ISL73846MEV3Z

2-Phase Boost Converter Evaluation Board

ISL73846MEV3Z is a two-phase 12V input, 28V output, synchronous boost converter featuring two ISL73846M devices in leader-follower configuration.

Specifications

- VDD: 5V to 19V
- PVDD: 8V to 13.2V
- VIN: 10.8V to 13.2V
- Maximum load current: 4A
- Switching frequency: 500kHz (per phase)

Features

- Interleaved 2-phase converter
- Synchronous boost converter

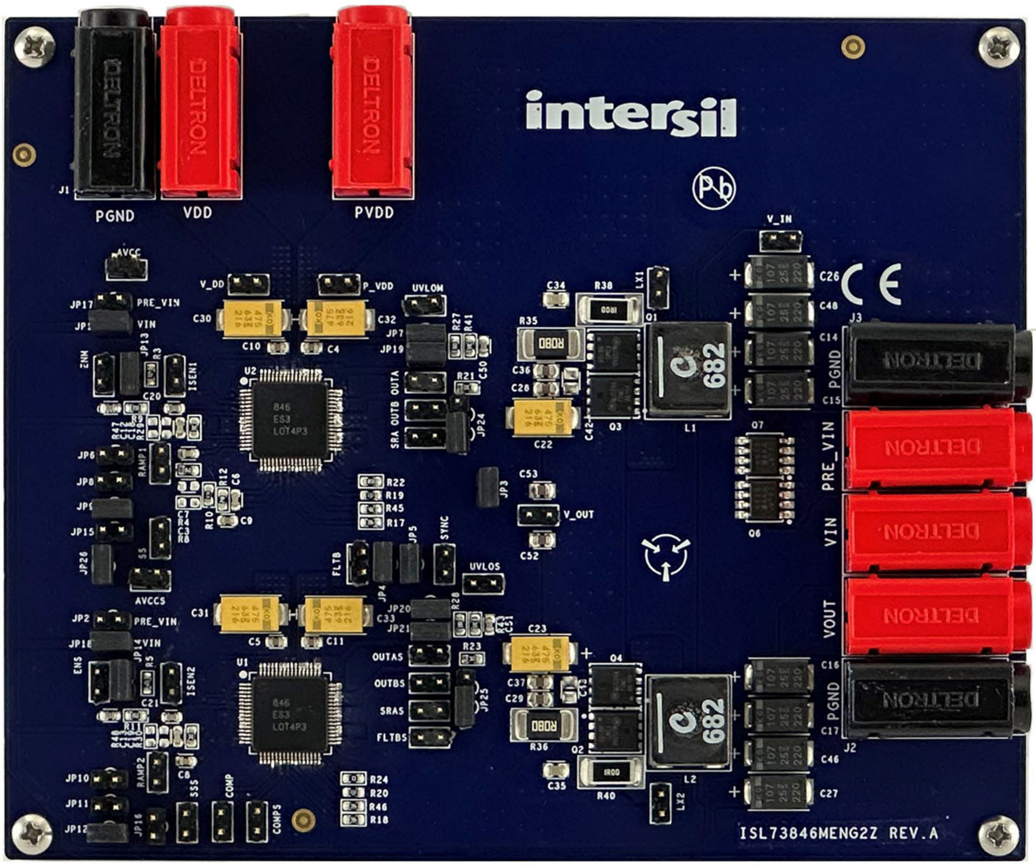


Figure 1. ISL73846MEV3Z 2-Phase Boost Converter Evaluation Board (Top)

Contents

1. Functional Description

The ISL73846MEV3Z board features two ISL73846M devices operating in leader-follower configuration. The two controllers generate interleaved PWM signals to drive two phases of an interleaved, synchronous 12V to 28V interleaved boost converter. The board is designed for 4A of load current from its 28V VOUT rail.

The VDD plug on the board supplies VDD of the two ISL73846M devices. The PVDD plug supplies the ISL73846M PVDD rail and the VDD rail of the HIP2211 drivers. The boost converter input can be supplied either through the VIN plug or through the PRE_VIN plug (see jumper configurations in Setup and Configuration). VOUT is the 28V output of the converter.

1.1 Operational Characteristics

The board VDD plug can be supplied from a 5V to 19V supply. This plug only supplies the ISL73846M VDD rails. The board PVDD plug can be supplied from an 8V to 13.2V supply. This plug supplies the ISL73846M PVDD rails and the HIP2211 VDD rails. The converter input voltage range (VIN or PRE_VIN) is tested from 10.8V to 13.2V.

Boost converters have a direct path for current to flow from the input to the output through the inductors (L1 and L2) and the body diodes of the two high-side MOSFETs (Q3 and Q4). If an overcurrent event occurs at the output of the converter, the controller goes into hiccup mode and stops switching. However, high current continues to flow from the input to the output through the path previously mentioned and potentially damages the power train by overheating.

Alternatively, PRE_VIN can power up the converter. PRE_VIN is connected to the converter VIN using two PMOS load switches. These switches are turned off in alternate hiccup cycles if overcurrent protection is triggered. This feature allows reducing average input current by approximately half when OCP occurs.

Renesas recommends not loading the converter with more than 8A of load current for long durations.

ISL73846M offers two alternative configurations for overcurrent protection (OCP):

- Hiccups if OC1 is detected in 4 out of last 8 switching cycles; hiccups immediately if OC2 is detected.
- Continuous pulse-by-pulse overcurrent protection if current reaches OC1 threshold. Hiccup if UV fault is detected or if OC2 is detected.

On this board, OC1 is detected if the input current peak value of either phase exceeds 7.5A, and OC2 is detected if the input current peak value of either phase exceeds 11.25A. UV fault is detected when the output voltage falls below 23.8V. Refer to the *ISL73846M Datasheet* for more information about the overcurrent protection configurations, OC1, OC2, and UV fault thresholds.

1.2 Setup and Configuration

The board should be pre-configured with the following jumper configurations:

- JP1 and JP13 for enable of U1 (default: use VIN plug to power up)
- JP18 and JP14 for enable of U2 (default: use VIN plug to power up)
- JP7 and JP19 for UVLO of U1
- JP20 and JP21 for UVLO of U2
- JP9 and JP12 to set overcurrent protection of both devices to hiccup mode (default: first configuration)
- JP4 to connect FLTB of U1 and U2 together
- JP5 to connect SYNC of U1 and U2 together
- JP3 to connect UVLO of U1 and U2 together
- JP26 to connect EN of U1 and U2 together
- JP24 and JP25 (pins 2 and 3 connected)

To use the PRE_VIN plug to supply the converter, remove the JP1 and JP18 jumpers and populate the JP17 and JP2 jumpers instead. By default, the board is configured to be powered up from VIN.

To use the pulse-by-pulse current limiting (second OCP configuration mentioned in Operational Characteristics) instead of the default OCP configuration, remove the JP9 and JP12 jumpers and populate the JP6 and JP11 jumpers.

2. Board Design

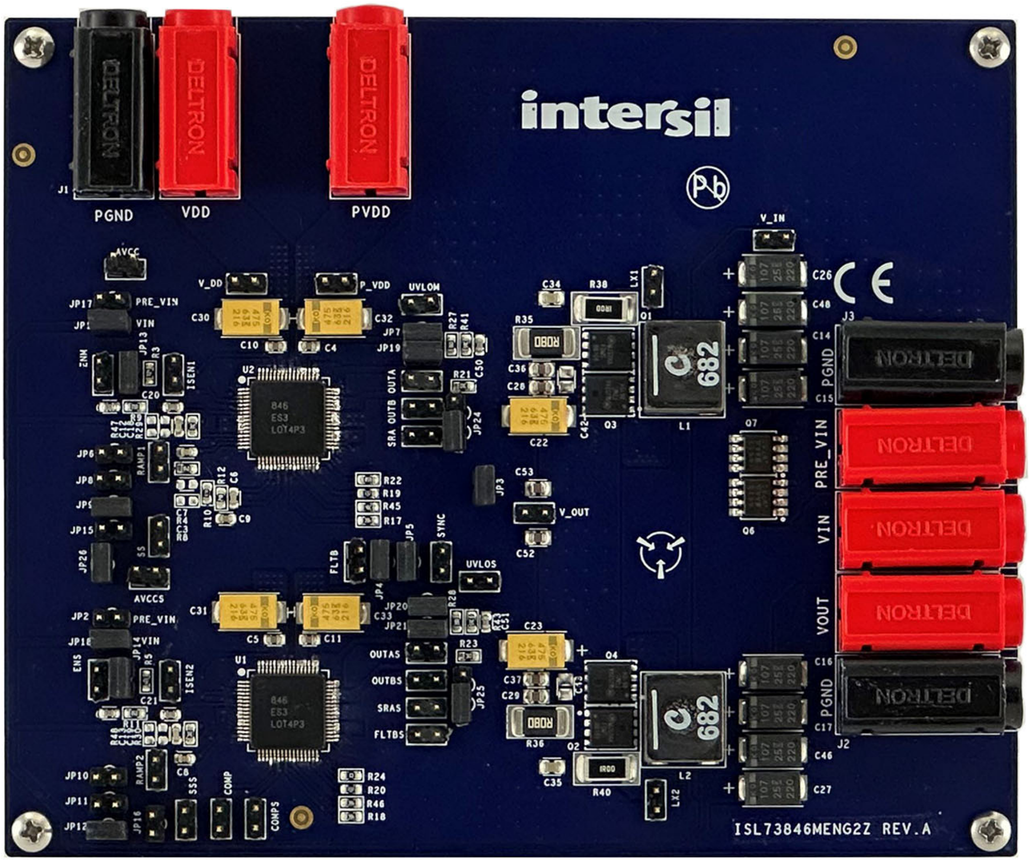


Figure 2. ISL73846MEV3Z Two-Phase Boost Converter Evaluation Board (Bottom)

2.1 Layout Guidelines

General layout practices for a high-performance half-bridge should be used for a synchronous boost converter. The physical loop area formed by the top and bottom FETs and the output capacitor should be small to minimize parasitic inductance. This is important to limit ringing at the switching node and to improve ripple at the output.

This board has six layers. The top and bottom layers are used for signal/power plane routing. Layers 2 and 5 are dedicated ground planes. Inner layers 3 and 4 are used for other signal/power plane routing.

Route current sense trace from the sense resistor to the IC as far away from switching nets (LX nodes, OUTA, OUTB, SRA, SRB, and SYNC nets) as possible. Similarly, route the output voltage feedback trace from VOUT to the feedback pin of the IC away from switching nets. Connect ceramic decoupling capacitors for VDD, PVDD, and AVCC close to the respective pins and ensure a direct connection to the inner PGND planes.

The ISL73846M controller has separate analog and power ground pins (AGND and PGND). The PGND pin is intended as the gate drive current return path. Route AGND separately from PGND and connect both grounds at one point on the board.

2.2 Schematic Diagrams

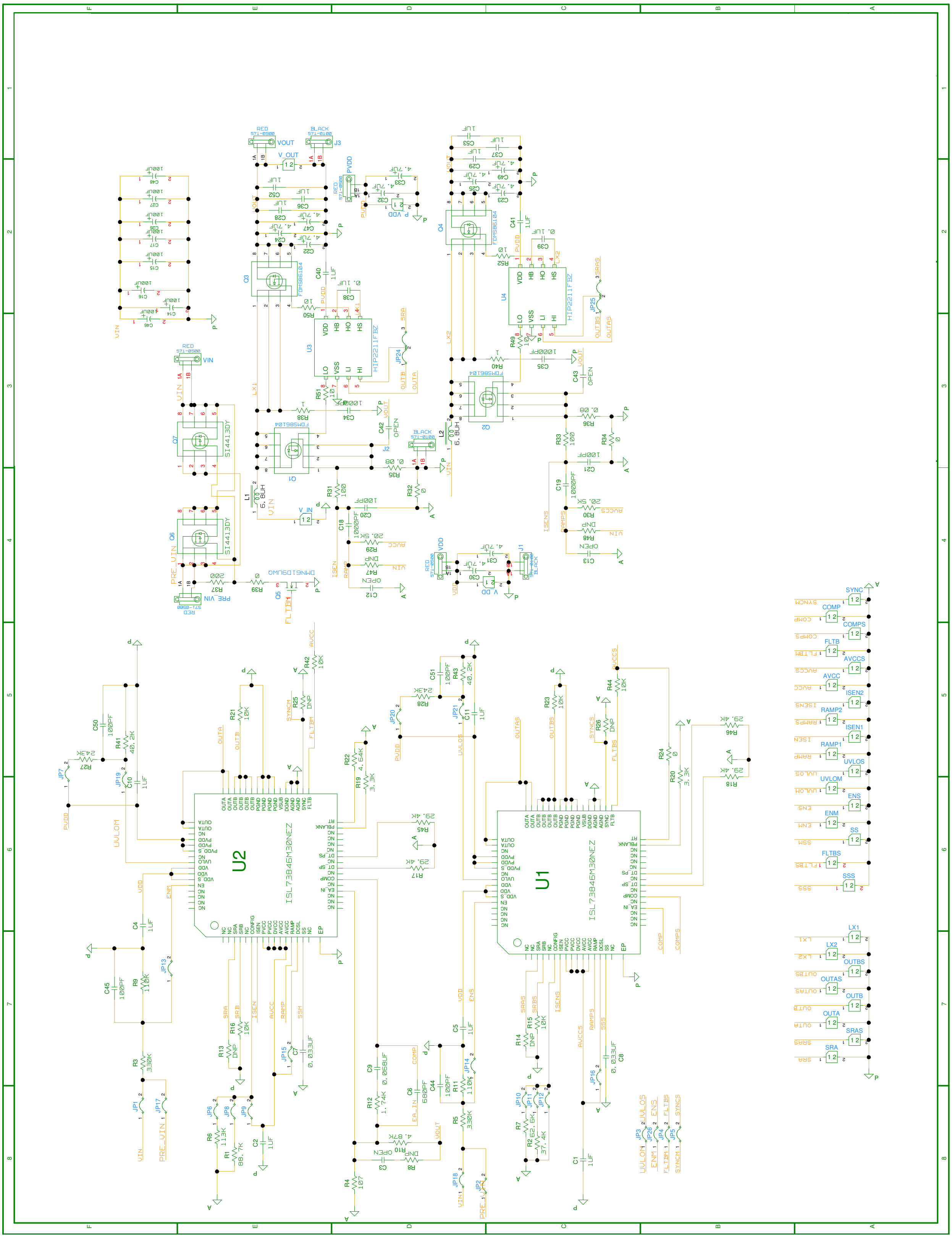


Figure 3. Schematic

2.3 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
5	PRE_VIN, PVDD, VDD, VIN, VOUT	10A RED Banana Jack Socket Terminal	Deltron	571-0500
29	AVCC, AVCCS, COMP, COMPS, ENM, ENS, FLTB, FLTBS, ISEN1, ISEN2, LX1, LX2, OUTA, OUTAS, OUTB, OUTBS, P_VDD, RAMP1, RAMP2, SRA, SRAS, SS, SSS, SYNC, UVLOM, UVLOS, V_DD, V_IN, V_OUT	Male 2 Pin Header 2.54mm (0.100) Pitch	FCI	68000-236
1	C9	0.068µF, 10%, 25V, 0603, Multilayer Cap	Kemet	C0603C683K3RACTU
2	R35, R36	0.08Ω, 2512, Current Sense Resistor	Bourns	CRA2512-FZ-R080ELF
1	Q5	60V, 340mA, N-Channel MOSFET	Diodes Inc.	DMN61D9UWQ
4	Q1, Q2, Q3, Q4	100V, 16A, 24mΩ, N-Channel MOSFET	Fairchild	FDMS86104
6	C20, C21, C50, C51, C52, C53	100pF, 10%, 50V, 0603, Multilayer Cap	Various	Generic
2	C18, C19	1000pF, 10%, 16V, 0603, Multilayer Cap	Various	Generic
2	C38, C39	0.1µF, 10%, 25V, 0603, Multilayer Cap	Various	Generic
2	C1, C2	1µF, 20%, 16V, 0603, Ceramic Cap	Various	Generic
2	C7, C8	0.033µF, 10%, 16V, 0603, Multilayer Cap	Various	Generic
1	C6	680pF, 10%, 50V, 0603, Multilayer Cap	Various	Generic
3	C3, C12, C13	0603 Multilayer Cap (DNP)	Various	Generic
2	C34, C35	1000pF, 10%, 50V, 0805, Multilayer Cap	Various	Generic
6	C28, C29, C36, C37, C44, C45	1µF, 20%, 50V, 0805, Multilayer Cap	Various	Generic
2	C42, C43	0805 Multilayer Cap (DNP)	Various	Generic
8	C14, C15, C16, C17, C26, C27, C46, C48	100µF, 20%, 25V, 30mΩ ESR, Conductive Polymer Cap	Kemet	T521X107M025ATE030
10	C22, C23, C24, C25, C30, C31, C32, C33, C47, C49	4.7µF, 20%, 63V, 75mΩ ESR, Up-Screen Commercial Polymer Electrolytic Cap	Kemet	T543D475M063AHE075
6	C4, C5, C10, C11, C40, C41	1µF, 10%, 50V, 0603, Multilayer Cap	Taiyo-Yuden	UMK107AB7105KA
2	R25, R26	0603 Metal Film Chip Resistor (DNP)	Various	Generic
2	R19, R20	3.3kΩ, 0.1%, 0603, Metal Film Chip Resistor	Various	Generic
5	R8, R13, R14, R47, R48	0603 Metal Film Chip Resistor (DNP)	Various	Generic
4	R49, R50, R51, R52	10Ω, 1%, 0603, Thick Film Chip Resistor	Various	Generic
3	R24, R32, R34	0Ω, 0603, Thick Film Chip Resistor	Various	Generic

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
2	R31, R33	100Ω, 1%, 0603, Thick Film Chip Resistor	Various	Generic
6	R15, R16, R21, R23, R42, R44	10kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
1	R4	107Ω, 1%, 0603, Thick Film Chip Resistor	Various	Generic
2	R9, R11	110kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
1	R6	113kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
1	R12	1.74kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
2	R29, R30	20.5K, 1%, 0603, Thick Film Chip Resistor	Various	Generic
2	R27, R28	243kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
4	R17, R18, R45, R46	29.4kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
2	R3, R5	330kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
2	R41, R43	40.2kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
1	R22	4.64kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
1	R10	4.87kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
1	R1	88.7kΩ, 1%, 0603, Thick Film Chip Resistor	Various	Generic
1	R39	0Ω, 0805, Thick Film Chip Resistor	Various	Generic
1	R37	200Ω, 5%, 0805, Thick Film Chip Resistor	Various	Generic
2	R38, R40	1Ω, 1%, 2512, Thick Film Chip Resistor	Various	Generic
1	R7	62.6kΩ, 0.1%, 0603, Thin Film Chip Resistor	KOA Speer	RN73H1JTTD6262B25
1	R2	37.4kΩ, 0.1%, 0603, Thin Film Chip Resistor	Yageo	RT0603BRE0737K4L
2	U3, U4	100V, High Frequency Half-Bridge Driver	Renesas	HIP2211FBZ
2	U1, U2	Rad Hard Dual Output PWM Controller	Renesas	ISL73846M30NEZ
3	J1, J2, J3	10A BLACK Banana Jack Socket Terminal	Deltron	571-0100
2	JP24, JP25	100 mil Spacing Through Hole Three Pin Jumper	Various	JUMPER-3-100
22	JP1, JP2, JP3, JP4, JP5, JP6, JP7, JP8, JP9, JP10, JP11, JP12, JP13, JP14, JP15, JP16, JP17, JP18, JP19, JP20, JP21, JP26	100 mil Spacing Through Hole Two Pin Jumper	Various	JUMPER2_100
2	Q6, Q7	30V, 9A, P-Channel MOSFET	Vishay	SI4413DY
2	L1, L2	6.8µH, 20%, 21.8A, Shielded Power Inductor	Coilcraft	XAL1010-682ME

2.4 Board Layout

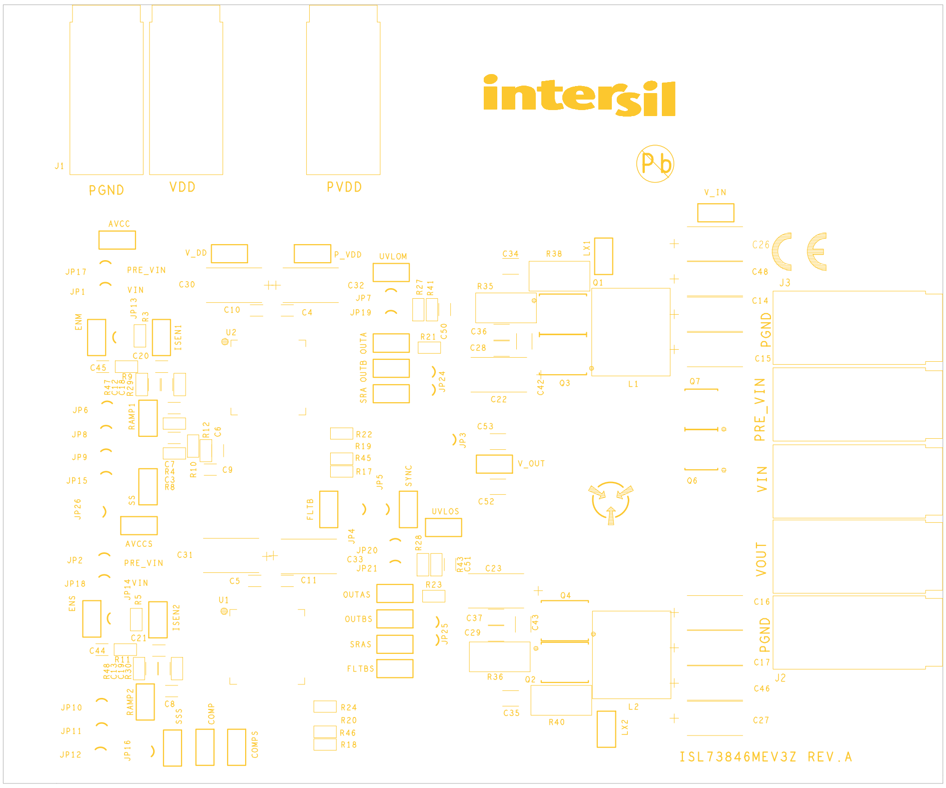


Figure 4. Silkscreen Top

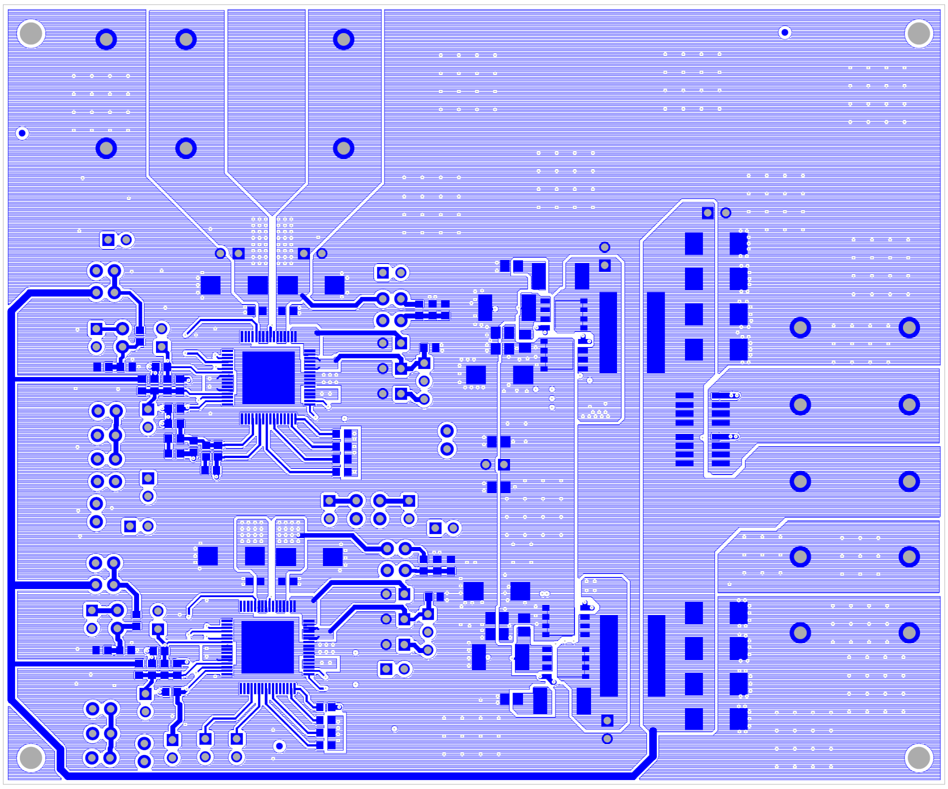


Figure 5. Top Layer

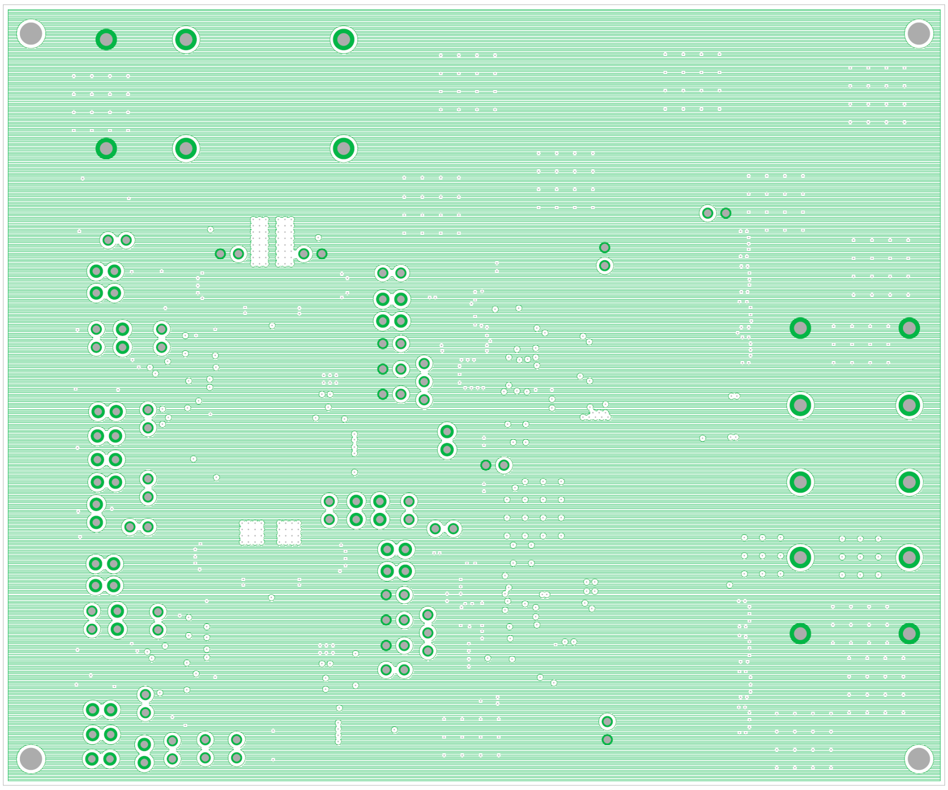
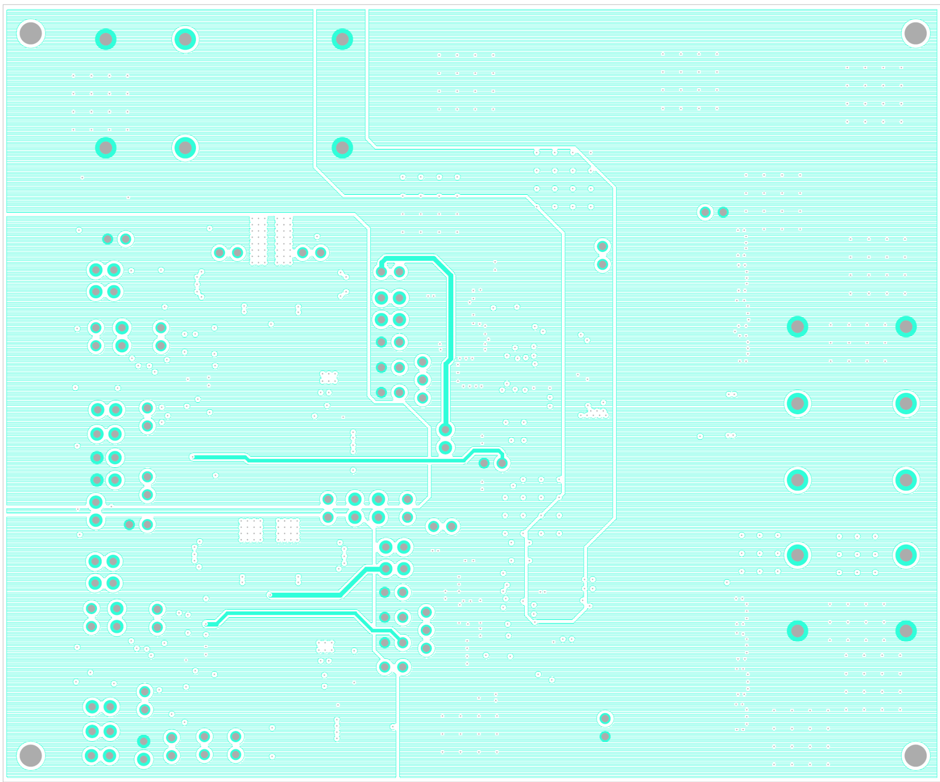


Figure 6. Layer 2



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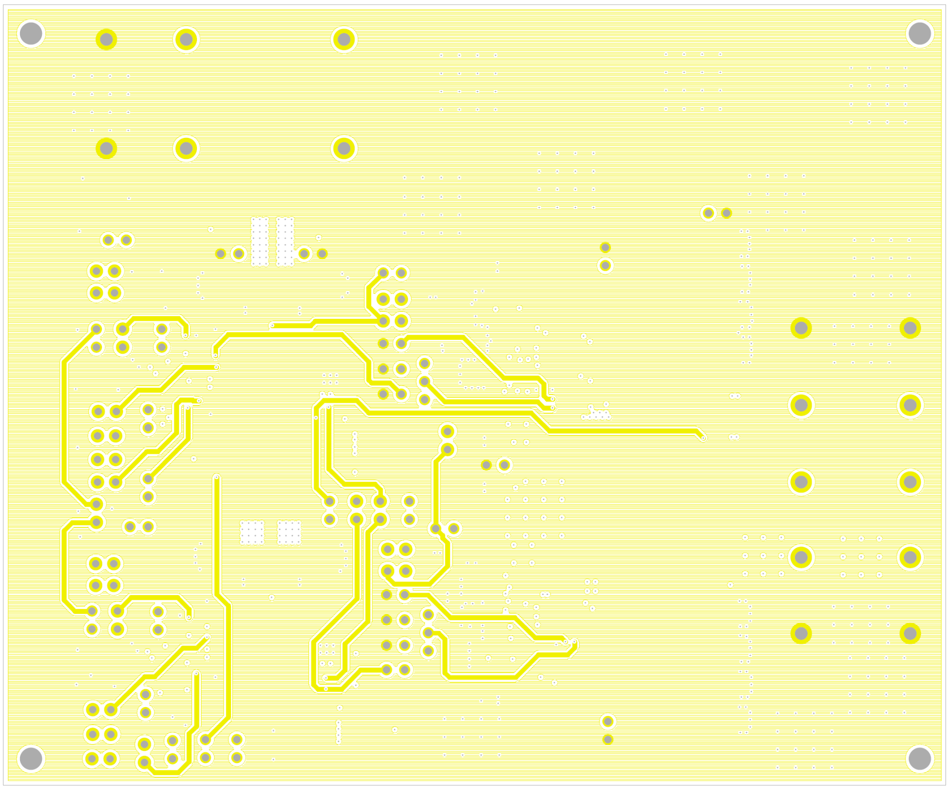

Figure 8. Layer 4

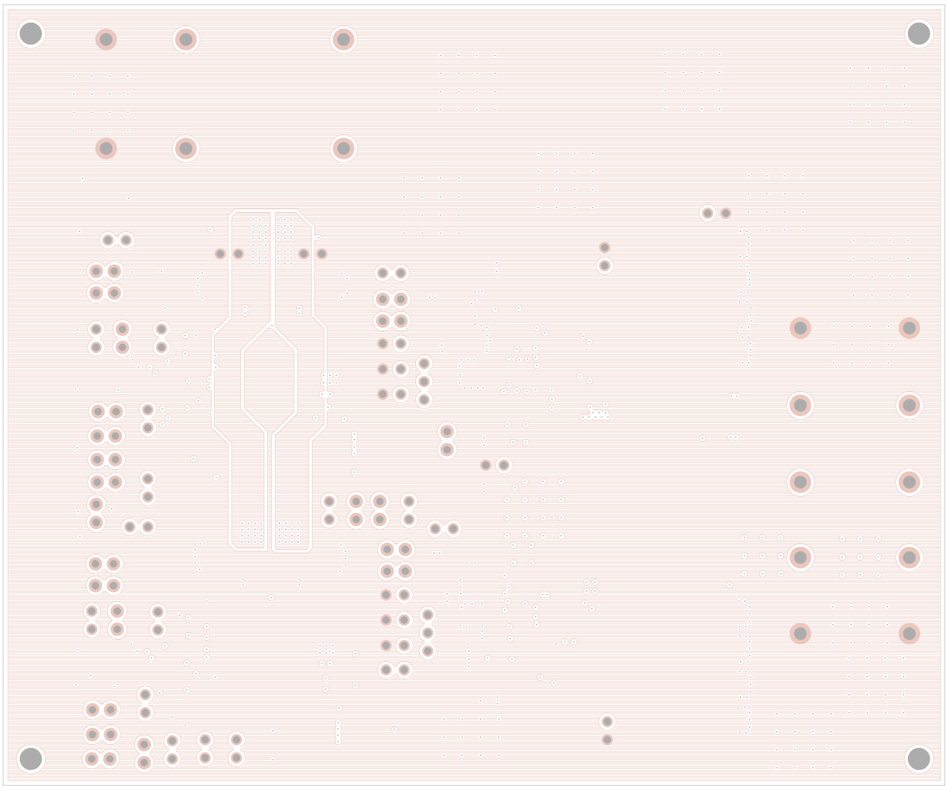

Figure 9. Layer 5

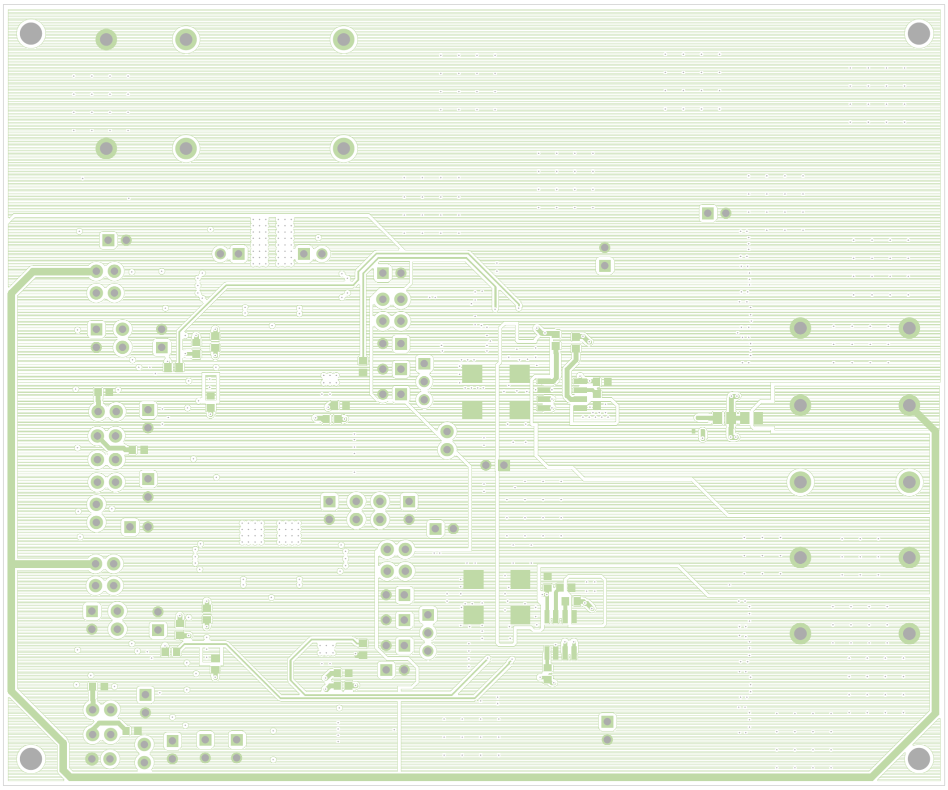

Figure 10. Bottom Layer

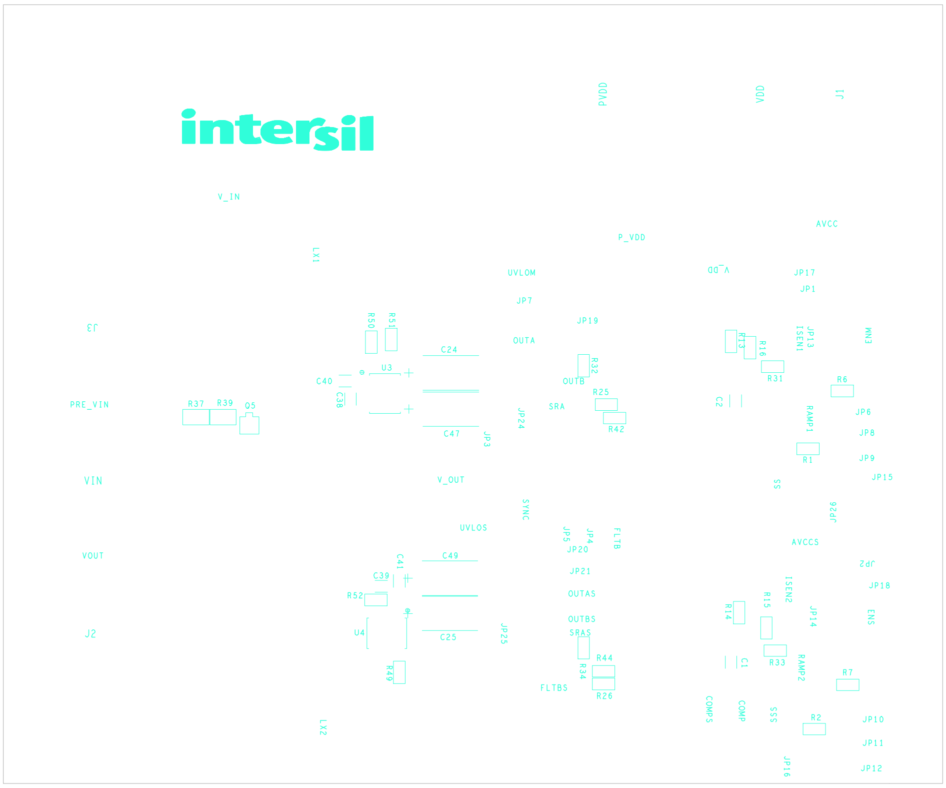

Figure 11. Silkscreen Bottom

3. Typical Performance Graphs

Typical steady state operation waveforms of ISL73846MEV3Z 2-phase boost converter at no-load and full load are shown in Figure 12 and Figure 13. Figure 14 shows efficiency of the converter at V_{IN} = 10.8V, 12V, and 13.2V.

Figure 12. No Load LX Voltages and Inductor Currents

Figure 13. Full Load LX Voltages and Inductor Currents

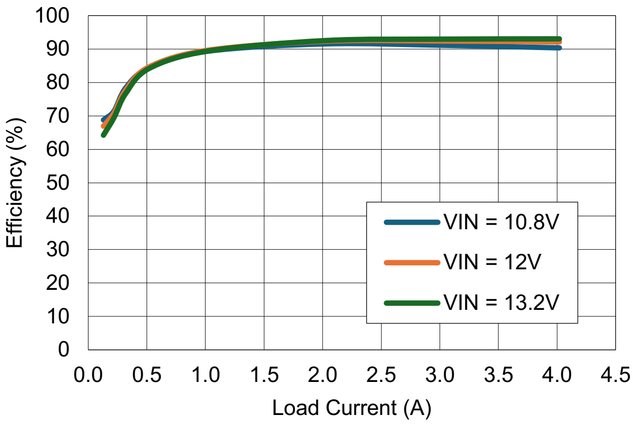

Figure 14. Efficiency

4. Ordering Information

Part Number	Description
ISL73846MEV3Z	ISL73846M 2-Phase Boost Converter Evaluation Board

5. Revision History

Revision	Date	Description
1.00	Dec 2, 2024	Initial release

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