EVL4248-QV-00A

36V, 140W, Buck-Boost with Integrated Low-Side MOSFETs, Supports High-Side Current Sense and I²C Evaluation Board

DESCRIPTION

The EVL4248-QV-00A evaluation board is designed to demonstrate the capabilities of the MP4248, a buck-boost converter with two low-side MOSFETs (LS-FETs). The device can deliver up to 140W of peak output power (P_{OUT}) at certain input-supply range with excellent efficiency.

The MP4248 is well-suited for USB power delivery (PD) applications. It can work with an external USB PD controller through the I²C interface.

It is recommended to read the MP4248 datasheet prior to making any changes to the EVL4248-QV-00A.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C, unless otherwise noted.

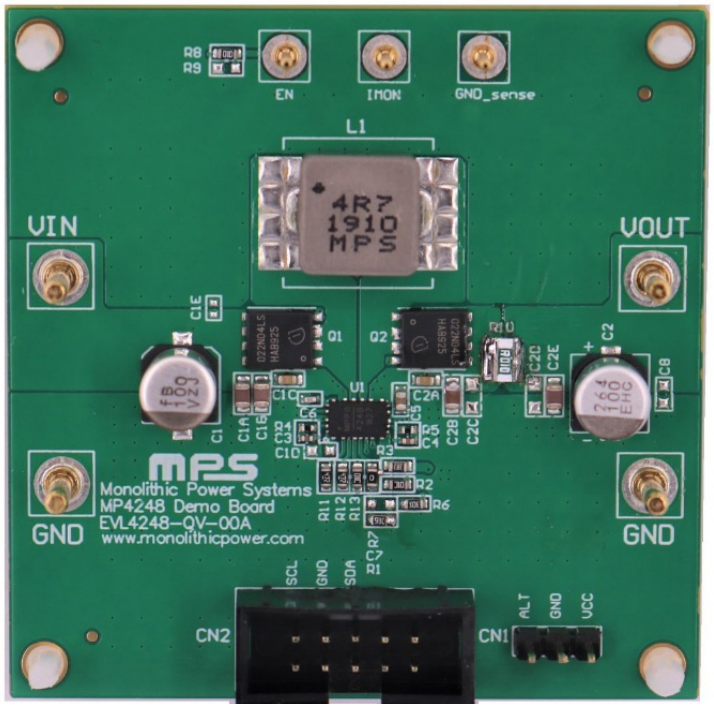
Parameters	Conditions	Value
Input voltage (V_{IN}) range (2)		3.6V to 36V
Output voltage (V_{OUT})	V_{IN} = 3.6V to 36V, I_{OUT} = 0A to 5A	V_{OUT} = 5V
Maximum output current (I_{OUT})		7A (1)
Typical efficiency	V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 5A	94.35%
Peak efficiency	V_{IN} = 12V, V_{OUT} = 15V, I_{OUT} = 2.5A	97.97%
Switching frequency (f_{SW})		420kHz

Notes:

1) The default output current (I_{OUT}) limit is 5.4A, and the resistor (R_{SENS}) must be reduced or shorted to output a 7A current.
2) If V_{IN} > 19V, the device can support 28V/5A, with a 140W output.

MPL Optimized Performance with MPS Inductor MPL-AL1050 Series

EVL4248-QV-00A EVALUATION BOARD



LxWxH (60mmx60mmx10mm)

4 Layers: 2oz/1oz/1oz/2oz

Board Number	MPS IC Number
EVL4248-QV-00A	MP4248GQV-0000

QUICK START GUIDE

1. Preset the power supply (V_{IN}) to 12V, then turn off the power supply.
2. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
3. Connect the electronic load terminals to:
   a. Positive (+): VOUT
   b. Negative (-): GND
4. After making the connections, turn on the power supply.
5. The output voltage (V_{OUT}) should start up automatically after start-up.
6. To modify the MP4248's register setting, connect the EVL4248-QV-00A to the USB-to-I²C communication kit (EVKT-USBI2C-02). Use Virtual Bench Pro 4.0 to read and write to the I²C registers.
7. If the MP4248's silicon die temperature exceeds 160°C, over-temperature protection (OTP) is triggered and the entire chip shuts down. Once the temperature falls below 140°C, the chip is enabled again and resumes normal operation.
8. Figure 1 shows the measurement equipment set-up.

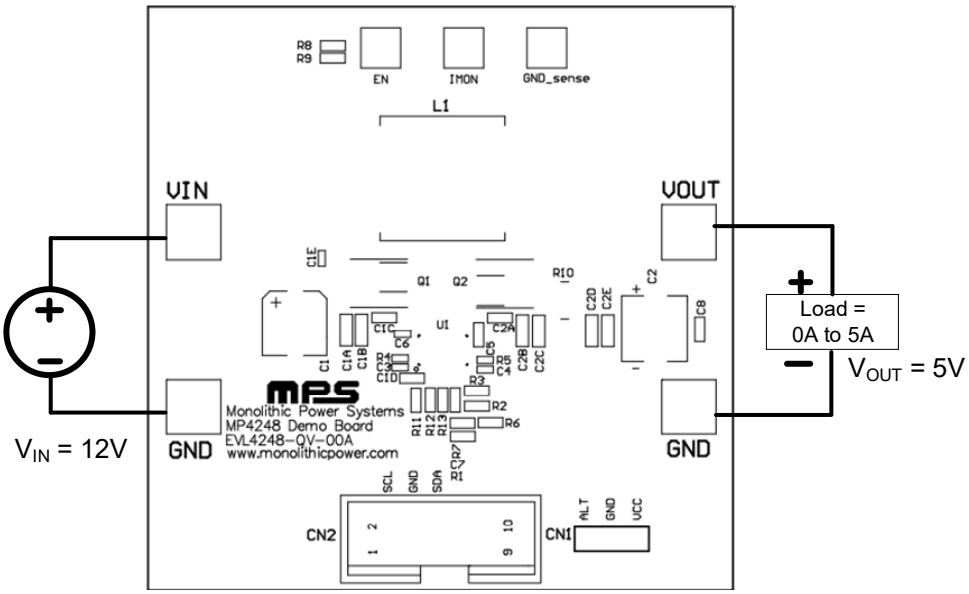


Figure 1: Measurement Equipment Set-Up

MP4248GQV-0000 CONFIGURATION TABLE

OTP Items	Description	Value
OPERATION	Turns the device on or off.	1: On
VOUT_COMMAND	Sets the output voltage (V_{OUT}).	V_{REF} = 0.5V
DITHER_ENABLE	Enables frequency spread spectrum (FSS).	0: Disabled
FREQ	Sets the switching frequency (f_{SW}).	01: 420kHz
SWA_FET_RON	Sets switch A's (SWA) on resistance.	01: 10mΩ
OUTPUT_OVP_EN	Enables output over-voltage protection (OVP).	1: Enabled (default)
OUTPUT_DISCHARGE_EN	Enables the output discharge function during the V_{IN}, I²C, or EN off period.	1: Enabled (default)
PFM/PWM_MODE	Selects automatic pulse-frequency modulation (PFM) / pulse-width modulation (PWM) mode or forced PWM mode.	1: Forced PWM mode (default)
CONSTANT_ CURRENT_LIMIT	Sets the output current (I_{OUT}) limit.	5.4A
LINE_DROP_ COMPENSATION	Enables line drop compensation.	0: Enable line drop compensation (default)
LINE_DROP_ COMPENSATION	Sets the V_{OUT} compensation value vs. the load current.	00: No compensation (default)
SWITCHING_ CURRENT_LIMIT	Sets switch B's (SWB) valley current limit and switch C's (SWC) peak current limit.	01: SWC peak 12A / SWB valley 9A (default)
RSENS	Selects the R_{SENS} value.	0: 5mΩ
SLEW_RATE_RISE	Sets the V_{OUT} rising slew rate.	01: 0.16mV/μs (default)
SLEW_RATE_FALL	Sets the V_{OUT} falling slew rate.	01: 0.04mV/μs
FREQ_MODE	Sets the frequency for buck-boost mode.	Reduce frequency to half of that in buck and boost mode (default)
CC_DISABLE	Enables the CC function.	0: Enable CC (default)
CC_BLANK_TIMER	Sets the blanking time before entering CC mode.	00: 250μs (default)
VIN_OV_THRESHOLD	Selects the input voltage (V_{IN}) OV threshold.	0: 38V
VIN_UVLO_THRESHOLD	Selects the V_{IN} under-voltage lockout (UVLO) threshold.	0: 3.3V
ABSOLUTE_OUTPUT_OVP	Selects the absolute OVP threshold.	1: 38.5V
OT-WARNING_FUNCTION	Enables the over-temperature (OT) warning function.	1: Disabled
I2C_ADDRESS	Sets the I²C slave address.	67h
VOUT_MSK	Masks ALT pin indication.	1: Mask
IOUT/POUT_MSK		0: No mask
RESERVED_MSK		1: Mask
TEMP_MSK		1: Mask
PG_STATUS#_MSK		1: Mask
PG_ALT_EDGE_MSK		1: Mask
GND_SHORT_ VBATT_MSK		1: Mask
UNKNOWN_MSK		1: Mask

EVALUATION BOARD SCHEMATIC

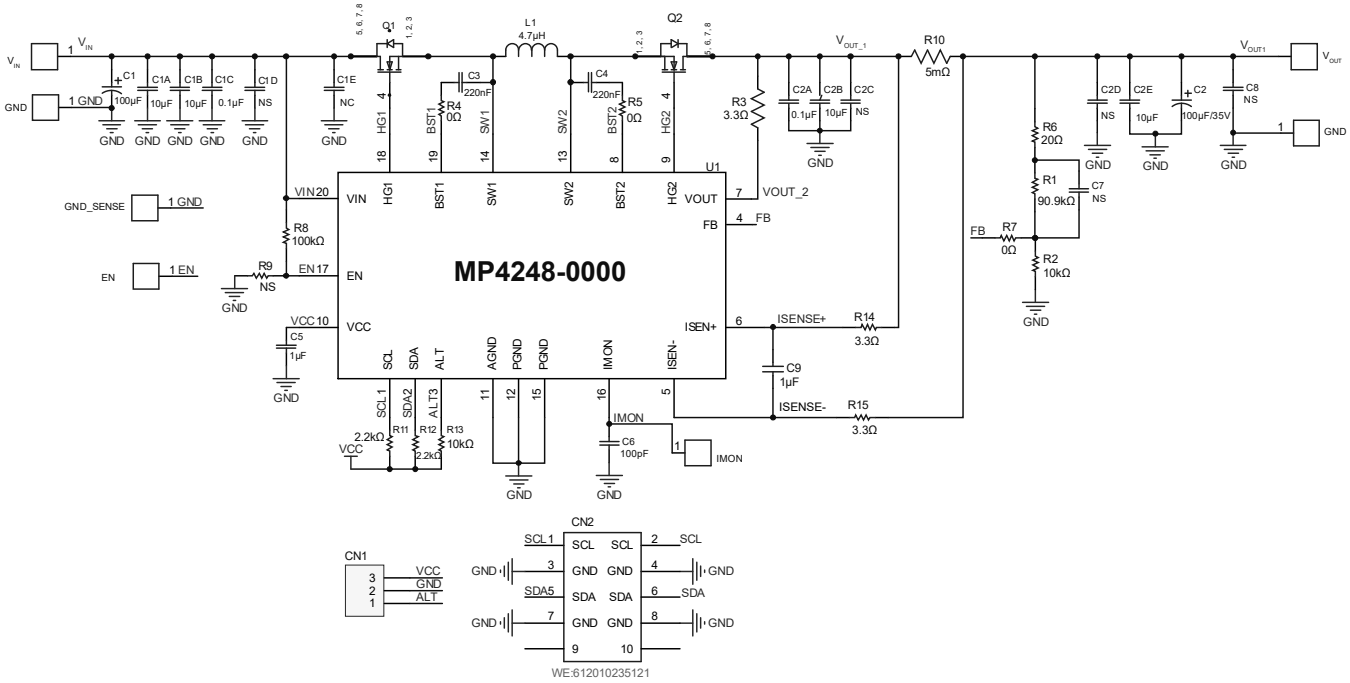


Figure 2: Typical Application Circuit (V_{IN} = 12V, V_{OUT} = 3.3V to 21V/5A, Default On)

EVL4248-QV-00A BILL OF MATERIALS (3)

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	C1	100µF	100µF, 35V	SMD	Nippon Chemi-Con	EMZJ350ARA101MF80G
1	C2	100µF	35V, hybrid, 35mΩ	SMD	Panasonic	EEHZK1V101XP
2	C1C, C2A	100nF	Ceramic capacitor, 50V, X7R	0603	Samsung	CL10B104KB8NNNC
4	C1A, C1B, C2B, C2E	10µF	Ceramic capacitor, 50V, X5R	0805	Murata	GRM21BR61H106KE43L
2	C3,C4	220nF	Ceramic capacitor, 16V, X7R	0402	Wurth	885012105017
0	C1E ,C7, R9, C1D, C2D,	NS				
1	C5	1µF	Ceramic capacitor, 10V, X7R	0603	Wurth	885012206026
1	C6	100pF	Ceramic capacitor, 25V, X7R	0402	Murata	GRM1555C1E101JA01D
1	C9	1µF	Ceramic capacitor, 10V, X5R	0402	Wurth	885012105012
1	R1	90.9kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0790K9L
2	R2, R13	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	R3	3.3Ω	Film resistor, 1%	0603	Yageo	RC0603FR-073R3L
2	R4, R5	0Ω	Film resistor, 1%	0402	Yageo	RC0402FR-070RL
1	R6	20Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0720RL
1	R7	0Ω	Film resistor, 1	0603	Yageo	RC0603FR-070RL
1	R8	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R10	0.005Ω	1%, long side, 1W, current-sense resistor	1508	Film Tech	RL3720WT-R005-F
2	R11, R12	2.2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-072K2L
2	R14, R15	3.3Ω	Film resistor, 1%	0402	Yageo	RC0402FR-073R3L
2	Q1, Q2	40V	V_{DS} = 40V, $R_{DS(ON)}$ = 9.4mΩ (V_{GS} = 4.5V), Q_G = 8.5nC (V_{GS} = 4.5V), ID = 30A	DFN (5mmx 6mm)	AOS	AONS66406
Optional	Q1, Q2		$R_{ON(DS)}$ = 7mΩ (V_{GS} = 4.5V), Q_G = 4.6nC, (V_{GS} = 4.5V)	PG-TSDSON-8 FL	Infineon	BSZ063N04LS6
1	CN1	3 pins	3-pin, 1 row, straight header	DIP	Wurth	61300311121

EVL4248-QV-00A BILL OF MATERIALS (3) *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	CN2	10-pin	I²C	DIP	Wurth	612010235121
3	EN, GND_SENSE, IMON	φ1.0	φ1.0 copper pin	DIP	Any	
4	VIN, VOUT, GND	φ2.0	φ2.0 copper pin	DIP	Any	
1	U1	MP4248	Buck-boost with low-side MOSFET	QFN-20 (3mmx 5mm)	MPS	MP4248GQV-0000
1	L1	4.7μH	Inductor, R_{DC} = 9.5mΩ, I_{SAT} = 15A	1050	MPS	MPL-AY1050-4R7

Notes:

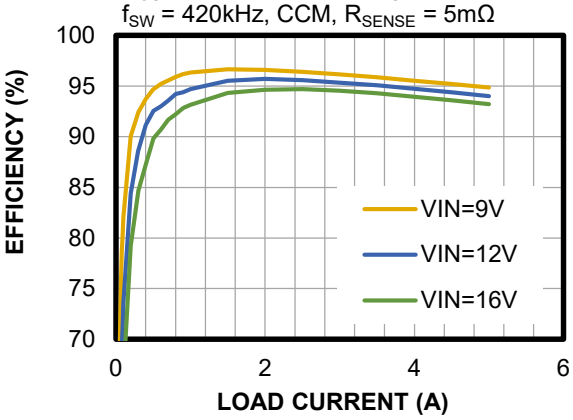
3) The BOM component selection is designed for <25V V_{OUT} applications. For >25V V_{OUT} applications, the BOM selection must change accordingly, such as the e-capacitor voltage rating and the feedback resistors.

EVB TEST RESULTS

V_{IN} = 12V, V_{OUT} = 5V, L = 4.7µH, f_{SW} = 420kHz, forced PWM mode, T_A = 25°C, unless otherwise noted.

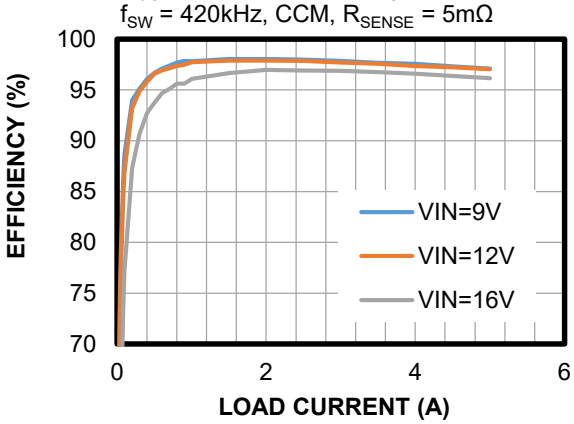
Efficiency vs. Load Current

V_{OUT} = 5V, L = 4.7µH, R_{DC} = 8mΩ, f_{SW} = 420kHz, CCM, R_{SENSE} = 5mΩ



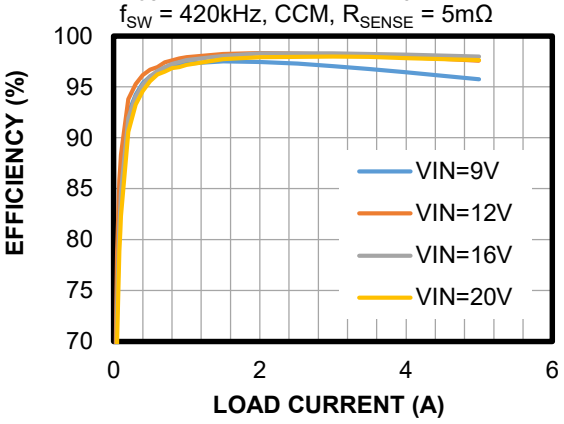
Efficiency vs. Load Current

V_{OUT} = 9V, L = 4.7µH, R_{DC} = 8mΩ, f_{SW} = 420kHz, CCM, R_{SENSE} = 5mΩ



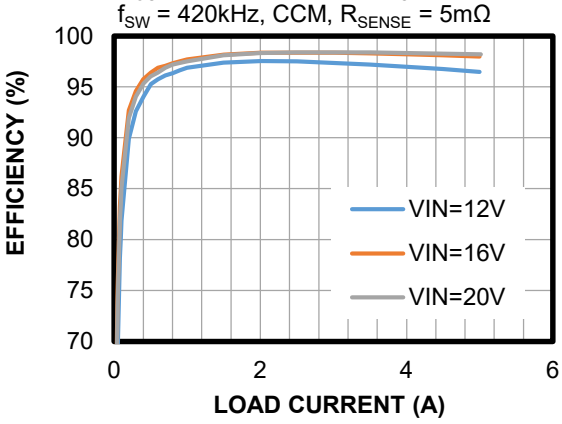
Efficiency vs. Load Current

V_{OUT} = 15V, L = 4.7µH, R_{DC} = 8mΩ, f_{SW} = 420kHz, CCM, R_{SENSE} = 5mΩ



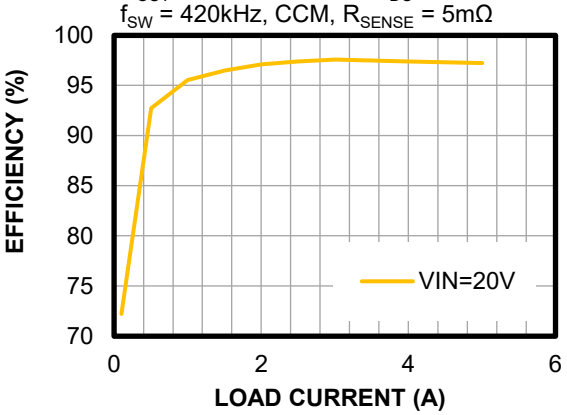
Efficiency vs. Load Current

V_{OUT} = 20V, L = 4.7µH, R_{DC} = 8mΩ, f_{SW} = 420kHz, CCM, R_{SENSE} = 5mΩ



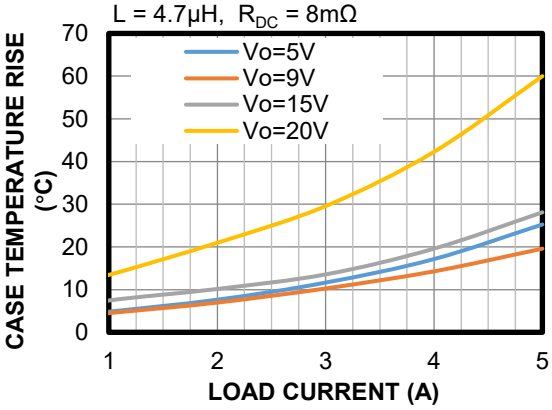
Efficiency vs. Load Current

V_{OUT} = 28V, L = 4.7µH, R_{DC} = 8mΩ, f_{SW} = 420kHz, CCM, R_{SENSE} = 5mΩ



Case Temperature Rise

V_{IN} = 12V, V_{OUT} = 5V/9V/15V/20V, f_{SW} = 420kHz, based on 6cmx6cm board, L = 4.7µH, R_{DC} = 8mΩ



PCB LAYOUT

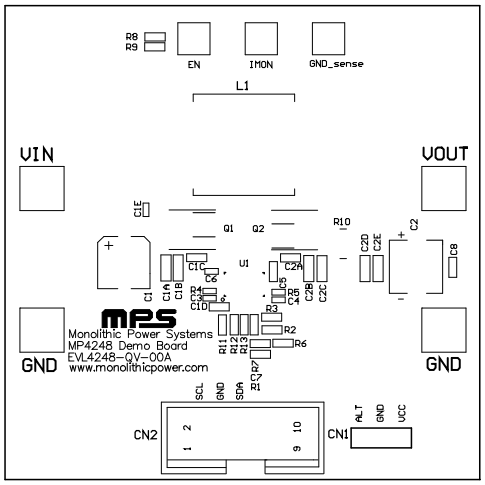


Figure 3: Top Silk

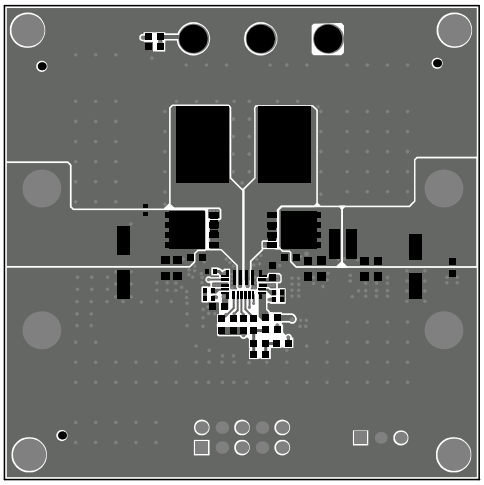


Figure 4: Top Layer

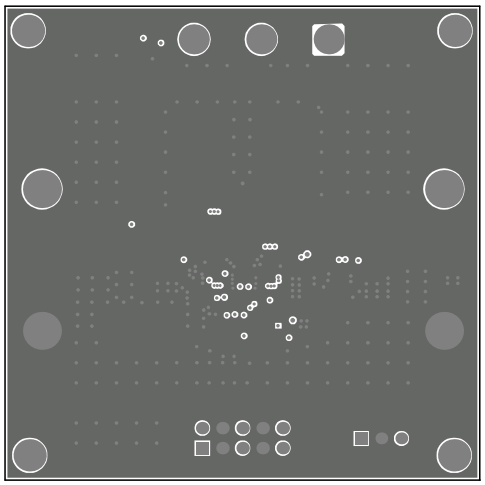


Figure 5: Mid-Layer 1

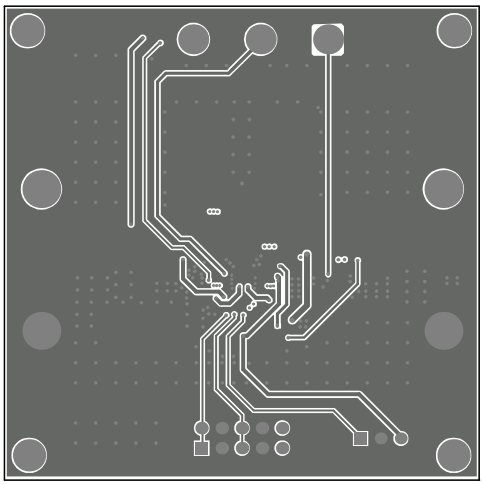


Figure 6: Mid-Layer 2

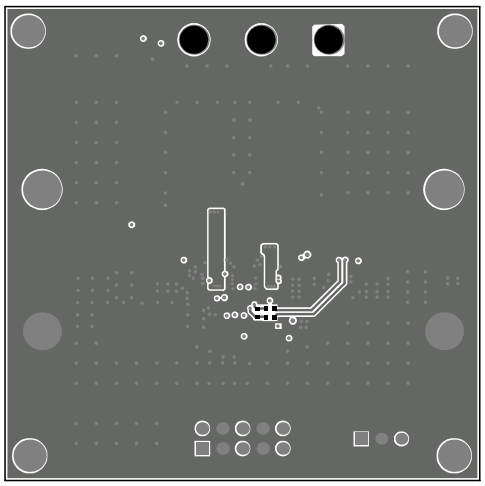


Figure 7: Bottom Layer

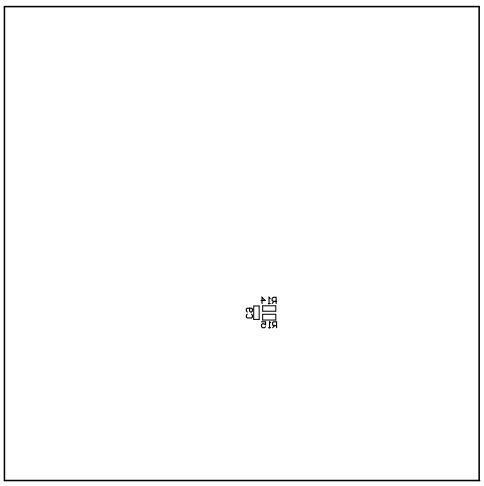


Figure 8: Bottom Silk

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	1/2/2024	Initial Release	-