ISL73847MDEMO2Z

The ISL73847MDEMO2Z demonstration board demonstrates the performance of the ISL73847M dual-phase buck controller in single-phase mode. The board is optimized for a 4.5V to 15V input operation to generate a 25A max, 1V output.

Specifications

- Input voltage supply (V_{IN}): 4.5V to 15V
- Preset output voltage (V_{OUT}): 1V
- Preset switching frequency: 500kHz
- Maximum load current: 25A
- Preset droop regulation

Features

- Power-Good LED indicator
- Integrated LDO (VCC)
- Droop regulation set by a single resistor

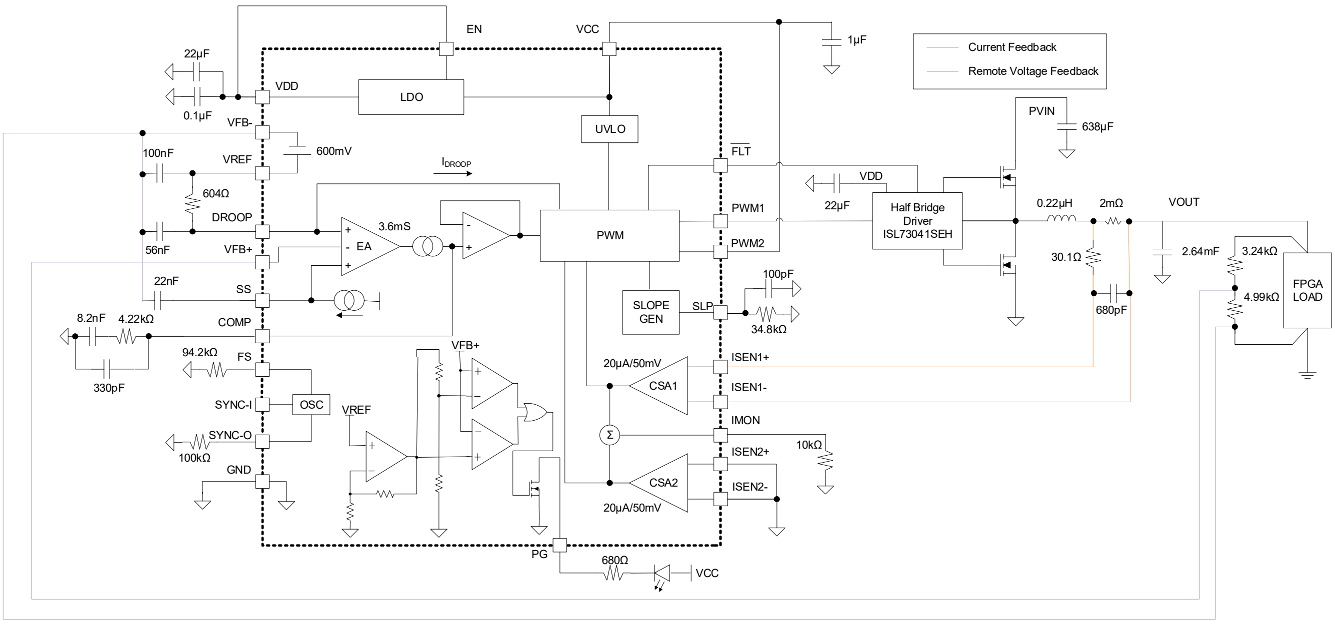

Figure 1. ISL73847MDEMO2Z Block Diagram

Contents

1. Functional Description

1.1 Operating Range

The ISL73847MDEMO2Z board requires one input supply (V_{IN}) to operate properly. This supply powers the ISL73847M controller analog supply input, plus additional supporting circuitry and the on-board buck power supply input. The user can set the VIN supply from 4.5V to 15V. The buck regulator circuit is preset for a 1V output voltage and a switching frequency of 500kHz with a 0.22µH output inductor and 2.64mF output capacitance.

1.2 Before Starting

The board does not come with any connectors. To properly use the board, solder connectors to the VIN, GND, and VOUT solder pads.

1.3 Quick-Start Guide

1. Apply a 4.5V to 15V voltage to VIN connectors, as shown in Figure 2. To use 4w sense lines from a power supply or a voltmeter to monitor the input voltage, solder a jumper to TP1.
2. If required, a resistor or electronic load can be connected to the VOUT connectors, as shown in Figure 2. To use 4w sense lines from an electronic load, solder a jumper to TP2.

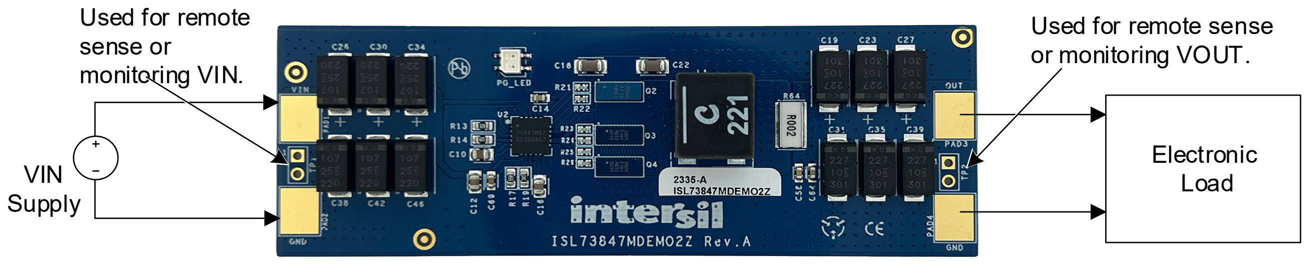

Figure 2. ISL73847MDEMO2Z Board Setup

1.4 Changing the Switching Frequency

The ISL73847MDEMO2Z is configured for a 500kHz switching frequency by a 94.2kΩ pull-down resistor (R_2) on the FS pin. The demonstration board includes a 0.22µH inductor and an array of output bypass capacitors for a 2.64mF, which makes up the LC filter. If you need to select a different switching frequency, see Figure 3 for choosing the appropriate R_2 value on FS. For more information about the FS pin, refer to the *ISL73847M Datasheet*.

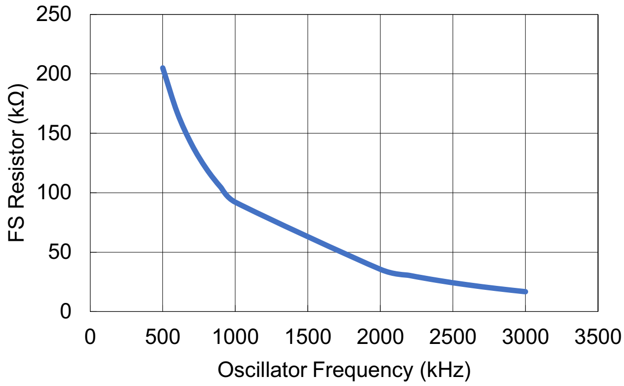

Figure 3. R_{FS} vs Frequency

1.5 Soft-Start Adjustment

The ISL73847MDEMO2Z is configured for a 2ms soft-start (SS) time by a 22nF bypass capacitor (C_2) connected to the SS pin. The SS time can be adjusted from 2ms to 200ms by changing the C_2 capacitor. If a different soft-start time is required, use the CSS equation in the *ISL73847M datasheet* to calculate the capacitance given the required soft-start time. For more information on SS, refer to the *ISL73847M datasheet*.

1.6 Droop Regulation

The ISL73847MDEMO2Z minimizes peak-to-peak transient response excursions by using a 604Ω resistor (R_1) connected between the VREF and DROOP pins. If droop regulation is unnecessary, replace the 604Ω with a 0Ω resistor to short the VREF and DROOP pins together. For more information about the droop regulation, refer to the *ISL73847M datasheet*.

1.7 Enabling/Disabling

The ISL73847MDEMO2Z automatically enables when VDD reaches a certain voltage on power-up by a 4.99kΩ resistor (R_6) connected between EN and VDD. For more information about enabling and disabling the controller, refer to the *ISL73847M datasheet*.

2. Board Design

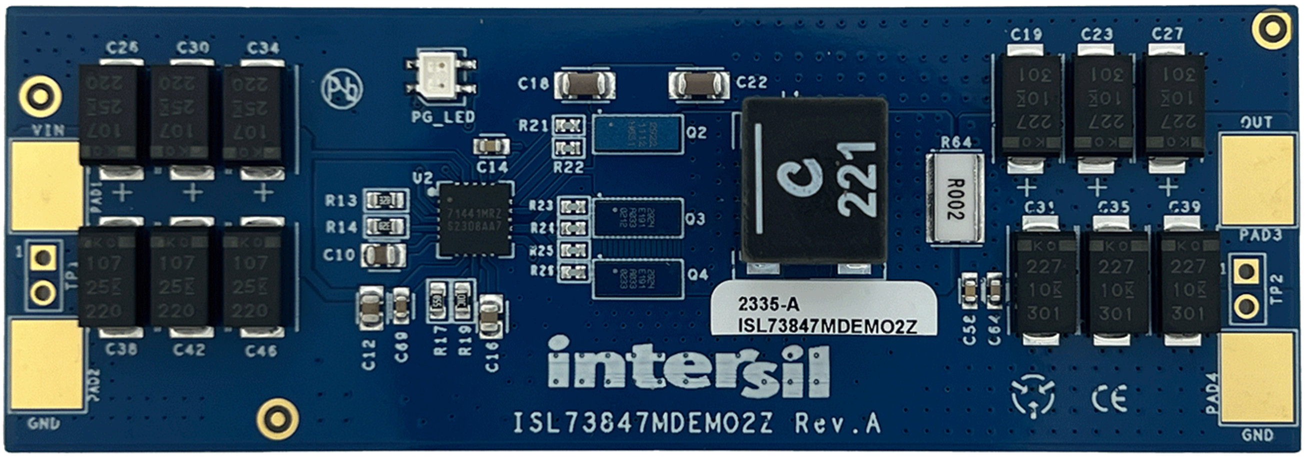

Figure 4. ISL73847MDEMO2Z Evaluation Board (Top)

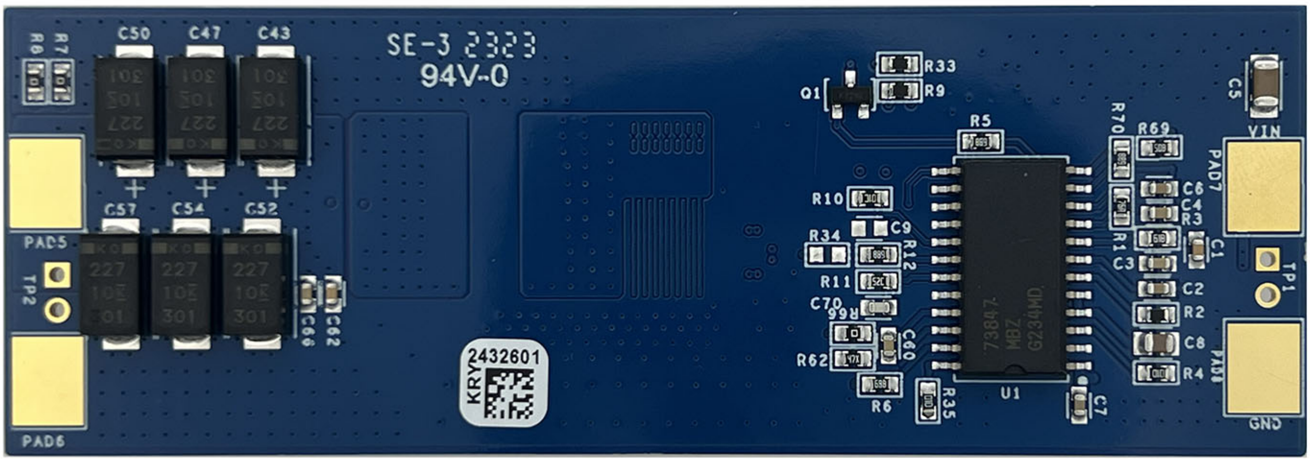

Figure 5. ISL73847MDEMO2Z Evaluation Board (Bottom)

2.1 Layout Guidelines

For detailed information about layout guidelines, refer to the *ISL73847M Datasheet*.

2.2 Schematic Diagrams

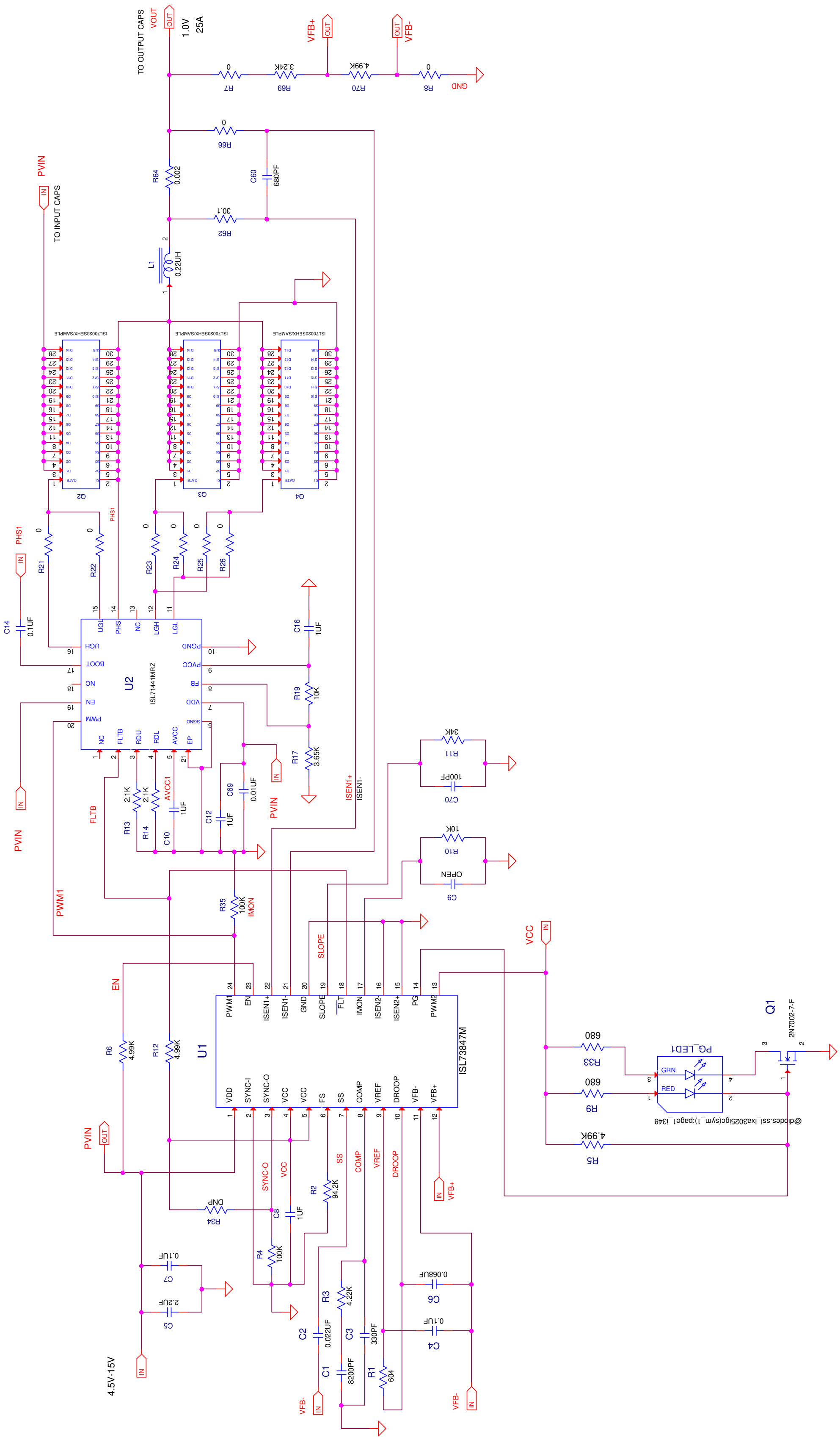

Figure 6. ISL73847MDEMO2Z Schematic (Page 1)

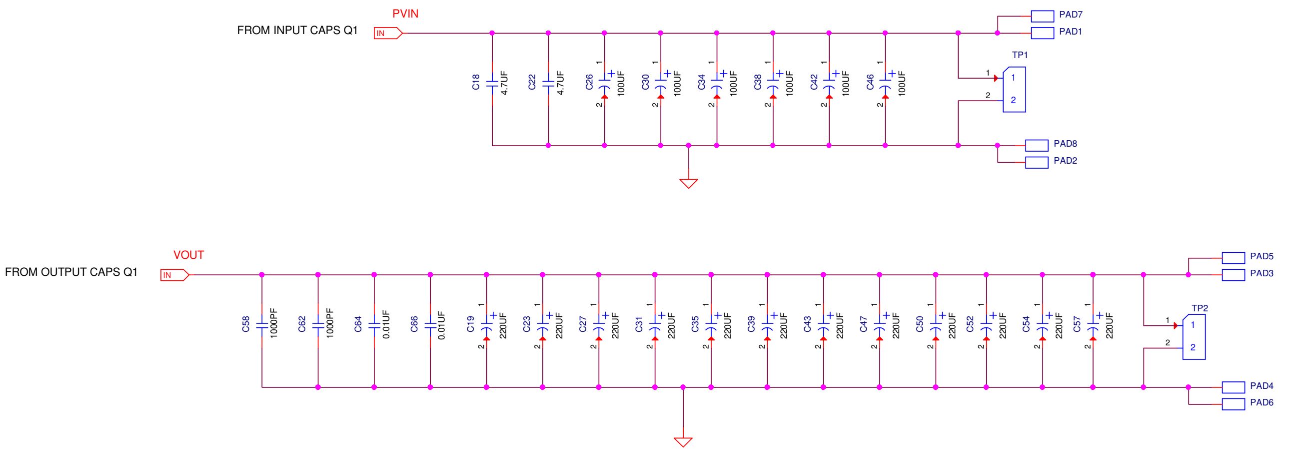

Figure 7. ISL73847MDEMO2Z Schematic (Page 2)

2.3 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1	-	PWB-PCB, ISL73847MDEMO2Z, REVA, ROHS	Imagineering Inc	ISL73847MDEMO2ZREVAPCB
2	C58, C62	CAP, SMD, 0603, 1000pF, 16V, 10%, X7R, ROHS	AVX	0603YC102KAT2A
2	C8, C10	CAP, SMD, 0805, 1.0µF, 25V, 10%, X7R, ROHS	TDK	C2012X7R1E105K125AB
2	C18, C22	CAP, SMD, 1206, 4.7µF, 25V, 10%, X7R, ROHS	TDK	C3216X7R1E475K
2	C64, C66	CAP, SMD, 0603, 0.01µF, 16V, 10%, X7R, ROHS	Yageo	CC0603KRX7R7BB103
1	C2	CAP, SMD, 0603, 0.022µF, 16V, 10%, X7R, ROHS	Yageo	CC0603KRX7R7BB223
1	C70	CAP, SMD, 0603, 100pF, 25V, 10%, X7R, ROHS	Yageo	CC0603KRX7R8BB101
2	C4, C14	CAP, SMD, 0603, 0.1µF, 25V, 10%, X7R, ROHS	Yageo	CC0603KRX7R8BB104
1	C7	CAP, SMD, 0603, 0.1µF, 50V, 10%, X7R, ROHS	Yageo	CC0603KRX7R9BB104
1	C3	CAP, SMD, 0603, 330pF, 50V, 10%, X7R, ROHS	Yageo	CC0603KRX7R9BB331
1	C60	CAP, SMD, 0603, 680pF, 50V, 10%, X7R, ROHS	Yageo	CC0603KRX7R9BB681
1	C6	CAP, SMD, 0603, 0.068µF, 50V, 10%, X7R, ROHS	Yageo	CC0603KRX7R9BB683
2	C12, C16	CAP, SMD, 0805, 1.0µF, 25V, 10%, X7R, ROHS	Samsung	CL21B105KAFNNNE
1	C5	CAP-AEC-Q200, SMD, 1206, 2.2µF, 25V, 10%, X7R, ROHS	Murata	GCJ31MR71E225KA12L

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1	C69	CAP, SMD, 0603, 0.01µF, 25V, 10%, X7R, ROHS	Murata	GRM188R71E103KA01D
0	C9	CAP, SMD, 0603, DNP-PLACE HOLDER, ROHS		
6	C26, C30, C34, C38, C42, C46	CAP-TANT, SMD, 7.3×4.3mm, 100µF, 25V, 20%, 30mΩ at 100MHz, ROHS	Kemet	T521X107M025ATE030
12	C19, C23, C27, C31, C35, C39, C43, C47, C50, C52, C54, C57	CAP-TANT, SMD, 7.3×4.3×2.8, 220µF, 10V, 20%, 6mΩ, ROHS	Kemet	T530D227M010ATE006
1	C1	CAP, SMD, 0603, 8200pF, 50V, 5%, X7R, ROHS	Vishay/Vitramon	VJ0603Y822JXACW1BC
1	L1	COIL-PWR INDUCT, AEC-Q200, SMD, 11.3×10mm, 0.22µH, 20%, 98.8A, ROHS	Coilcraft	XAL1010-221MEB
1	PG_LED	LED, SMD, 3×2.5mm, 4P, RED/GREEN, 12/20MCD, 2V	Lumex	SSL-LXA3025IGC-TR
2	Q3, Q4	IC-SAMPLE DIE, RAD HARD, 40V GAN FET, ROHS	Renesas Electronics America	ISL70020SEHX/SAMPLE
1	Q2	IC-SAMPLE DIE, RAD HARD, 100V GAN FET, ROHS	Renesas Electronics America	ISL70023SEHX/SAMPLE
1	U2	IC-GAN FET DRIVER, HALF-BRIDGE, 20P, QFN, ROHS	Renesas Electronics America	ISL71441MRZ
1	U1	IC-20V DUAL PHASE CONTROLLER, SMD, 24P, WSOIC , ROHS	Renesas Electronics America	ISL73847MBZ
1	Q1	TRANSISTOR, N-CHANNEL, 3LD, SOT-23, 60V, 115mA, ROHS	Diodes, Inc.	2N7002-7-F
2	R9, R33	RES-AEC-Q200, SMD, 0603, 680Ω, 1/10W, 1%, TF, ROHS	Vishay/dale	CRCW0603680RFKEA
0	R34	RES, SMD, 0603, DNP-PLACE HOLDER, ROHS		
1	R64	RES-AEC-Q200, SMD, 2512W, 0.002Ω, 3W, 2%, MF, ROHS	Susumu Co., LTD	KRL6432E-M-R002-G-T1
6	R21, R22, R23, R24, R25, R26	RES, SMD, 0402, 0Ω, 1/16W, 1%, THINFILM, ANTI-SULFER, ROHS	Vishay/BC Components	MCS04020Z0000ZE000
2	R4, R35	RES, SMD, 0603, 100K, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-07100KL
2	R10, R19	RES, SMD, 0603, 10K, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-0710KL

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
2	R13, R14	RES, SMD, 0603, 2.1K, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-072K1L
1	R62	RES, SMD, 0603, 30.1Ω, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-0730R1L
1	R11	RES, SMD, 0603, 34K, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-0734KL
1	R69	RES, SMD, 0603, 3.24K, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-073K24L
1	R17	RES, SMD, 0603, 3.65K, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-073K65L
1	R3	RES, SMD, 0603, 4.22K, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-074K22L
4	R5, R6, R12, R70	RES, SMD, 0603, 4.99K, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-074K99L
1	R1	RES, SMD, 0603, 604Ω, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-07604RL
3	R7, R8, R66	RES, SMD, 0603, 0Ω, 1/10W, TF, ROHS	Yageo	RC0603JR-070RL
1	R2	RES, SMD, 0603, 94.2K, 1/10W, 0.1%, THINFILM, ROHS	Yageo	RT0603BRD0794K2L
0	PAD1-PAD8	DO NOT POPULATE OR PURCHASE	-	-
0	TP1, TP2	DO NOT POPULATE OR PURCHASE	-	-

2.4 Board Layout

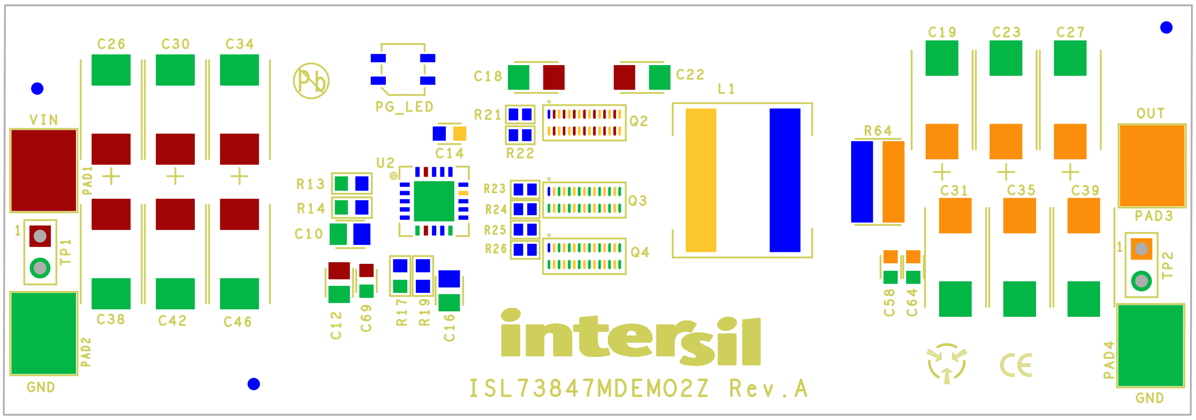

Figure 8. Silkscreen Top Layer

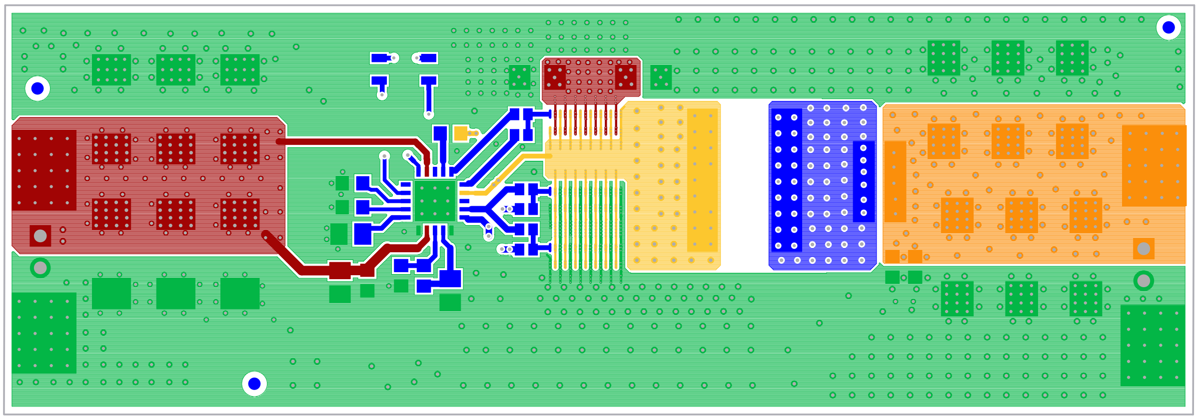

Figure 9. Top Layer

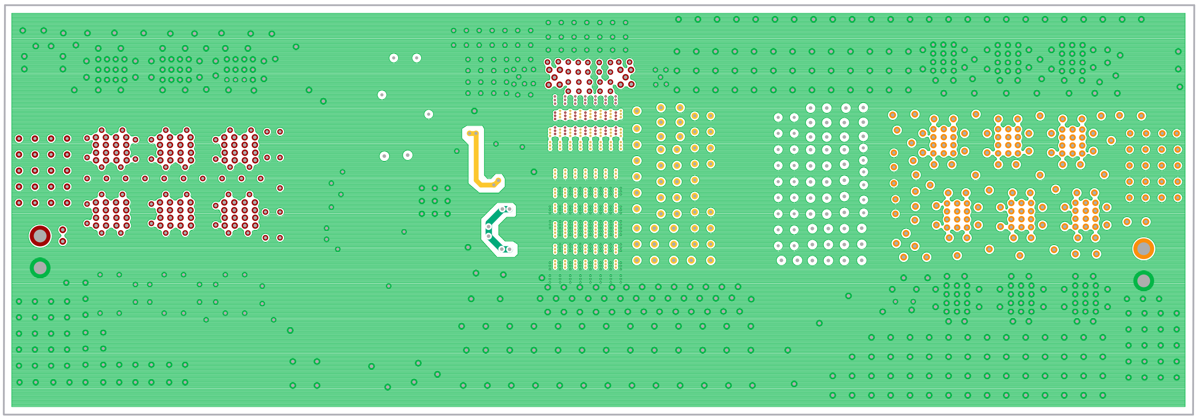

Figure 10. Layer 2

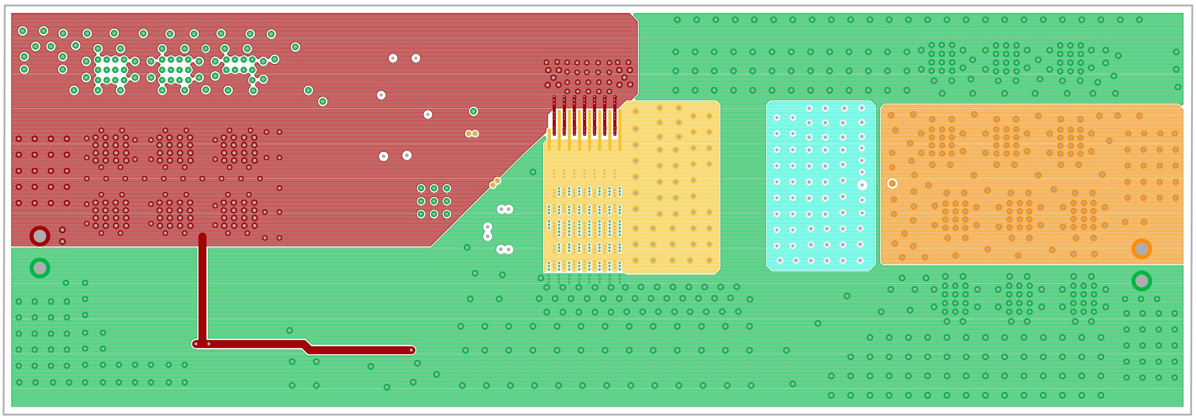

Figure 11. Layer 3

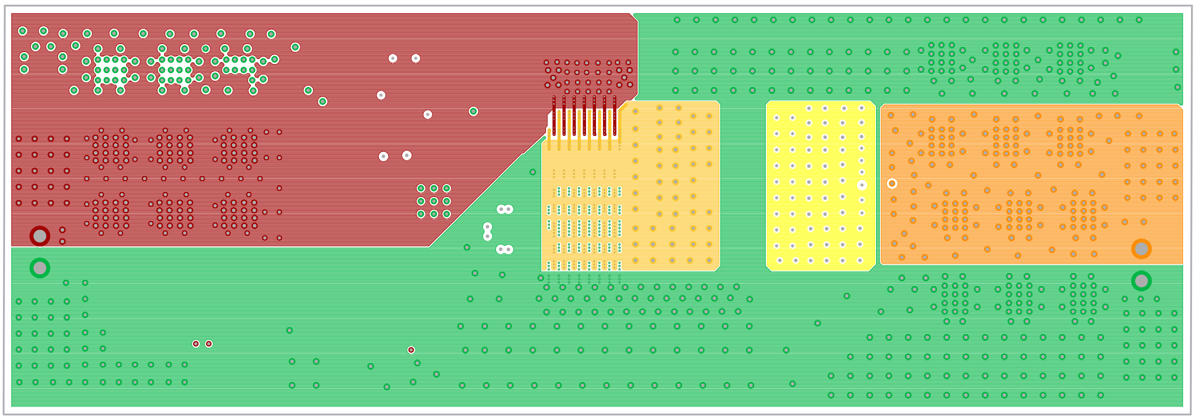

Figure 12. Layer 4

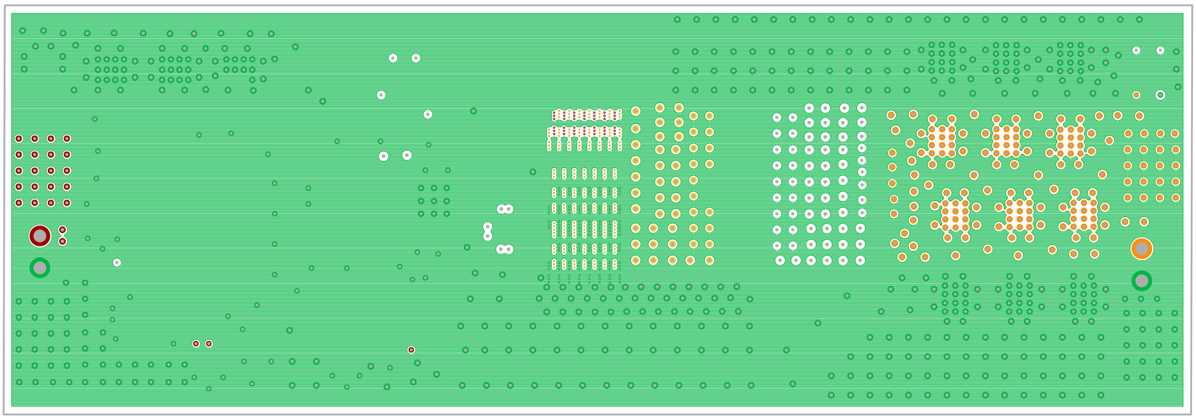

Figure 13. Layer 5

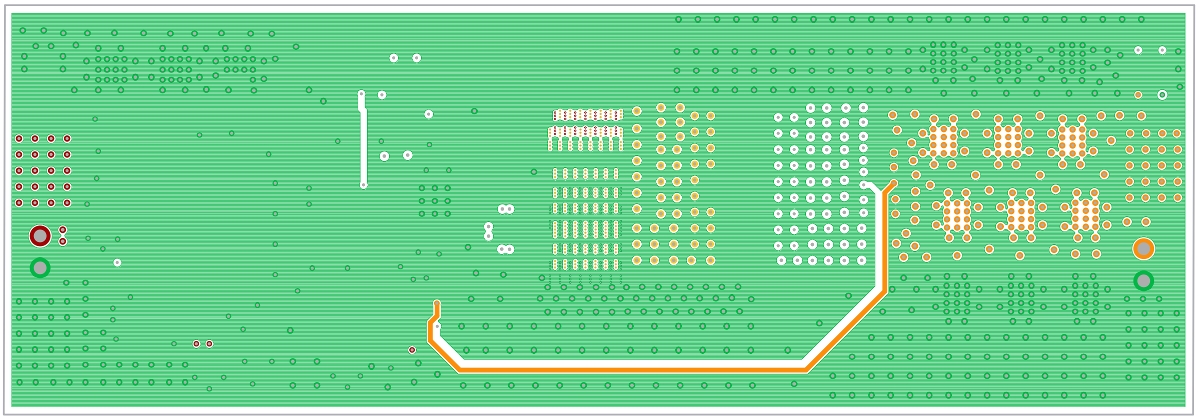

Figure 14. Layer 6

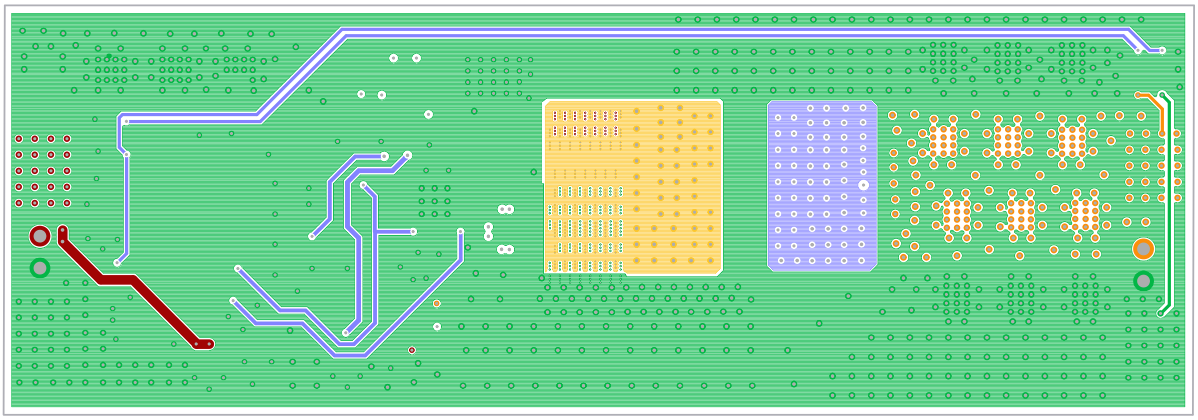

Figure 15. Layer 7

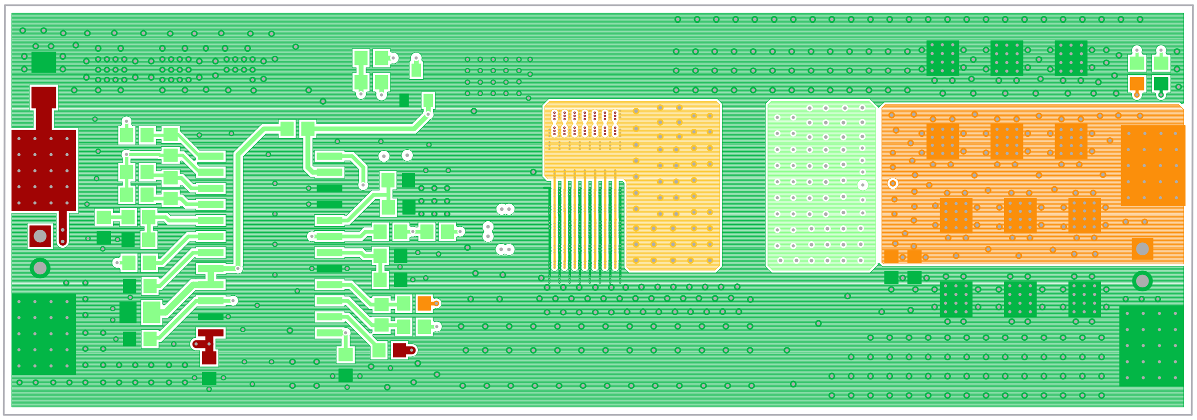

Figure 16. Bottom Layer

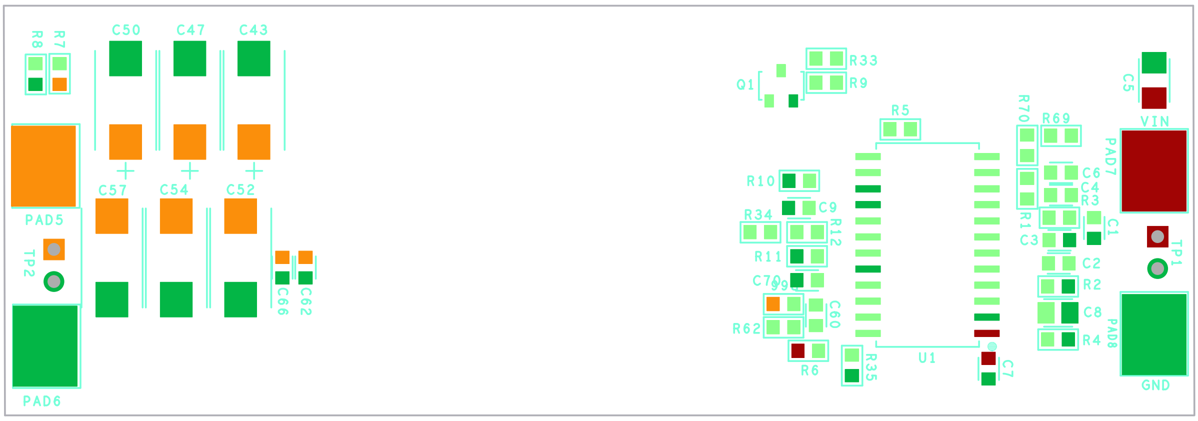

Figure 17. Silkscreen Bottom Layer

3. Typical Performance Graphs

Unless otherwise noted, V_{OUT} = 1V; L_{OUT} = 220nH, C_{OUT} = 2.64mF, C_{DROOP} = 56nF, C_{VREF} = 100nF, R_{DROOP} = 604Ω, R_{FS} = 94.2kΩ, C_{SS} = 22nF, C_{COMP} = 8.2nF, R_{COMP} = 4.22kΩ, C_{POLE} = 330pF, C_{VCC}= 1µF, R_{SLP} = 34.8kΩ, C_{SLP} = 100pF, T_A = +25°C

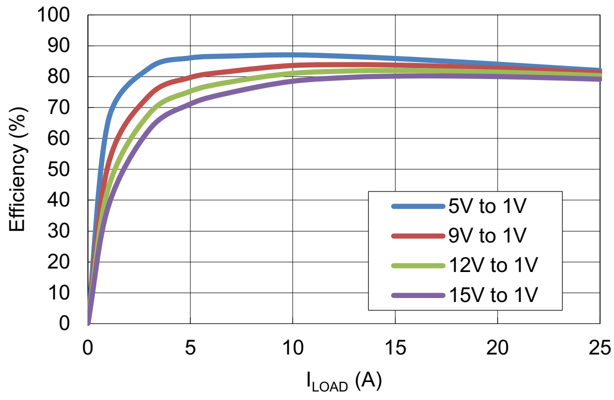

Figure 18. Conversion Efficiency for Various V_{IN} (f_{SW} = 500kHz)

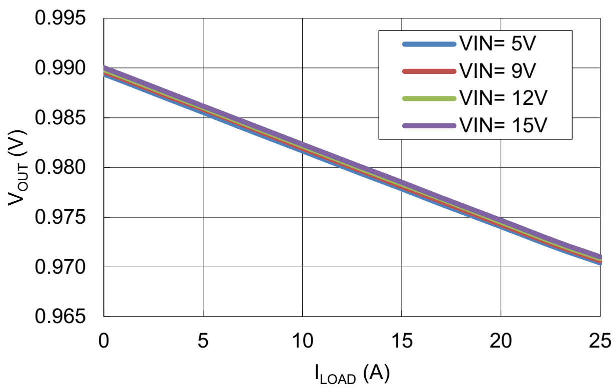

Figure 19. Droop Regulation for Various V_{IN}

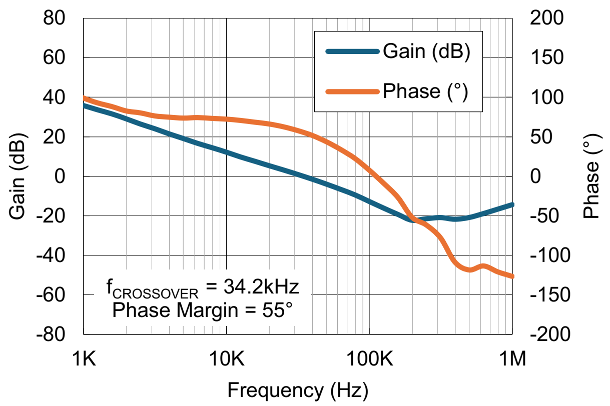

Figure 20. Gain and Phase vs Frequency (V_{IN} = 5V, I_{LOAD} = 0A, f_{SW} = 500kHz)

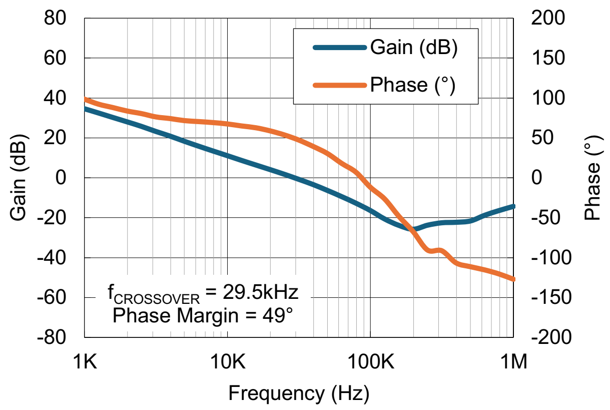

Figure 21. Gain and Phase vs Frequency (V_{IN} = 12V, I_{LOAD} = 0A, f_{SW} = 500kHz)

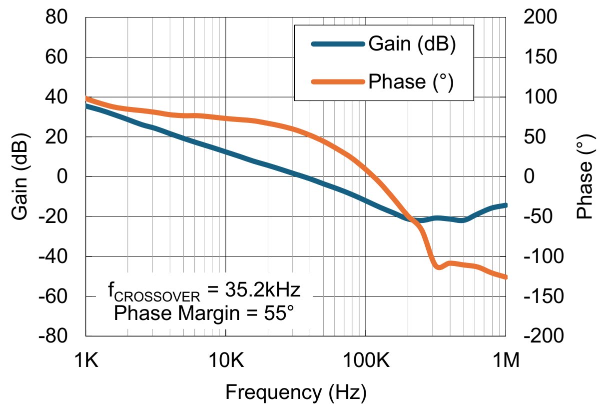

Figure 22. Gain and Phase vs Frequency (V_{IN} = 5V, I_{LOAD} = 12.5A, f_{SW} = 500kHz)

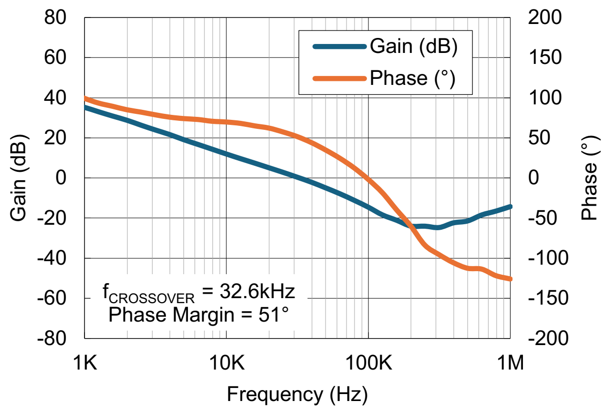

Figure 23. Gain and Phase vs Frequency (V_{IN} = 12V, I_{LOAD} = 12.5A, f_{SW} = 500kHz)

Unless otherwise noted, V_{OUT} = 1V; L_{OUT} = 220nH, C_{OUT} = 2.64mF, C_{DROOP} = 56nF, C_{VREF} = 100nF, R_{DROOP} = 604Ω, R_{FS} = 94.2kΩ, C_{SS} = 22nF, C_{COMP} = 8.2nF, R_{COMP} = 4.22kΩ, C_{POLE} = 330pF, C_{VCC}= 1µF, R_{SLP} = 34.8kΩ, C_{SLP} = 100pF, T_A = +25°C

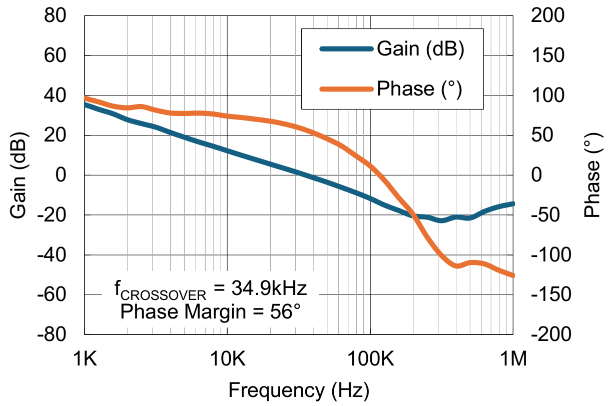

Figure 24. Gain and Phase vs Frequency (V_{IN} = 5V, I_{LOAD} = 25A, f_{SW} = 500kHz)

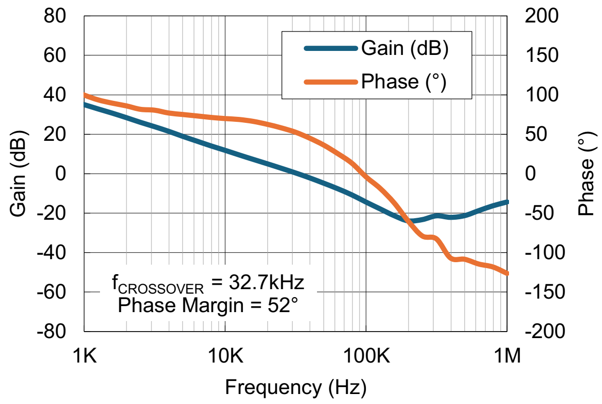

Figure 25. Gain and Phase vs Frequency (V_{IN} = 12V, I_{LOAD} = 25A, f_{SW} = 500kHz)

4. Ordering Information

Part Number	Description
ISL73847MDEMO2Z	ISL73847M demonstration board

5. Revision History

Revision	Date	Description
1.01	May 13, 2024	Added Figures 20 through 25.
1.00	Sep 27, 2023	Initial release

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