

ISL73847MDEMO1Z

The ISL73847MDEMO1Z demonstration board demonstrates the performance of the [ISL73847M](#) dual-phase buck controller. The board is optimized for a 4.5V to 15V input operation to generate a 50A max, 1V output.

Features

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

Specifications

- Input voltage supply (V_{IN}): 4.5V to 15V
- Preset output voltage (V_{OUT}): 1V
- Preset switching frequency: 500kHz
- Maximum load current: 50A
- Preset droop regulation

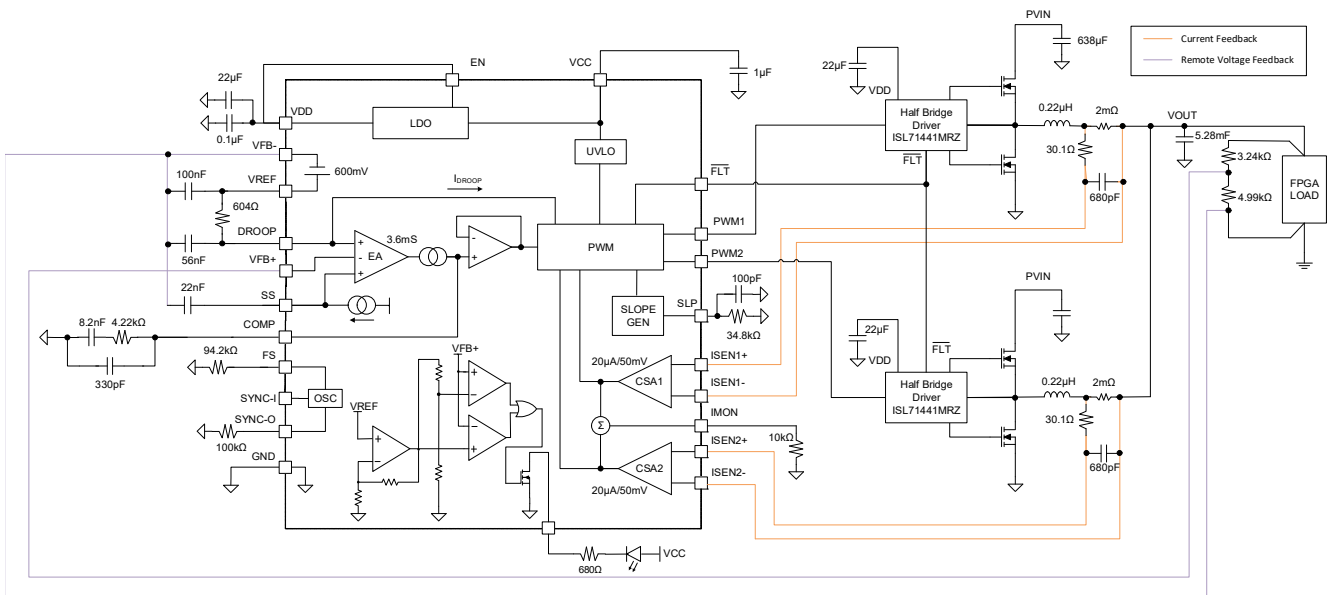


Figure 1. ISL73847MDEMO1Z Block Diagram

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1. Functional Description

1.1 Operating Range

The ISL73847MDEMO1Z 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 onboard buck power supply input. You can set the V_{IN} 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 0.22 μ H output inductor and 2.64mF output capacitance per phase with the option of being synchronized to an external clock using SYNC-I.

1.2 Before Starting

The board does not come with any connectors. To properly use the board, you must solder connectors to the V_{IN} , GND, and V_{OUT} solder pads.

1.3 Quick-Start Guide

1. Apply a 4.5V to 15V voltage to V_{IN} 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 V_{OUT} connectors, as shown in Figure 2. To use 4w sense lines from an electronic load, solder a jumper to TP2.

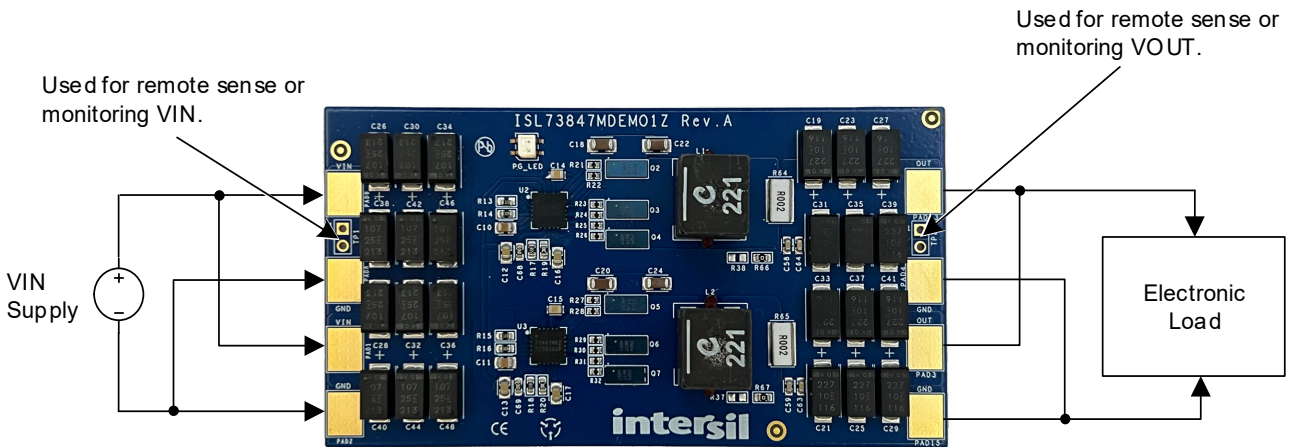


Figure 2. ISL73847MDEMO1Z Board Setup

1.4 Changing the Switching Frequency

The ISL73847MDEMO1Z 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 output capacitance per phase, 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*.

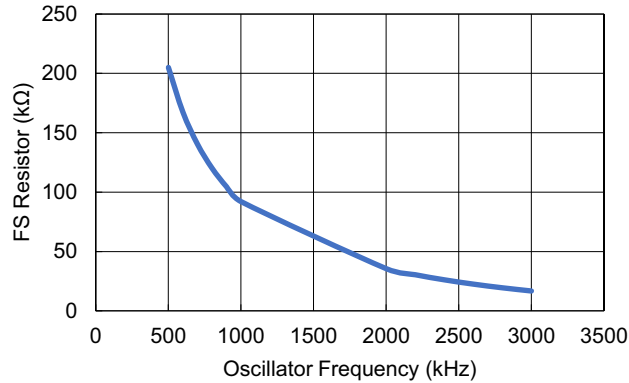


Figure 3. R_{FS} vs Frequency

1.5 Soft-Start Adjustment

The ISL73847MDEMO1Z 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 you must select a different soft-start time, use [Equation 1](#) to calculate the capacitance given the required soft-start time. For more information on SS, refer to the *ISL73847M datasheet*.

$$(EQ. 1) \quad C_{SS} = \frac{t_{SS} \times 1 \times 10^{-5}}{V_{REF}}$$

where:

- C_{SS} is the soft-start capacitance in Farads
- t_{SS} is the required soft-start time in seconds
- V_{REF} is the reference voltage, which is nominally 0.6V

1.6 Droop Regulation

The ISL73847MDEMO1Z 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 IMON

The ISL73847MDEMO1Z monitors the average current through the inductor as a voltage on the IMON pin. A 10kΩ pull-down resistor (R_{10}) is connected to the IMON pin. A 100pF bypass capacitor is added in parallel to R_{10} to improve averaging. For more information about the IMON pin, refer to the *ISL73847M datasheet*.

1.8 Enabling/Disabling

The ISL73847MDEMO1Z automatically enables when VDD reaches a certain voltage on power-up by a 4.99kΩ resistor (R₆) connected between EN and VDD. For more information about enabling and disabling the controller, refer to the *ISL73847M datasheet*.

2. Board Design

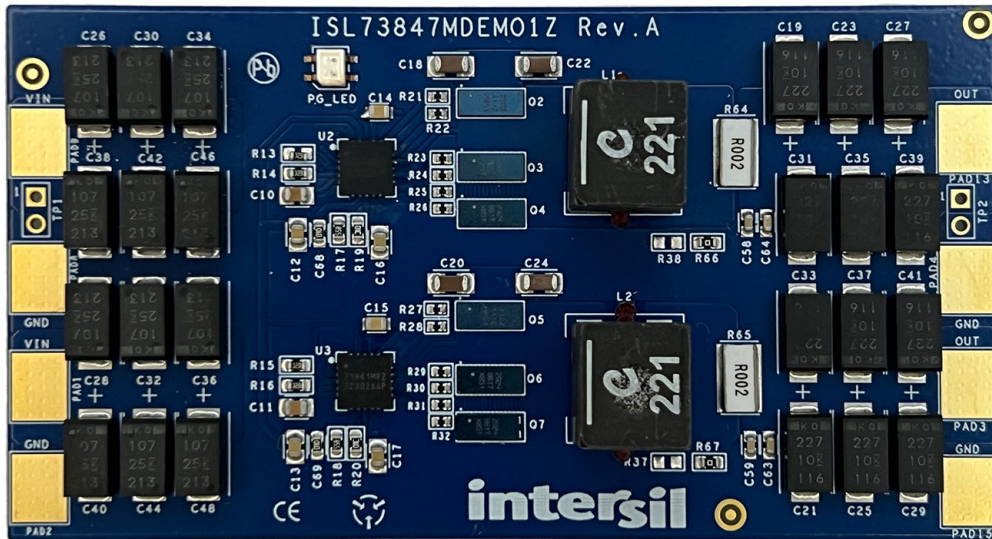


Figure 4. ISL73847MDEMO1Z Evaluation Board (Top)

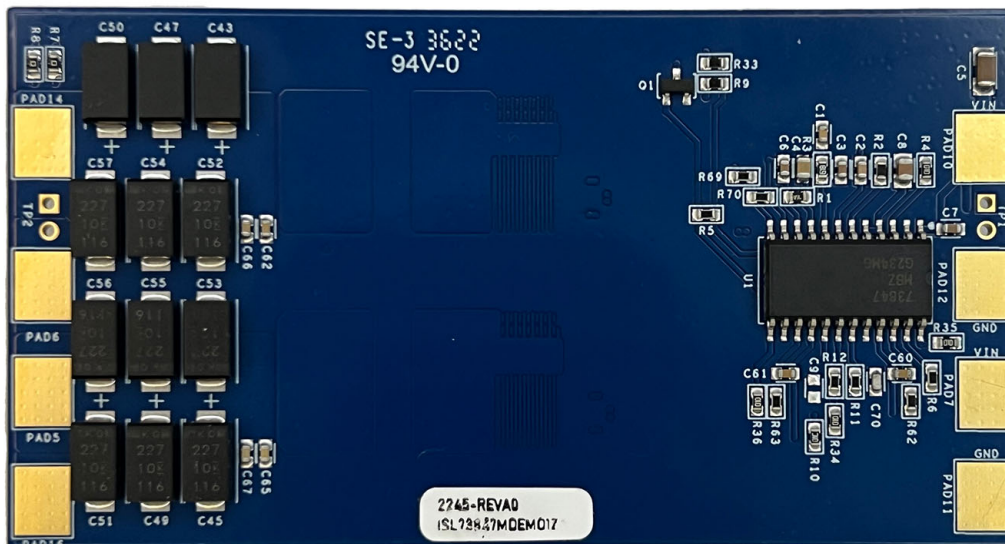


Figure 5. ISL73847MDEMO1Z Evaluation Board (Bottom)

2.1 Layout Guidelines

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

2.2 Schematic Diagrams

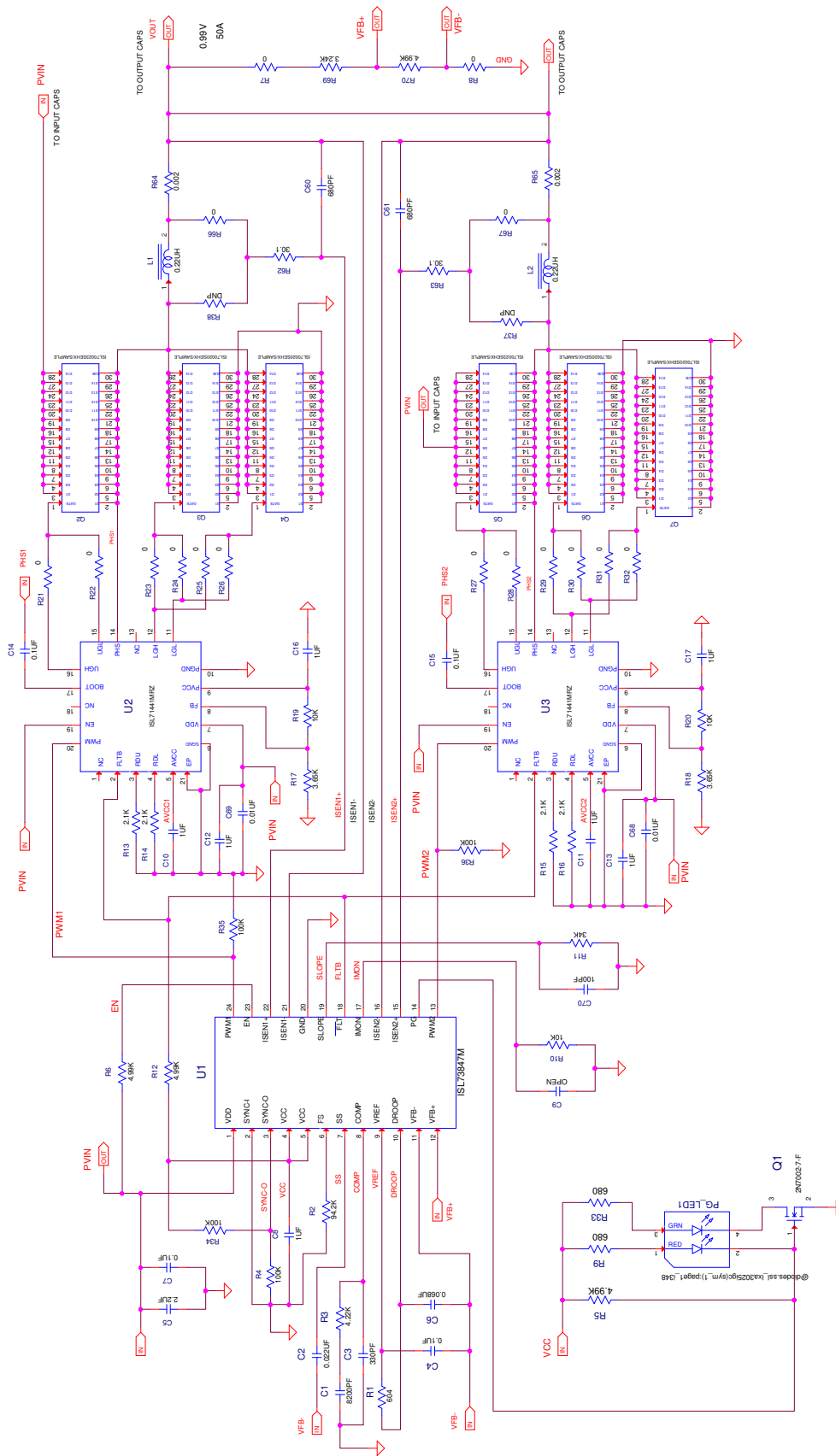
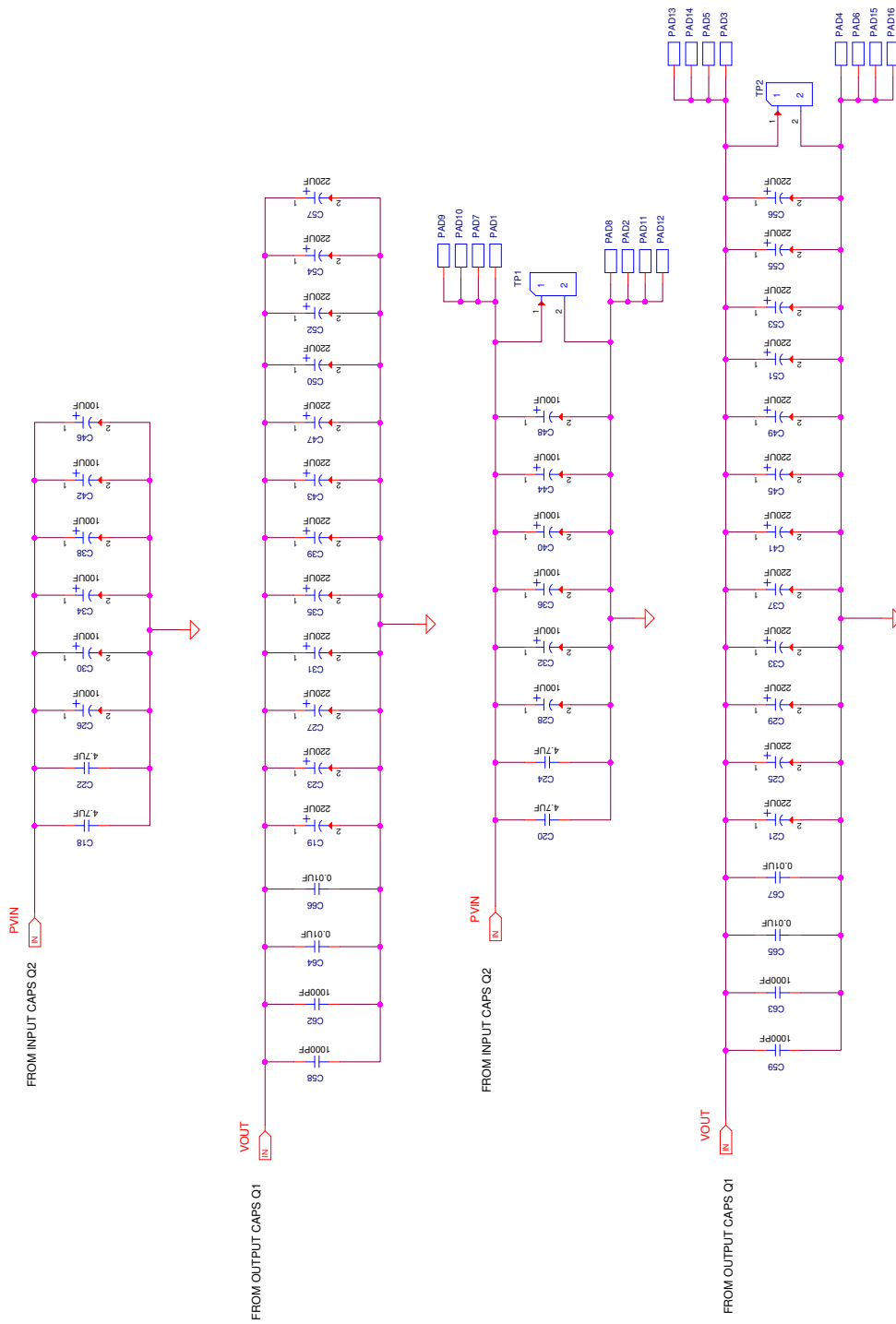


Figure 6. ISL73847MDEMO1Z Schematic (Page 1)



2.3 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1		PWB-PCB, ISL73847MDEMO1Z, REVB, ROHS	Imagineering Inc	ISL73847MDEMO1ZREVBPCB
1	C6	CAP, SMD, 0603, 0.056 μ F, 50V, 10%, X7R, ROHS	Kemet	C0603X563K5RAC7867
3	C8, C10, C11	CAP, SMD, 0805, 1.0 μ F, 25V, 10%, X7R, ROHS	TDK	C2012X7R1E105K
1	C5	CAP-AEC-Q200, SMD,1206, 2.2 μ F, 25V, 10%, X7R, ROHS	Murata	GCJ31MR71E225KA12L
1	C70	CAP, SMD, 0603, 100pF, 25V, 10%, X7R, ROHS	Kemet	C0603C101K3RAC7867
4	C58, C59, C62, C63	CAP, SMD, 0603, 1000pF, 16V, 10%, X7R, ROHS	Venkel	C0603X7R160102KNE
4	C64-C67	CAP, SMD, 0603, 0.01 μ F, 16V, 10%, X7R, ROHS	Venkel	C0603X7R160-103KNE
2	C68, C69	CAP, SMD, 0603, 0.01 μ F, 25V, 10%, X7R, ROHS	Venkel	C0603X7R250-103KNE
3	C4, C14, C15	CAP, SMD, 0603, 0.1 μ F, 25V, 10%, X7R, ROHS	Yageo	CC0603KRX7R8BB104
1	C7	CAP, SMD, 0603, 0.1 μ F, 50V, 10%, X7R, ROHS	AVX	06035C104KAT2A
1	C2	CAP, SMD, 0603, 0.022 μ F, 16V, 10%, X7R, ROHS	Venkel	C0603X7R160-223K
1	C3	CAP, SMD, 0603, 330pF, 50V, 10%, X7R, ROHS	Yageo	CC0603KRX7R8BB104
2	C60, C61	CAP, SMD, 0603, 680pF, 50V, 10%, X7R, ROHS	Murata	GRM188R71H681KA01D
1	C9	CAP, SMD, 0603, DNP- PLACE HOLDER, ROHS		
4	C12, C13, C16, C17	CAP, SMD, 0805, 1.0 μ F, 25V, 10%, X5R, ROHS	AVX	08053D105KAT4A
24	C19, C21, C23, C25, C27, C29, C31, C33, C35, C37, C39, C41, C43, C45, C47, C49, C50, C51, C52, C53, C54, C55, C56, C57	CAP-TANT, SMD, 7.3 \times 4.3 \times 2.8, 220 μ F, 10V, 20%, 6m Ω , ROHS	Kemet	T521X107M025ATE030
1	C1	CAP, SMD, 0603, 8200pF, 50V, 5%, X7R, ROHS	Vishay/Vitramon	VJ0603Y822JXACW1BC
2	L1, L2	COIL-PWR INDUCT, AEC- Q200, SMD, 11.3 \times 10mm, 0.22 μ H, 20%, 98.8A, ROHS	Coilcraft	XAL1010-221MEB
1	PG_LED	LED, SMD, 3 \times 2.5mm, 4P, RED/GREEN, 12/20MCD, 2V	Lumex	SSL-LXA3025IGC-TR

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
4	Q3, Q4, Q6, Q7	TRANSISTOR, RAD HARD, 40V GAN FET, 4P, CLCC, ROHS	Renesas Electronics	ISL70020SEHX/SAMPLE
2	Q2, Q5	IC-PROTO, RAD-HARD, 100V, GAN FET, 4P, CLCC, ROHS	Renesas Electronics	ISL70023SEHX/SAMPLE
2	U2, U3	IC-GAN FET DRIVER, HALF-BRIDGE, 20P, QFN, ROHS	Renesas Electronics	ISL71441MRZ
1	U1	IC-RAD LIGHT BUCK CONTROLLER, 24P, FP, ROHS	Renesas Electronics	ISL73847MBZ
1	Q1	TRANSISTOR, N-CHANNEL, 3LD, SOT-23, 60V, 115mA, ROHS	Diodes, Inc.	2N7002-7-F
12	R21-R32	RES-AEC-Q200, SMD, 0402, 0Ω, 1/16W, TF, ROHS	Vishay/Dale	CRCW04020000Z0ED
2	R9, R33	RES-AEC-Q200, SMD, 0603, 680Ω, 1/10W, 1%, TF, ROHS	Vishay/Dale	CRCW0603680RFKEA
2	R19, R20	RES, SMD, 0402, 10K, 1/16W, 1%, TF, ROHS	Panasonic	ERJ-2RKF1002X
2	R17, R18	RES, SMD, 0402, 3.65K, 1/16W, 1%, TF, ROHS	Panasonic	ERJ-2RKF3651
2	R7, R8	RES, SMD, 0603, 0Ω, 1/10W, TF, ROHS	Venkel	CR0603-10W-000T
1	R10	RES, SMD, 0603, 10K, 1/10W, 1%, TF, ROHS	Venkel	CR0603-10W-1002FT
4	R4, R34-36	RES, SMD, 0603, 100K, 1/10W, 1%, TF, ROHS	Venkel	CR0603-10W-1003FT
4	R13-R16	RES, SMD, 0603, 2.1K, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-3EKF2101V
2	R62, R63	RES, SMD, 0603, 30.1Ω, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-0730R1L
1	R69	RES, SMD, 0603, 3.24K, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-3EKF3241V
1	R11	RES, SMD, 0603, 34.8K, 1/10W, 1%, TF, ROHS	Venkel	CR0603-10W-3482FT
1	R3	RES, SMD, 0603, 4.22K, 1/10W, 1%, TF, ROHS	Rohm	MCR03EZPF4221
4	R5, R6, R12, R70	RES, SMD, 0603, 4.99K, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-3EKF4991V
1	R1	RES, SMD, 0603, 604Ω, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-3EKF6040V
1	R2	RES, SMD, 0603, 94.2K, 1/10W, 0.1%, THINFILM, ROHS	Yageo	RT0603BRD0794K2L

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
4	Four corners	BUMPONS,0.44inWx0.20in H,CYLINDRICAL DOME,BLK,ROHS	3M	SJ-5003 (BLACK)
0	TP1, TP2	DNP		

2.4 Board Layout

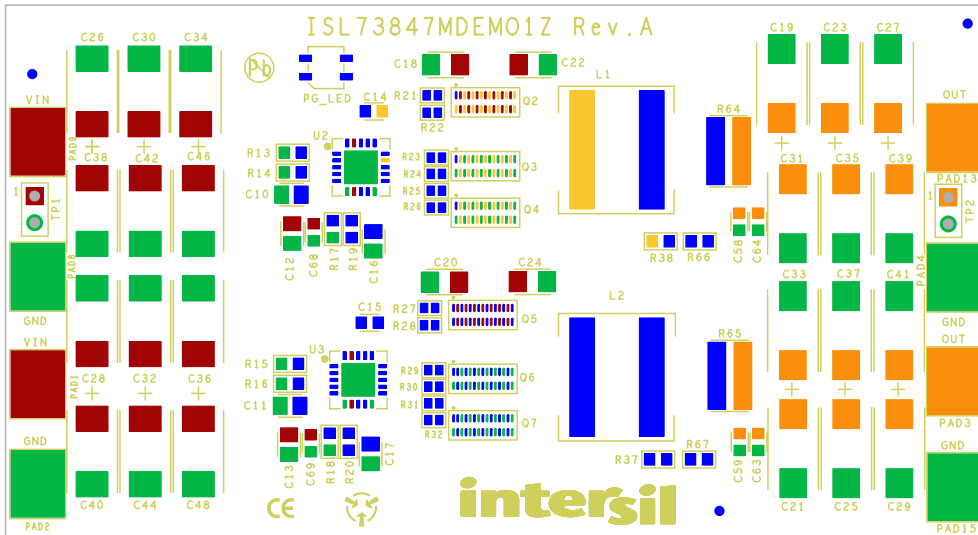


Figure 8. Silkscreen Top Layer

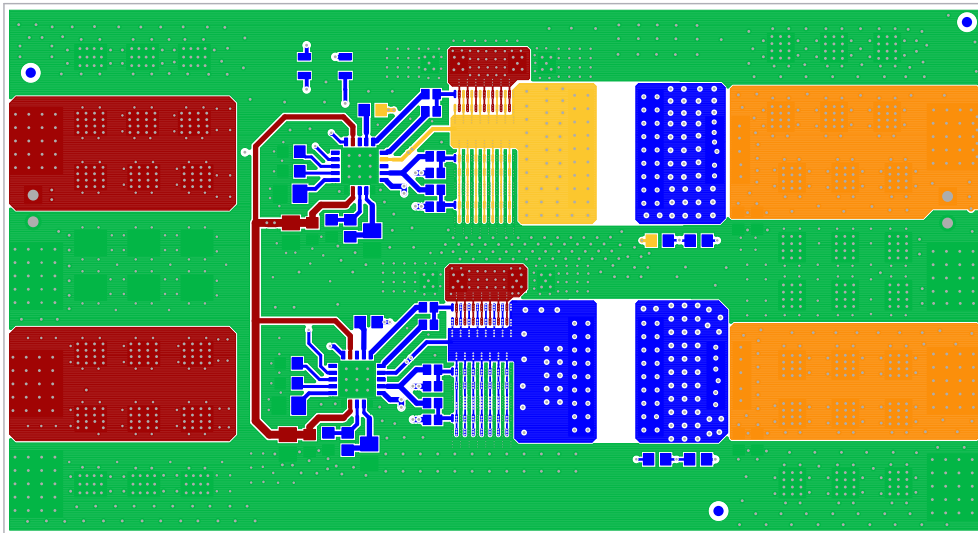


Figure 9. Top Layer

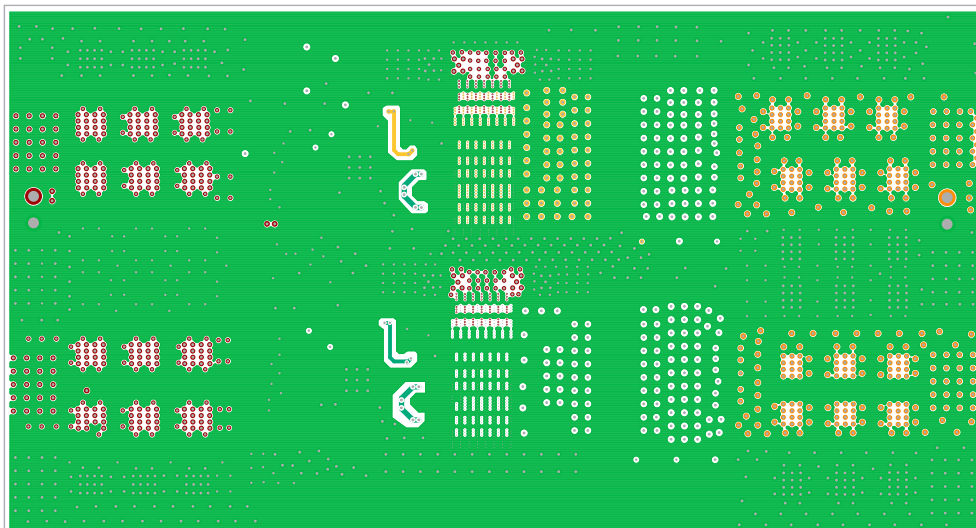


Figure 10. Layer 2

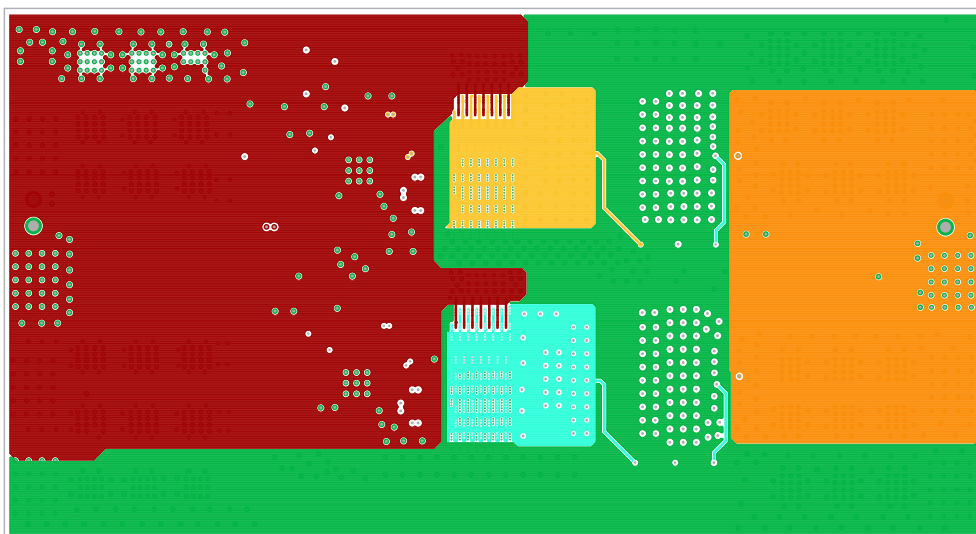


Figure 11. Layer 3

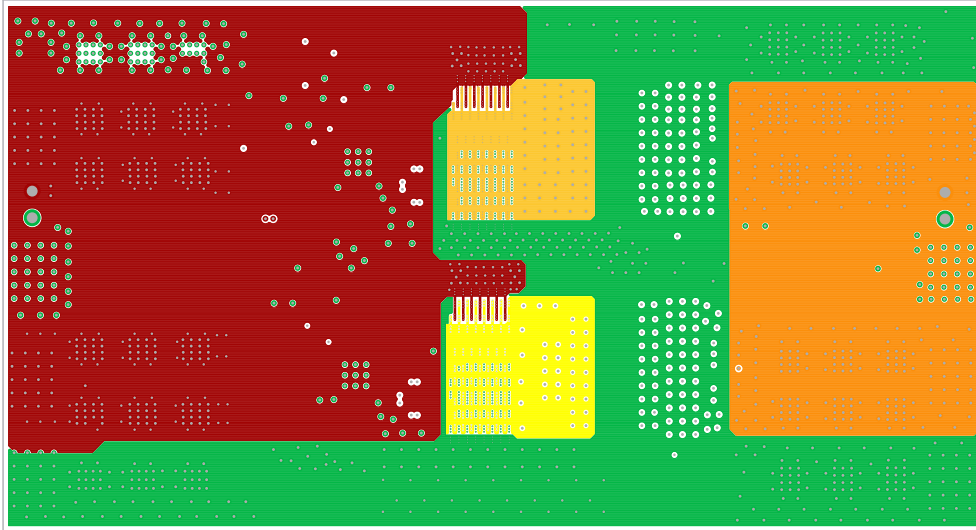


Figure 12. Layer 4

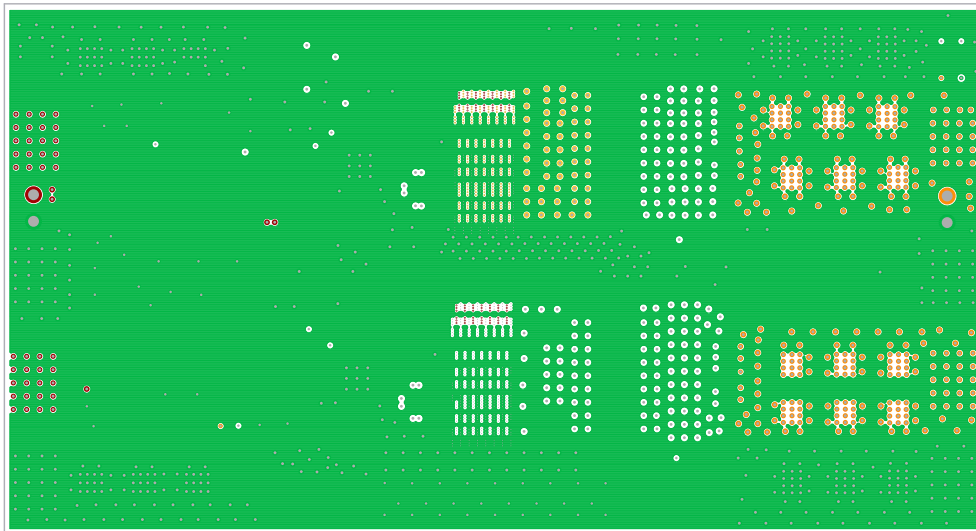


Figure 13. Layer 5

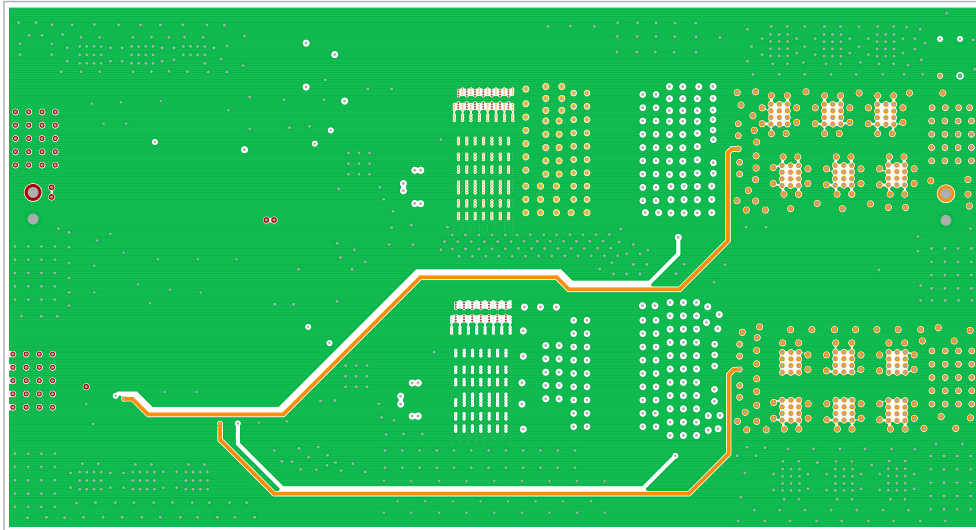


Figure 14. Layer 6

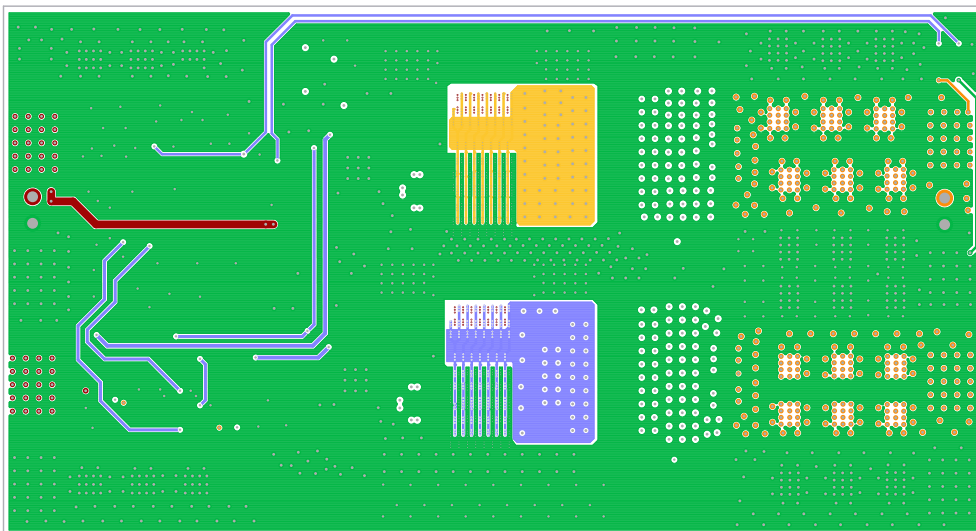


Figure 15. Layer 7

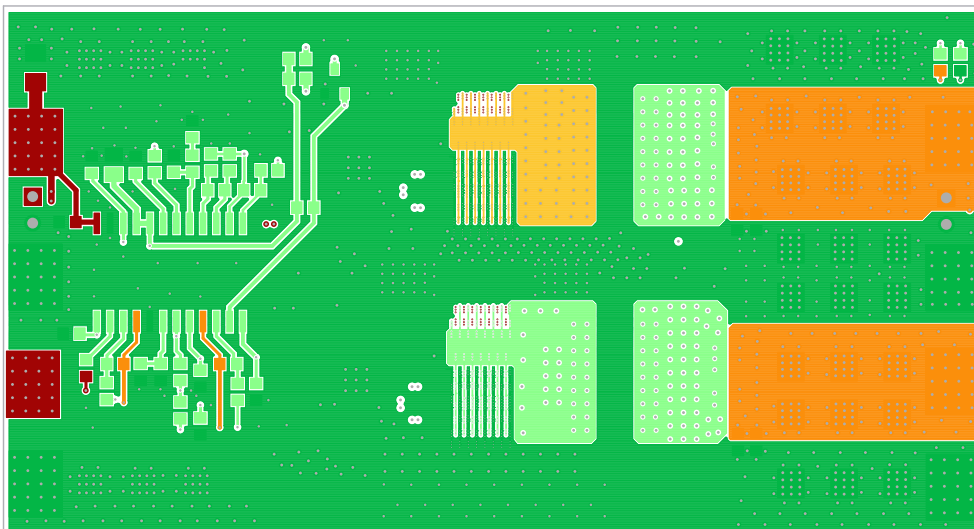


Figure 16. Bottom Layer

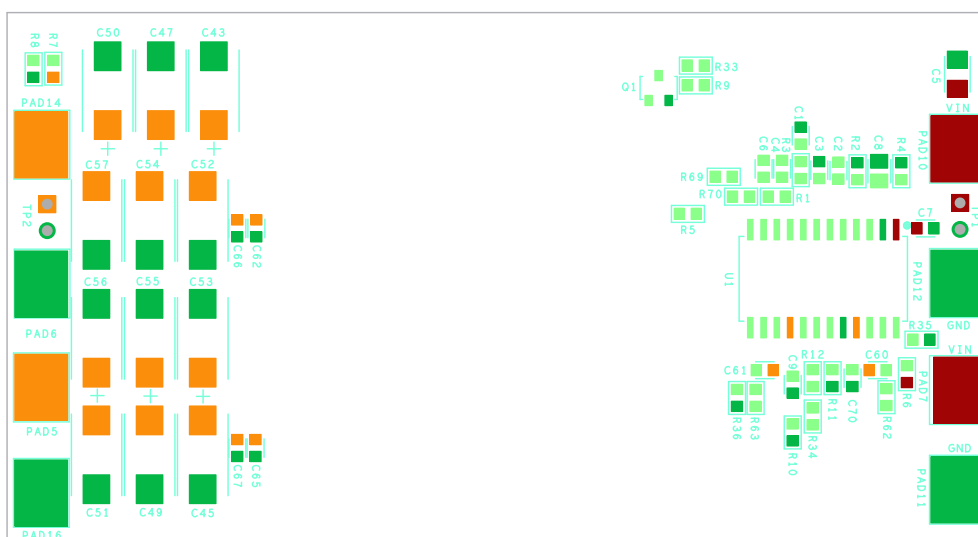


Figure 17. Silkscreen Bottom Layer

3. Typical Performance Graphs

Unless otherwise noted, $V_{OUT} = 1V$; $L_{OUT} = 220nH$ per phase, $C_{OUT} = 2.64mF$ per phase, $C_{DROOP} = 56nF$, $C_{VREF} = 100nF$, $R_{DROOP} = 0\Omega$, $R_{FS} = 94.2k\Omega$, $C_{SS} = 22nF$, $C_{COMP} = 8.2nF$, $R_{COMP} = 4.22k\Omega$, $C_{POLE} = 330pF$, $C_{VCC} = 1\mu F$, $R_{SLP} = 34.8k\Omega$, $C_{SLP} = 100pF$, $T_A = +25^\circ C$

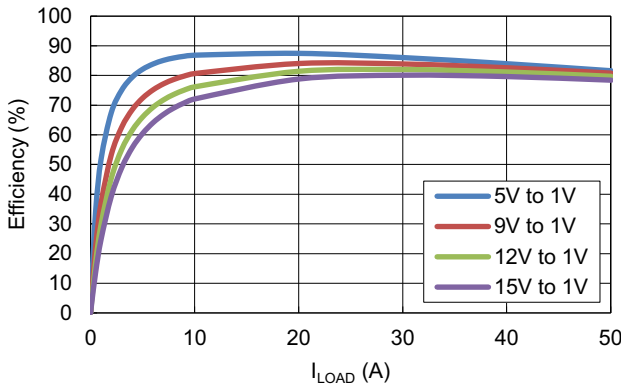


Figure 18. Conversion Efficiency for Various V_{IN}
 ($f_{SW} = 500kHz$, ISL70020SEHX, ISL70023SEHX,
 XAL1010-221ME)

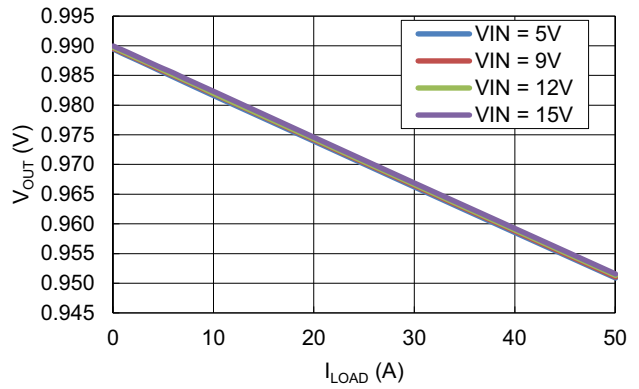
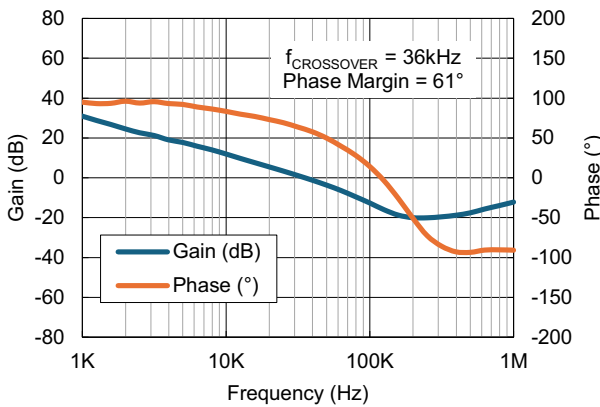
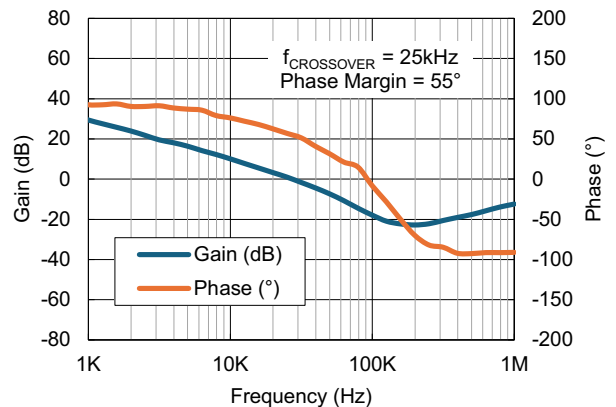


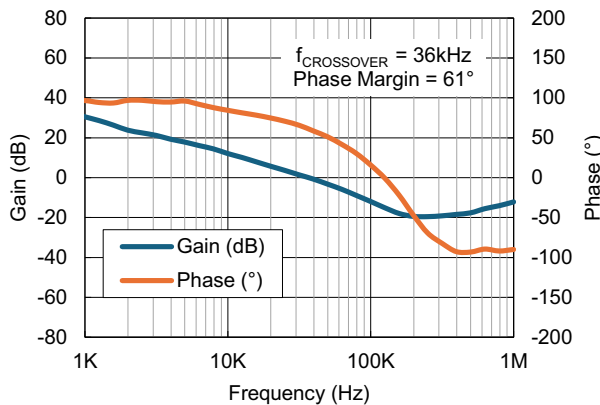
Figure 19. Droop Regulation for Various V_{IN}
 ($R_{DROOP} = 604\Omega$)



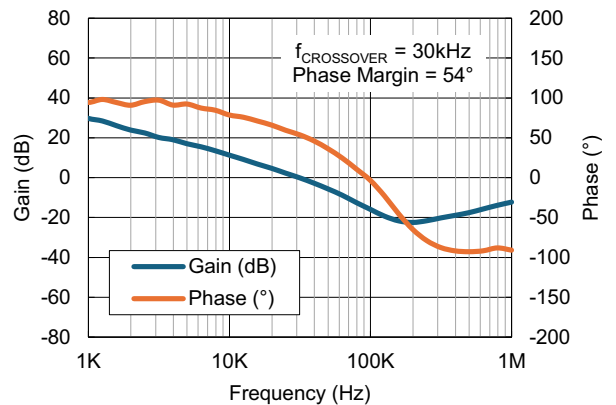
**Figure 20. Gain and Phase vs Frequency ($V_{IN} = 5V$,
 $I_{LOAD} = 0A$, $f_{SW} = 500kHz$)**



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



**Figure 22. Gain and Phase vs Frequency ($V_{IN} = 5V$,
 $I_{LOAD} = 25A$, $f_{SW} = 500kHz$)**



**Figure 23. Gain and Phase vs Frequency ($V_{IN} = 12V$,
 $I_{LOAD} = 25A$, $f_{SW} = 500kHz$)**

Unless otherwise noted, $V_{OUT} = 1V$; $L_{OUT} = 220nH$ per phase, $C_{OUT} = 2.64mF$ per phase, $C_{DROOP} = 56nF$, $C_{VREF} = 100nF$, $R_{DROOP} = 0\Omega$, $R_{FS} = 94.2k\Omega$, $C_{SS} = 22nF$, $C_{COMP} = 8.2nF$, $R_{COMP} = 4.22k\Omega$, $C_{POLE} = 330pF$, $C_{VCC} = 1\mu F$, $R_{SLP} = 34.8k\Omega$, $C_{SLP} = 100pF$, $T_A = +25^\circ C$ (Cont.)

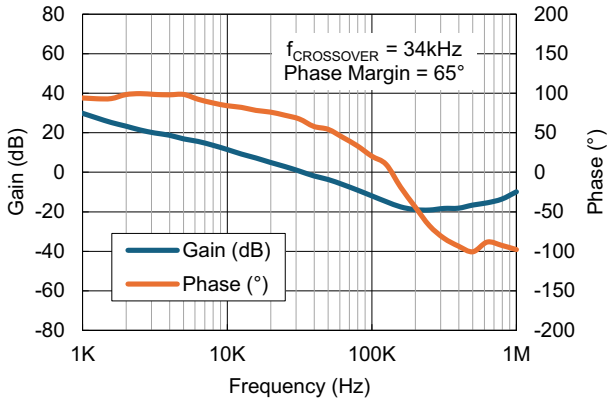


Figure 24. Gain and Phase vs Frequency ($V_{IN} = 5V$, $I_{LOAD} = 50A$, $f_{SW} = 500kHz$)

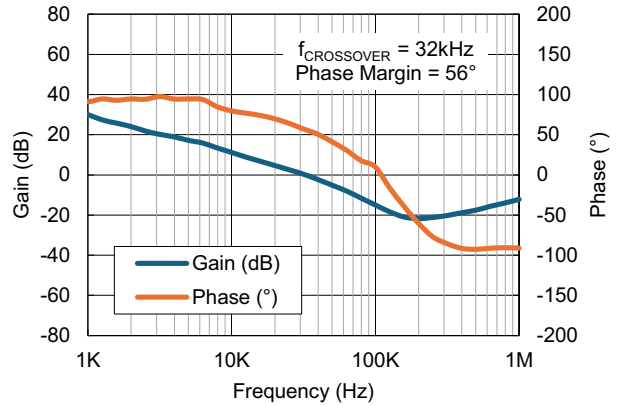


Figure 25. Gain and Phase vs Frequency ($V_{IN} = 12V$, $I_{LOAD} = 50A$, $f_{SW} = 500kHz$)

4. Ordering Information

Part Number	Description
ISL73847MDEMO1Z	ISL73847M demonstration board

5. Revision History

Revision	Date	Description
1.01	May 13, 2024	Added Figures 20 through 25.
1.00	Apr 14, 2023	Initial release

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