ISL73007SEHEVAL1Z

The ISL73007SEHEVAL1Z evaluation board (shown in Figure 3) features the ISL73007SEH buck regulator. This IC is a small foot print radiation hardened POL designed for critical low power applications.

The ISL73007SEH is operational over 3V to 18V integrating both high-side and low-side power FETs and switches at a default 500kHz frequency. The switching frequency can also be programmed from 300kHz up to 1MHz using an external resistor. The ISL73007SEH uses constant-frequency peak current mode control architecture for fast loop transient response. The ISL73007SEH can use either its internal compensation at the 500kHz default switching frequency or an external Type II compensation at other frequencies to stabilize the loop as determined by specific design and performance requirements. When integrating both P-channel and N-channel power devices and with the option of internal compensation, a minimum of external components are required, thereby reducing the BOM count and complexity of the design.

The ISL73007SEHEVAL1Z demonstration board and this accompanying manual provide a quick and easy method to evaluate the ISL73007SEH part in both an internal or an external 500kHz configuration.
See the *ISL73007SEH datasheet* for information about the operation, function, and performance of the device.

Features

- Optimized for 12V to 3.3V conversion
- Jumper configurable to either the internal or external 500kHz switching frequency, slope and compensation configuration
- 3A output current

Specifications

The ISL73007SEHEVAL1Z demonstration board is configurable by jumpers for either external or internal configuration of frequency, compensation or slope. The board allows for other conditions to be evaluated with user-modification of components and connections.

The electrical ratings of the ISL73007SEHEVAL1Z demonstration board are shown in Table 1.

Table 1. Electrical Ratings

Parameter	Rating
PVIN Supply Voltage	10.8V - 18V
DC Output Voltage	3.3V
Operating Frequency	500kHz
Output Current	3A
Temperature	-55ºC to +125ºC

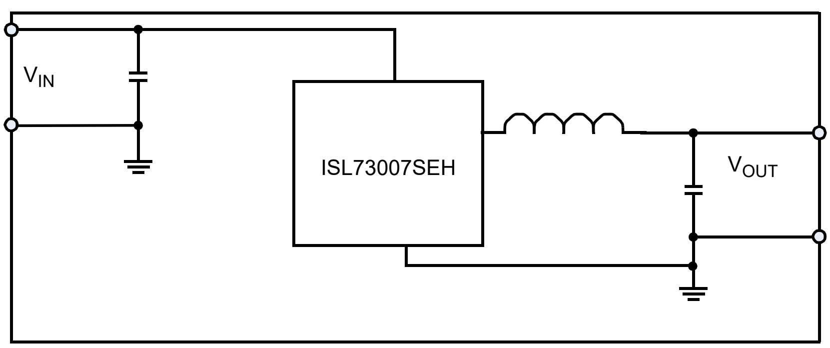

Figure 1. Block Diagram

Contents

1. Functional Description

The ISL73007SEHEVAL1Z demonstration board is default configured for 12V to 3.3V conversion with a 3A maximum output current and contains the ISL73007SEH voltage regulator IC. Any of the external configurations for switching frequency, control loop and slope compensations can be chosen by jumpers JP4, JP5 and JP3 respectively. Figure 1 shows the ISL73007SEHEVAL1Z demonstration board block diagram. Photographs of the ISL73007SEHEVAL1Z are shown in Figure 3 and Figure 4.

The ISL73007SEHEVAL1Z demonstration board provides test point access to critical pins of the IC device and convenient pads for connecting test equipment. For more information, see the schematic (Figure 5), PCB layers (Figure 7 through Figure 12), and Bill of Materials. Performance data taken using the ISL73007SEHEVAL1Z and basic lab equipment is shown in Figure 13 through Figure 24.

1.1 Operational Characteristics

The ISL73007SEHEVAL1Z only requires a single voltage supply > 10.8V connected to the PVIN pad to operate, outputting 3.3V on the VOUT pad with a 3A output current capability. Configured for a nominal PVIN voltage of 12V, the input operating voltage at which the IC turns on is set by the resistor divider (R_1 and R_2) on the ENABLE pin. **Note:** Do not exceed 5V on the ENABLE pin.

1.2 Setup and Configuration

The following equipment is recommended for testing the board:

- 12V power supply
- 100MHz oscilloscope

Complete the following steps to configure and use the board:

1. Configure the board as shown in Figure 2.
2. Connect and turn on a 12V power supply to the PVIN pad.
3. Using the oscilloscope to look at VIN and VOUT waveforms and to also observe the behavior of the LX phase node located on pins 13 and 14 of the IC package. Proper probe grounding must be practiced when observing clean waveforms.
4. Output current loading can be externally added at the VOUT and GND pads for loaded output evaluations. A DVM(s) can be employed to monitor the input and output voltages and currents.

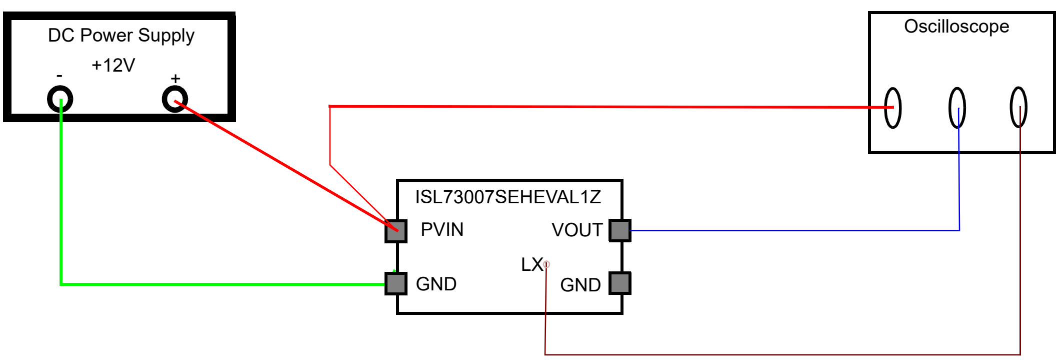

Figure 2. ISL73007SEH Basic Evaluation Test Setup Block Diagram

2. Board Design

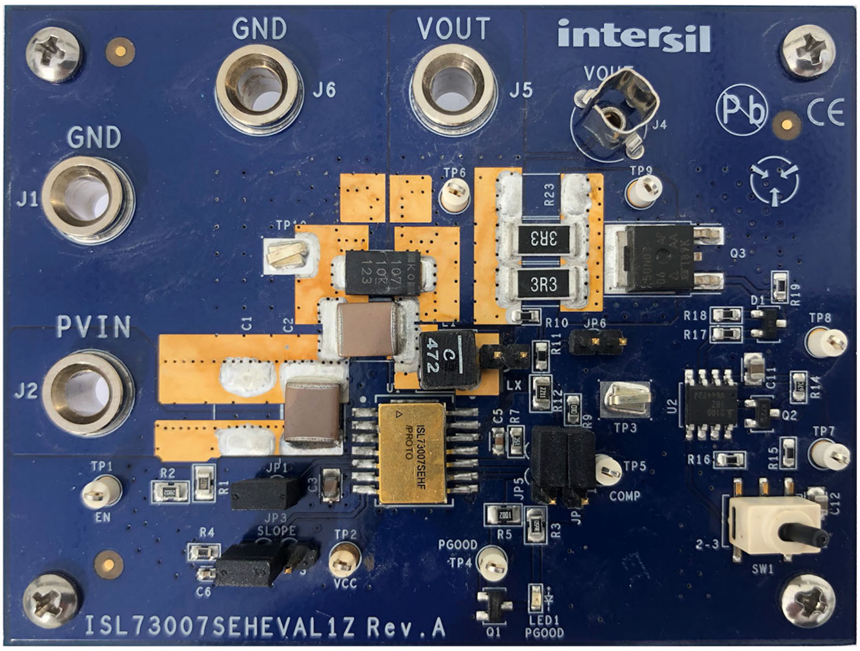

Figure 3. ISL73007SEHEVAL1Z Evaluation Board (Top)

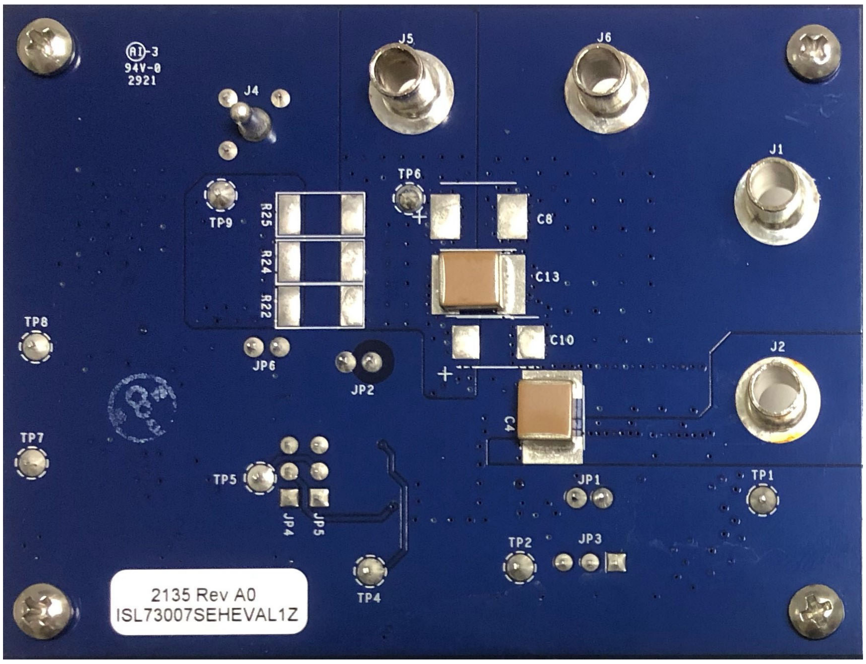

Figure 4. ISL73007SEHEVAL1Z Evaluation Board (Bottom)

2.1 Basic Layout

The ISL73007SEH is located in the center of the board and is labeled U1. Input power is to be connected across the PVIN and GND jacks. The output voltage appears across the VOUT and GND jacks. C_{IN} is provided by C_2 and C_4 (flip side). The output LC filter is comprised of the $L_{OUT,}$ L_1 and C_{OUT} is provided by C_7 and $C_{9.}$ JP1 sets the EN threshold to enable the IC when PVIN is ~10.8V, otherwise ENABLE can be accessed by TP1. The transient generator circuit is towards the right of the board. Consult the schematic in (Figure 5) for details.

2.2 Layout Guidelines

PCB design is critical to reduce parasitic inductances with critical components being closely placed to the IC. The critical components in order would be the loop compensation RC, the slope resistor, and the low ESR ceramic input capacitors. Avoid placing any traces or components under the LX shapes to avoid noise coupling from the switching node.

2.3 Schematic Diagrams

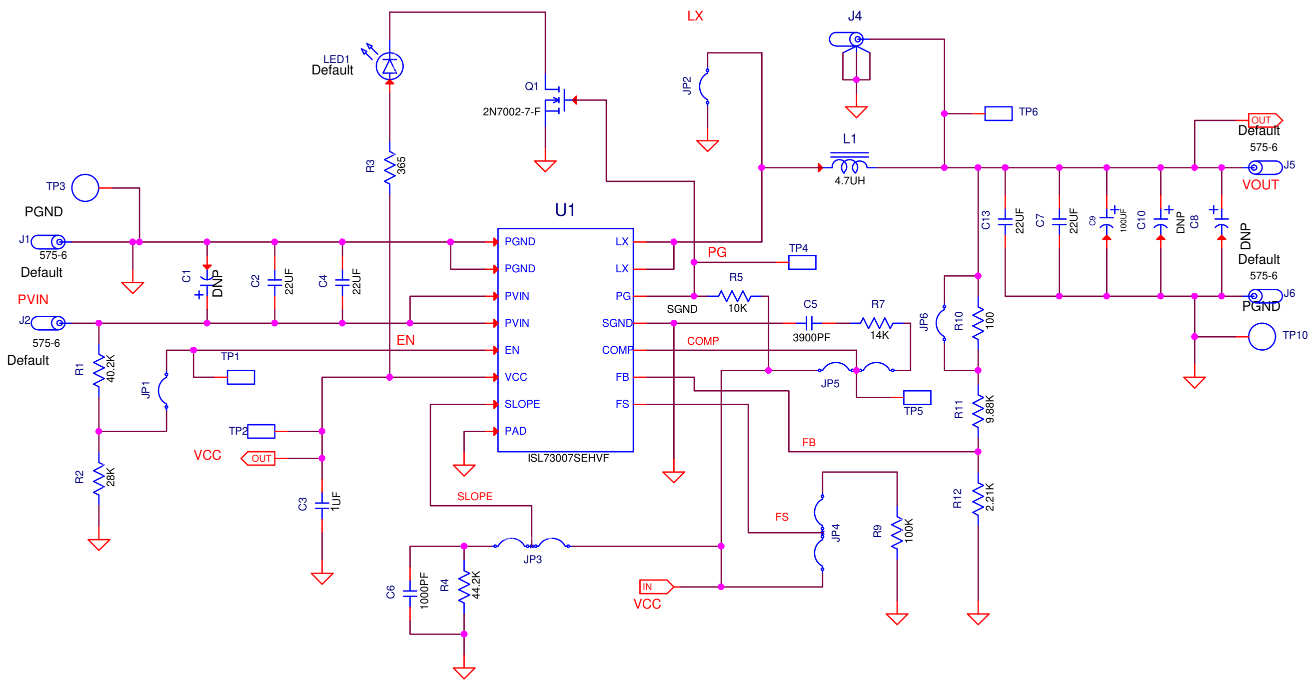

Figure 5. ISL73007SEHEVAL1Z Schematic

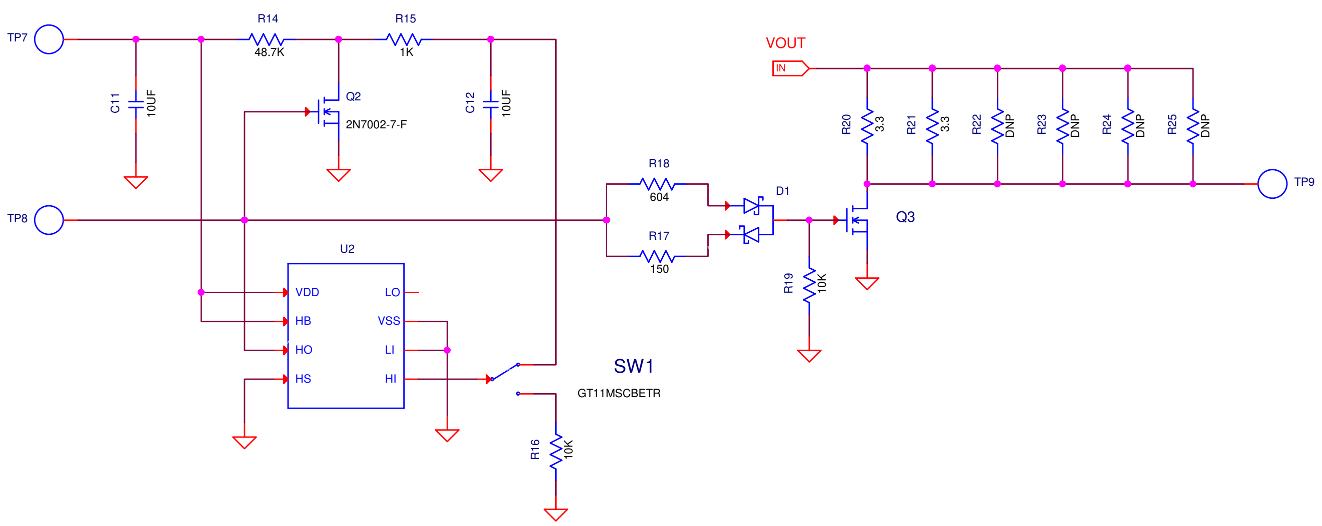

Figure 6. Transient Generator Schematic

2.4 Bill of Materials

Reference Designator	Description	Manufacturer	Manufacturer Part
U1	IC-RAD HARD 3A POL REGULATOR, 14P, CFP, ROHS	Renesas Electronics	ISL73007SEHF/PROTO
L1	COIL-PWR INDUCT, SMD, 5.4x5.2mm, 4.7µH.20%, 7.4A, 19.6mohm, ROHS	Coilcraft	XEL5050-472MEC
C2, C4, C7	Multilayer Cap	Generic	C5750X7R1E226M
C3	Multilayer Cap	Generic	GCM188R71E105KA64D
C5	Multilayer Cap	Generic	GRM1885C1H392FA01D
C6	Multilayer Cap	Generic	CC0603KRX7R8BB102
C9	CAP-TANT, SMD, 7.3x4.3mm, 100µF, 25V, 20%, 30mΩ at 100MHz, ROHS	Kemet	T521X107M025ATE030
R1	Thick Film Chip Resistor	Various	Generic
R2	Thick Film Chip Resistor	Various	Generic
R3	Thick Film Chip Resistor	Various	Generic
R4	Thick Film Chip Resistor	Various	Generic
R5	Thick Film Chip Resistor	Various	Generic
R7	Thick Film Chip Resistor	Various	Generic
R9	Thick Film Chip Resistor	Various	Generic
R10	Thick Film Chip Resistor	State of the Art	S0603CPX1000F10
R11	Thin Film Chip Resistor	KOA Speer	RN73H1JTTD9881F100
R12	Thick Film Chip Resistor	Various	Generic
JP1	Two Pin Jumper	Generic	JUMPER2_100

Reference Designator	Description	Manufacturer	Manufacturer Part
JP3, JP4, JP5	Three Pin Jumper	Generic	JUMPER-3-100
JP2, JP6	Two Pin Differential Test Points	Generic	JUMPER2_100
Q1	N-Channel EMF Effect Transistor (Pb-FREE)	Generic	2N7002-7-F
LED1	AllnGaP Green LED	Liteon	LTST-C190KGKT
Transient Generator Components			
U2	100V/2A Peak High Freq Half Bridge Driver (Pb-FREE)	Renesas	HIP2100IBZ
Q2	N-Channel EMF Effect Transistor (Pb-FREE)	Fairchild	2N7002-7-F
Q3	N-Channel 30V (D-S) MOSFET (RoHS compliant)	Vishay	SUD50N03-06AP-E3
C11, C12	10µF Ceramic Chip Capacitor	Samsung	CL21B106KOQNNNE
R14	48.7kΩ Thick Film Chip Resistor	Various	Generic
R15	1kΩ Thick Film Chip Resistor	Various	Generic
R16, R19	10kΩ Thick Film Chip Resistor	Various	Generic
R17	150Ω Thick Film Chip Resistor	Various	Generic
R18	604Ω Thick Film Chip Resistor	Various	Generic
R20-R22	3.3Ω Thick Film Chip Resistor	Various	Generic
D1	30V 200mA Schottky Barrier Diode	Diodes	BAT54S
SW1	SPDT On-None-On (2 Switch Positions) SM Ultraminiature Toggle Switch	C&K	GT11MSCBETR

2.5 Board Layout

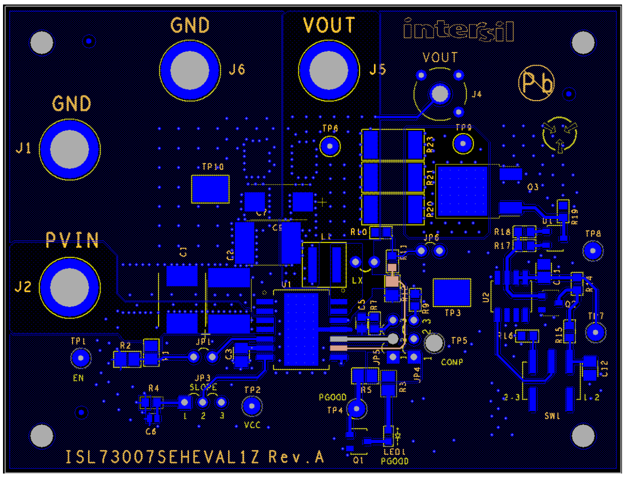

Figure 7. Top Layer

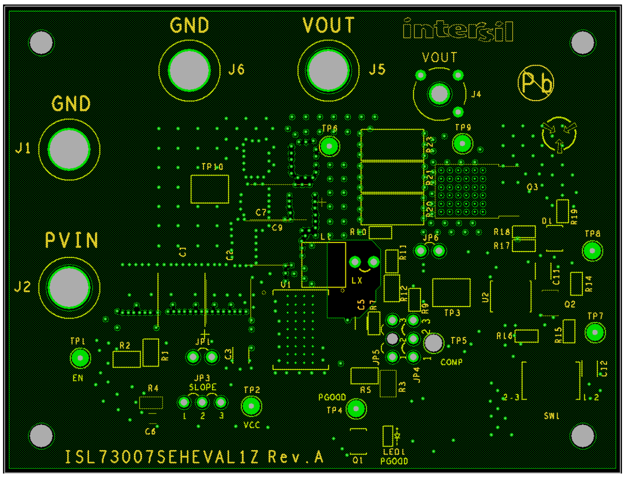

Figure 8. Layer 2

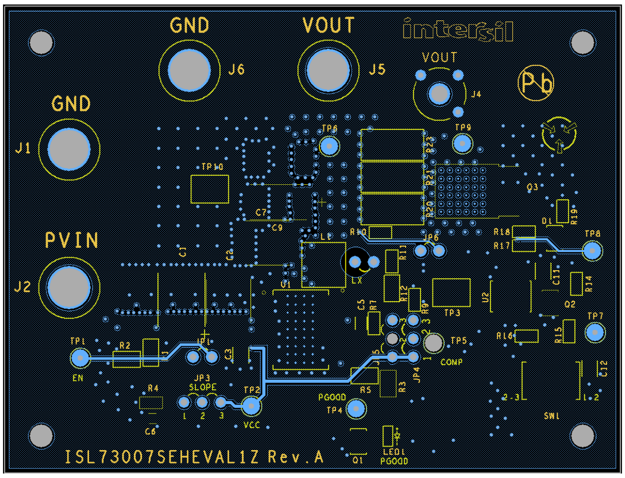

Figure 9. Layer 3

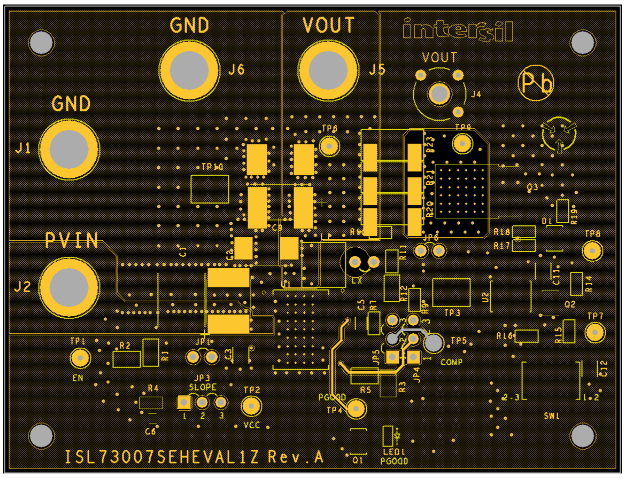

Figure 10. Bottom Layer

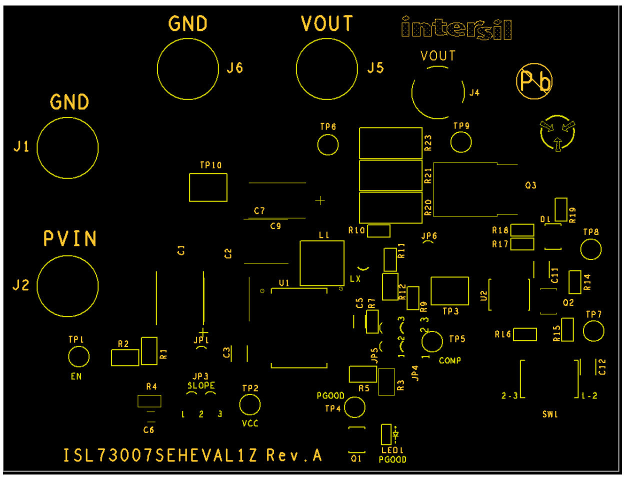

Figure 11. Top Silk Layer

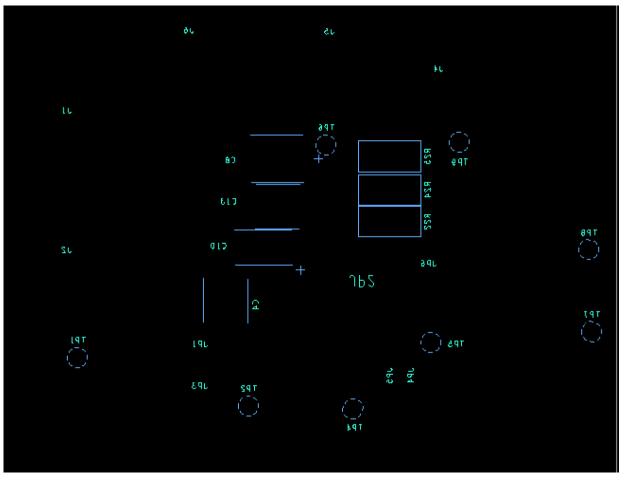

Figure 12. Bottom Silk Layer

3. Typical Performance Graphs

Unless otherwise noted, PVIN = 12V; V_{OUT} = 3.3V, f_{SW} = 500kHz, T_A = Room Ambient

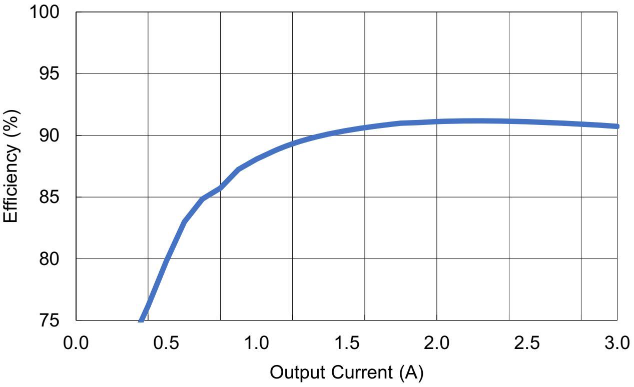

Figure 13. Efficiency

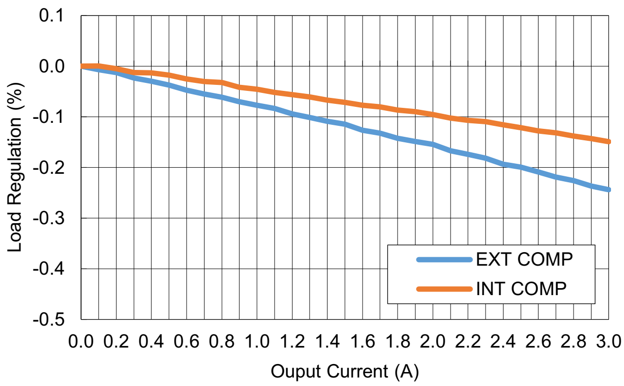

Figure 14. Load Regulation Int & Ext comp

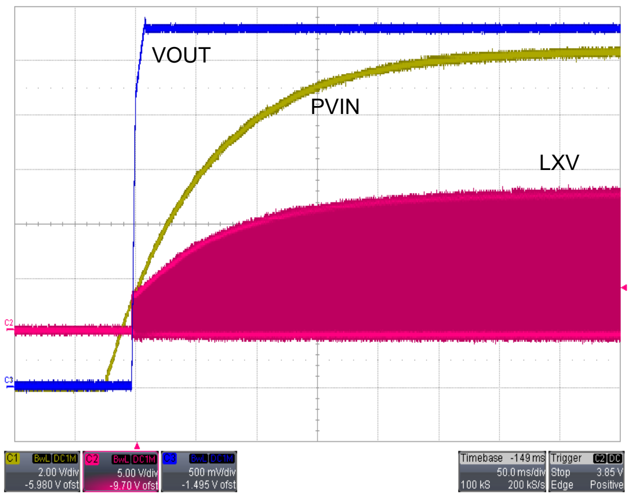

Figure 15. Turn-on by PVIN, 1Ω load

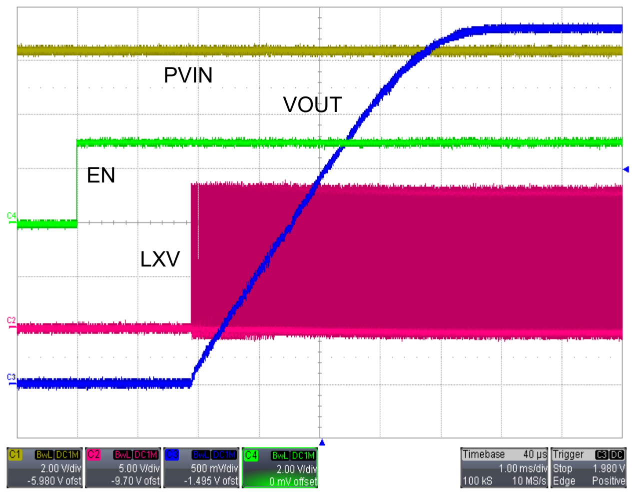

Figure 16. Enabled Turn-on, 1Ω load

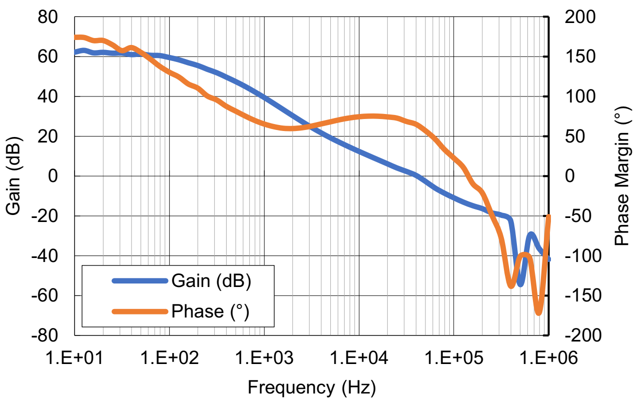

Figure 17. Ext Comp Gain/Phase BODE Plot, I_{OUT} = 1.5A

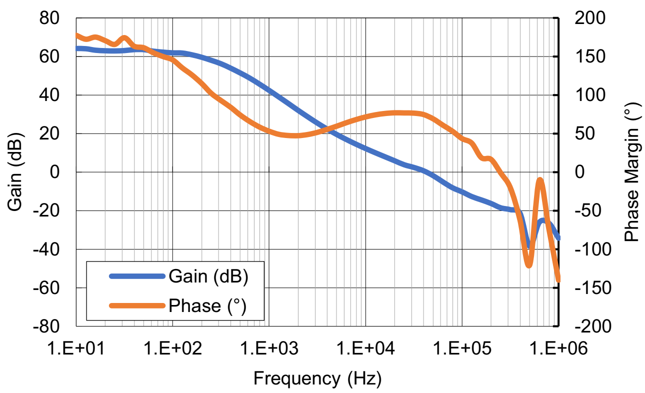

Figure 18. Int Comp Gain/Phase BODE Plot, I_{OUT} = 1.5A

Unless otherwise noted, PVIN = 12V; V_{OUT} = 3.3V, f_{SW} = 500kHz, T_A = Room Ambient (Cont.)

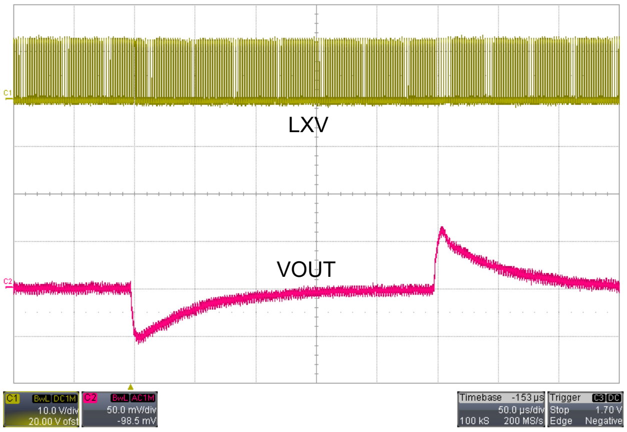

Figure 19. 2A Load Transient (External Compensation)

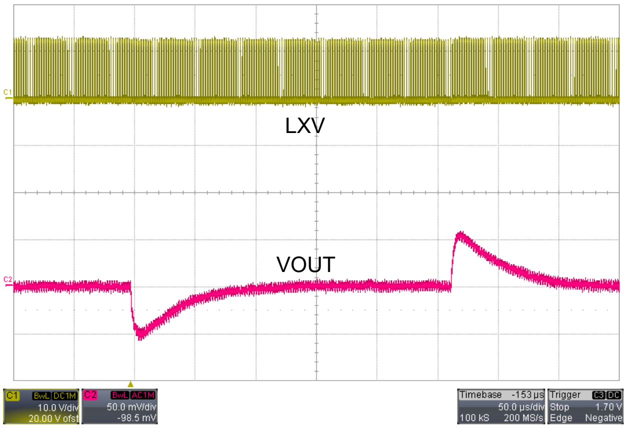

Figure 20. 2A Load Transient (Internal Compensation)

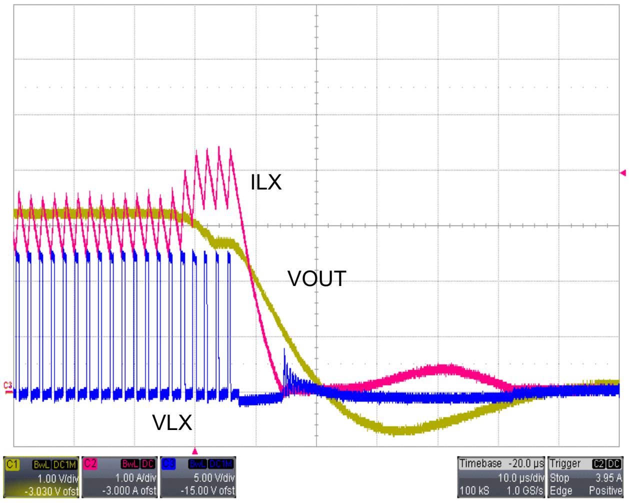

Figure 21. Positive Overcurrent Protection

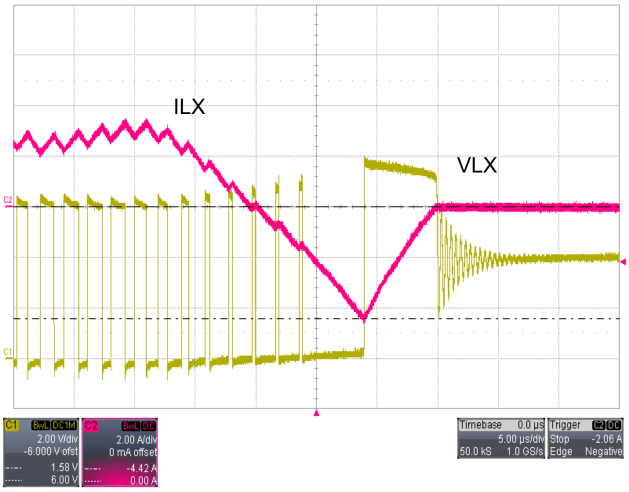

Figure 22. Negative Overcurrent Protection

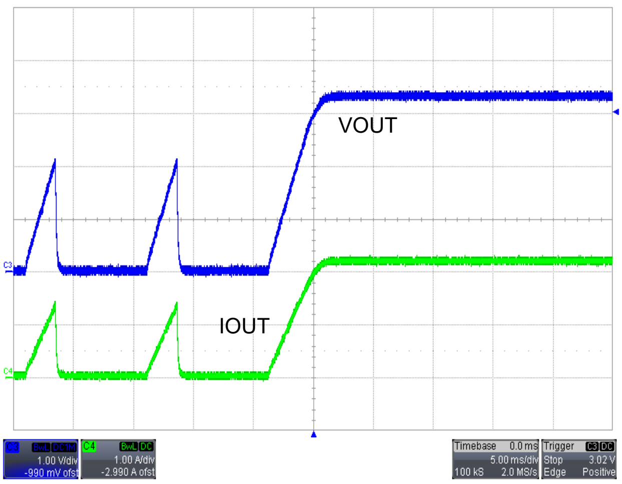

Figure 23. V_{OUT} Restart from OC

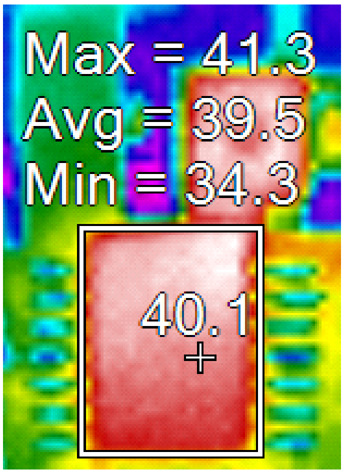

Figure 24. Package Temperature, I_{OUT} = 3A

4. Ordering Information

Part Number	Description
ISL73007SEHEVAL1Z	Radiation Hardened ISL73007SEH buck regulator evaluation board

5. Revision History

Revision	Date	Description
1.01	Dec 1, 2022	Updated Schematic, board photo, and BOM
1.00	Mar 30, 2022	Initial release

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