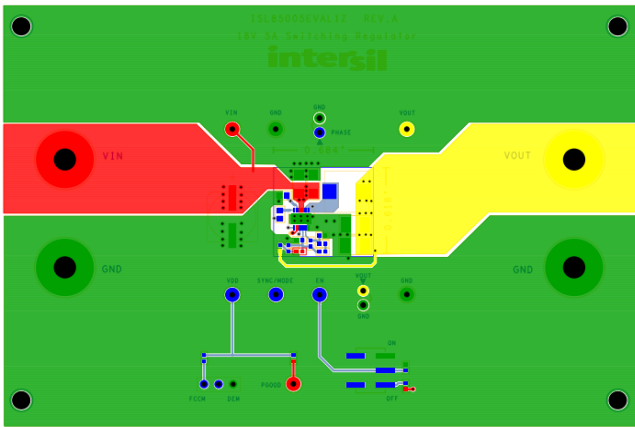


FIGURE 6. TOP LAYER

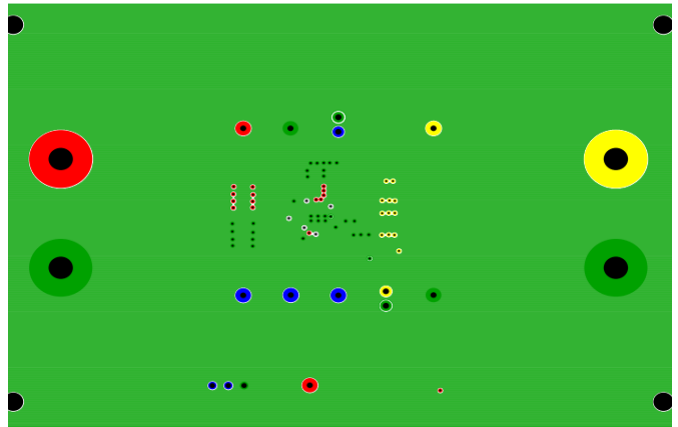


FIGURE 7. LAYER 2

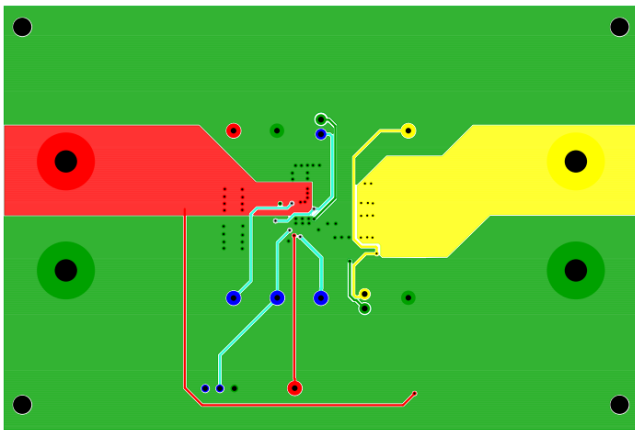


FIGURE 8. LAYER 3



FIGURE 9. BOTTOM LAYER

## ISL85005AEVAL1Z PCB Layout



FIGURE 10. TOP LAYER



FIGURE 11. LAYER 2

## ISL85005AEVAL1Z PCB Layout (Continued)

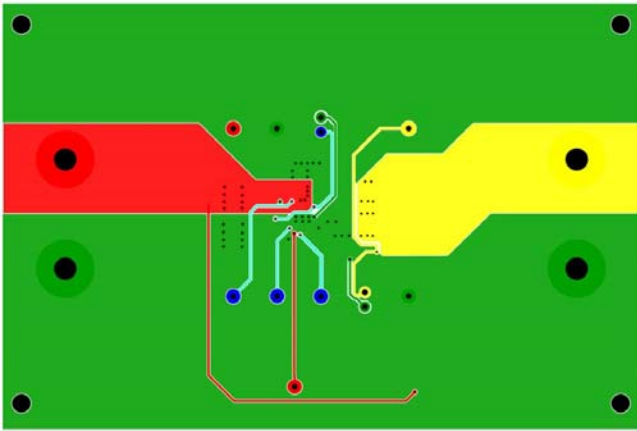


FIGURE 12. LAYER 3



FIGURE 13. BOTTOM LAYER

## Typical Performance Curves

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $L = 3.3\mu H$ ,  $f_{SW} = 500kHz$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

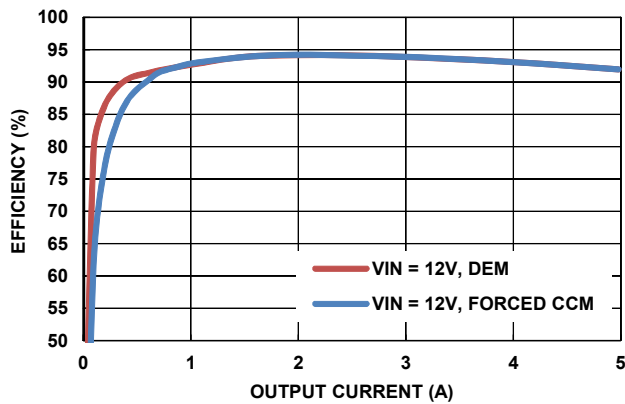


FIGURE 14. EFFICIENCY vs LOAD

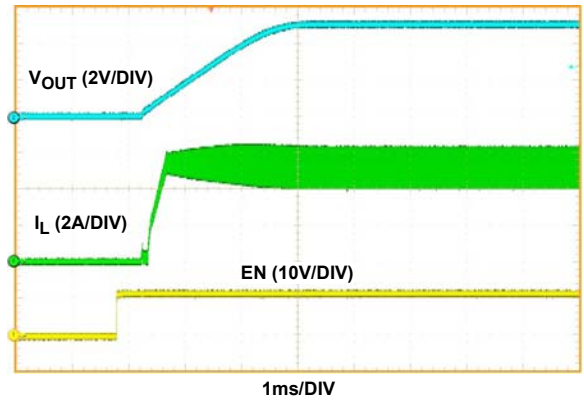


FIGURE 15. START-UP WITH EN,  $I_{OUT} = 5A$

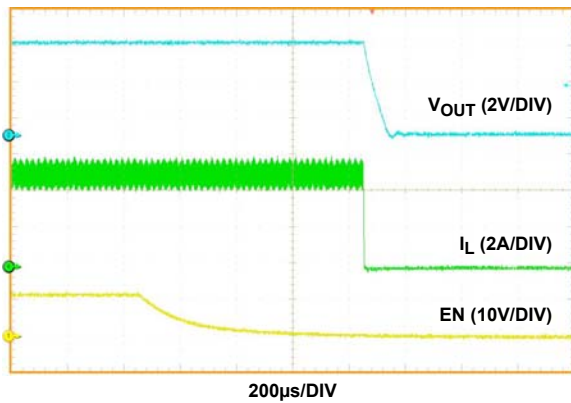


FIGURE 16. SHUTDOWN WITH EN,  $I_{OUT} = 5A$

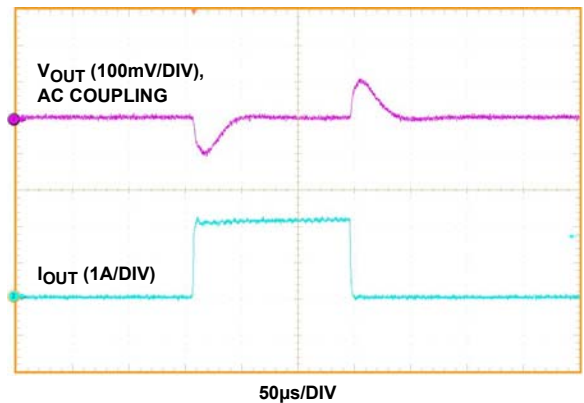


FIGURE 17. LOAD TRANSIENT,  $0A \rightarrow 2.5A \rightarrow 0A$ ,  $2.5A/\mu s$