EVQ5472-Q-00A

Fully Integrated, 16V, 12A x 2, Dual-Output Buck Converter with Parallel Mode, 450mA LDO, I²C Interface and Flexible System Configurations, AEC-Q100 Qualified

DESCRIPTION

The EVQ5472-Q-00A is an evaluation board designed to demonstrate the capabilities of the MPQ5472, a complete power management IC that integrates two high-efficiency, step-down DC/DC converters, an adjustable output low-dropout (LDO) regulator, and a flexible logic interface.

The DC/DC converter's constant-on-Time (COT) control provides fast transient response. A configurable, 500kHz to 1.25MHz switching frequency (f_{SW}) significantly reduces the external inductor and capacitor size. Full protection features include over-current protection (OCP), under-voltage protection (UVP), over-voltage protection (OVP), and thermal shutdown.

The output voltage (V_{OUT}) is adjustable via the I²C bus or preset by the multiple-time programmable (MTP) memory function. The power-on/-off sequence and delay are configurable via the MTP or can be controlled via the I²C bus online.

The two rails can work in either independent mode or parallel mode, which can be configured. The current balance function is implemented when working in parallel mode.

It is recommended to read the MPQ5472 datasheet prior to making any changes to the EVQ5472-Q-00A.

PERFORMANCE SUMMARY (1)

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

Parameters	Conditions	Value
Input voltage (V_{IN}) (1) (2)		5V
Output voltage (V_{OUT}) (1) (3)	V_{IN} = 3V to 6V, dual-phase, single-output mode	V_{OUT1} = V_{OUT2} = 0.9V
Maximum output current (I_{OUT})	V_{IN} = 5V	20A
Typical efficiency	V_{IN} = 5V, V_{OUT} = 0.9V, I_{OUT} = 20A, f_{SW} = 500kHz	82.91%
Peak efficiency	V_{IN} = 5V, V_{OUT} = 0.9V, I_{OUT} = 5A, f_{SW} = 500kHz	91.11%
Switching frequency (f_{SW})		500kHz

Notes:

1) For varying input/output voltage specifications with different inductors, the application circuit parameters may require changes.
2) The MPQ5472's V_{IN} range is between 3V and 16V.
3) V_{OUT} can be adjusted between 0.3V and 3.8V via the digital interface. For more details, refer to the MPQ5472 datasheet.

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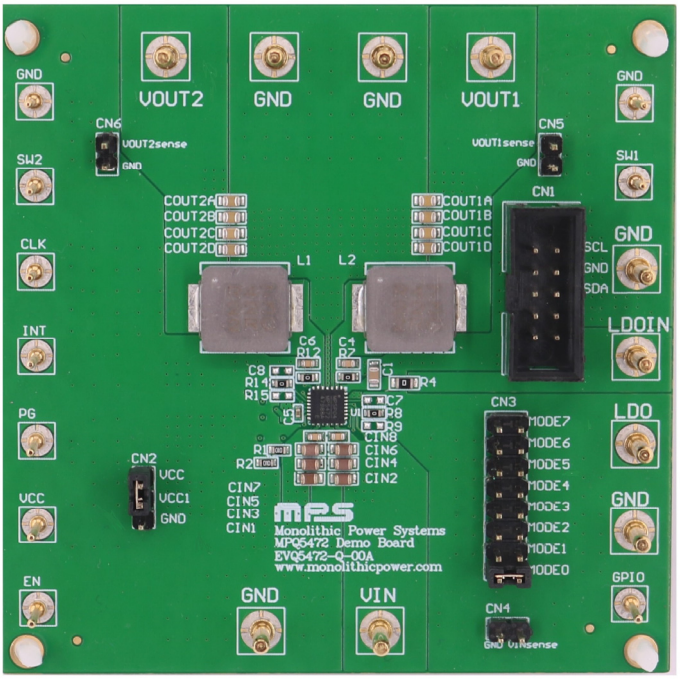
EVQ5472-Q-00A EVALUATION BOARD



LxWxH (8cmx8cmx1.8cm)
4 Layers (2oz, 1oz, 1oz, 2oz)

Board Number	MPS IC Number
EVQ5472-Q-00A	MPQ5472GRE-0000-AEC1

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DEFAULT MULTIPLE-TIME PROGRAMMABLE (MTP) CONFIGURATIONS

Table 1 shows the default multiple-time programmable (MTP) memory configurations for MPQ5472GRE-0000.

Table 1: MPQ5472GRE-0000 Default Mode 0 Configurations (4)

Bit Name	Command Code	Bits	Default Code	Default Value	Range/Values	Min Value	Max Value	Resolution/ LSB	Unit
MODE0_ VOUT1_ SETTING	0x70, 0x72	7:0, 5:3	011100 00, 100	900	300mV to 2047mV (BUCK1_FB_ HALF = 0) or 300mV to 3800mV (BUCK1_FB_ HALF = 1)	300	2047/ 3800	1 (BUCK1_FB_ HALF = 0) / 2 (BUCK1_FB_ HALF = 1)	mV
MODE0_ VOUT2_ SETTING	0x71, 0x72	7:0, 2:0	011100 00, 100	900	300mV to 2047mV (BUCK1_FB_ HALF = 0) or 300mV to 3800mV (BUCK1_FB_ HALF = 1)	300	2047/ 3800	1 (BUCK2_FB_ HALF = 0) / 2 (BUCK2_FB_ HALF = 1)	mV
MODE0_ BUCK1_ FB_HALF	0x72	7	0	FB voltage	FB voltage, 1/2 FB voltage	-	-	-	-
MODE0_ BUCK2_ FB_HALF	0x72	6	0	FB voltage	FB voltage, 1/2 FB voltage	-	-	-	-
MODE0_ BUCK1_ FSW	0x73	3:2	00	500	500 to 1250	500	1250	250	kHz
MODE0_ BUCK2_ FSW	0x73	1:0	00	500	500 to 1250	500	1250	250	kHz
RESERVED	0x73	5:4	00	N/A	-	-	-	-	-
MODE0_ CLK_MODE	0x73	7	1	Master converter	Slave converter, master converter	-	-	-	-
MODE0_ SINGLE/ DUAL	0x73	6	1	Dual-phase single output	Single-phase dual output, dual-phase single output	-	-	-	-
MODE0_ BUCK1_ POWER_ ON_DELAY	0x74	7:0	000011 00	Soft starts when counting 12 clock pulses	0 to 1024	0	1024	1, 2, 4, 8, 16, or 24	-
MODE0_ BUCK2_ POWER_ ON_DELAY	0x75	7:0	000011 00	Soft starts when counting 12 clock pulses	0 to 1024	0	1024	1, 2, 4, 8, 16, or 24	-
MODE0_ VOUT1_ SOFT_ START_ TIME	0x76	7:5	001	2	1, 2, 4, 6, 8, 10, 12, or 14	1	14	-	ms
MODE0_ VOUT2_ SOFT_ START_ TIME	0x76	4:2	001	2	1, 2, 4, 6, 8, 10, 12, or 14	1	14	-	ms
MODE0_ LDO_EN	0x76	1	0	LDO disabled	LDO enabled	-	-	--	-
RESERVED	0x76	0	0	NA	-	-	-	-	-

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Table 1: MPQ5472GRE-0000 Default Mode 0 Configurations *(continued)* (4)

Bit Name	Command Code	Bits	Default Code	Default Value	Range/Values	Min Value	Max Value	Resolution/ LSB	Unit
MODE0_ LDO_ SOFT_ START_ TIME	0x77	7:5	001	2	1, 2, 4, 6, 8, 10, or 12, 14	1	14	-	ms
MODE0_ I2C_ ADDRESS	0x77	4:2	000	000	0 to 7	000	111	-	-
MODE0_ GPIO_ CTRL	0x77	1:0	11	11: The GPIO output is floating/ high	The GPIO output is low, floating, or high. The GPIO is an analog input for ADC, part of flex-time control, and used as the external converter's enable signal.	-	-	-	-
MODE0_ LDO_ SETTING	0x78	7:0	00111100	1800	600 (001 0100) to 3600 (001 0101)	600	3600	30	mV
MODE0_ LDO_ POWER_ ON_DELAY	0x79	7:0	00001000	Soft starts when counting 8 clock pulses	0 to 1024	0	1024	1, 2, 4, 8, 16, or 24	-
MODE0_ GPIO_ POWER_ ON_DELAY	0x7A	7:0	00010100	Soft starts when counting 20 clock pulses	0 to 1024	0	1024	1, 2, 4, 8, 16, or 24	-

Note:

4) The mode 0 and MODE resistor is 0Ω.

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QUICK START GUIDE

The EVQ5472-Q-00A is easy to set up and use to evaluate the MPQ5472's performance. For the proper measurement equipment set-up, refer to Figure 1 and follow the guidelines below:

1. Preset the power source (V_{IN}) to be between 3V and 6V. The typical value is 5V.
2. Turn the power source off.
3. Connect the power source terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
4. Connect the load (no initial load) terminals to:
   a. Positive (+): VOUT1 or VOUT2
   b. Negative (-): GND
5. After making the connections, turn the power supply on. The board should automatically start up.
6. Check for the proper output voltage (V_{OUT}).
7. Once the proper V_{OUT} is established, adjust the load within the operating range and measure the efficiency, output ripple voltage, and any other relevant parameters. (5)
8. After completing all tests, adjust the load to 0A, then turn the input power supply off.

Note:

5) When measuring the output or input voltage ripple, do not use the oscilloscope probe's long ground lead.

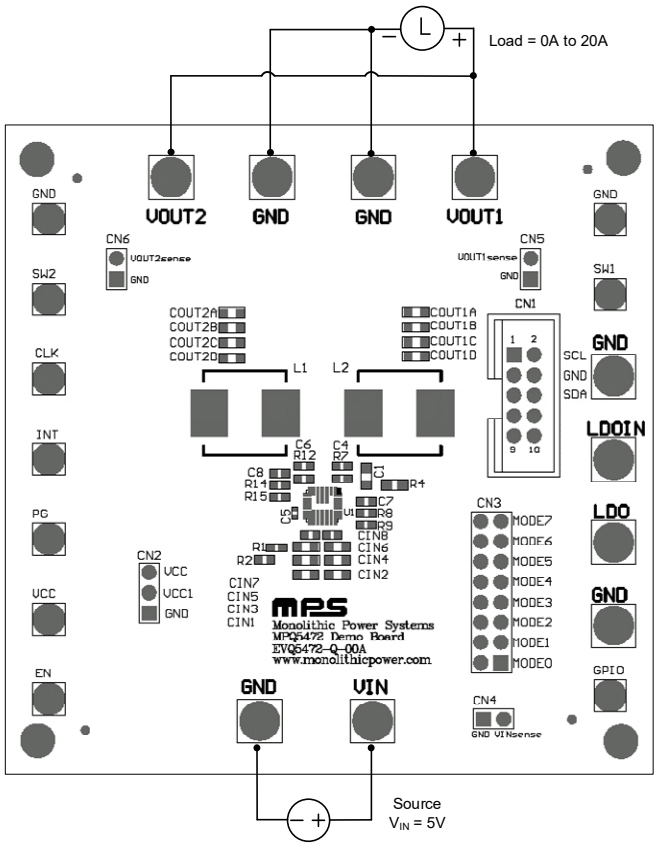

Figure 1: Measurement Equipment Set-Up

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EVALUATION BOARD SCHEMATIC

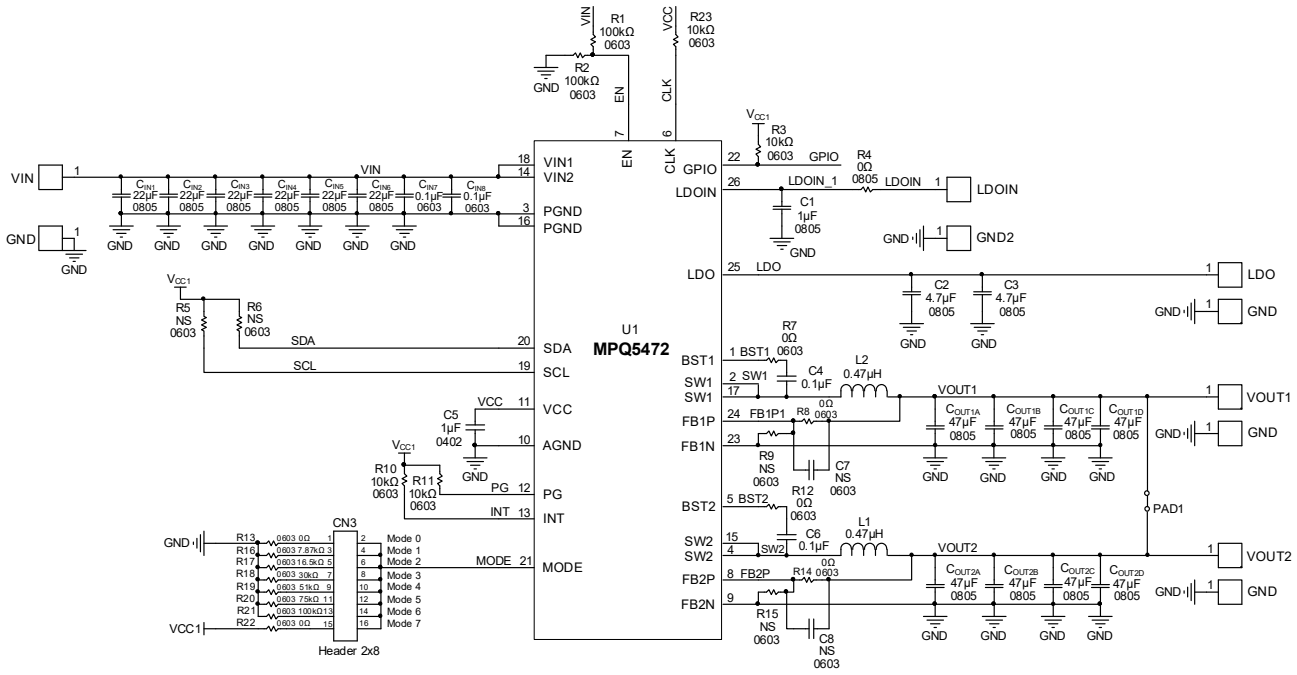

Figure 2: Evaluation Board Schematic (6)

Note:

6) To improve efficiency, connect the VCC pin to VIN via a 10Ω resistor at V_{IN} = 3.3V.

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EVQ5472-Q-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
6	C_{IN1}, C_{IN2}, C_{IN3}, C_{IN4}, C_{IN5}, C_{IN6}	22µF	Ceramic capacitor, 25V, X5R	0805	Murata	GRM21BR61E226ME44L
4	C4, C6, C_{IN7}, C_{IN8}	0.1µF	Ceramic capacitor, 25V, X7R	0603	Murata	GRM188R71E104KA01D
1	C1	1µF	Ceramic capacitor, 10V, X7R	0805	Murata	GRM21BR71A105KA01L
2	C2, C3	4.7µF	Ceramic capacitor, 16V, X5R	0805	Wurth	885012207053
1	C5	1µF	Ceramic capacitor, 10V, X5R	0402	Murata	GRM155R61A105KE01D
0	C7, C8	NS				
8	C_{OUT1A}, C_{OUT1B}, C_{OUT1C}, C_{OUT1D}, C_{OUT2A}, C_{OUT2B}, C_{OUT2C}, C_{OUT2D}	47µF	Ceramic capacitor, 10V, X5R	0805	Murata	GRM21BR61A476ME15L
0	R5, R6, R9, R15	NS				
2	R1, R2	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
3	R3, R10, R11	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	R4	0Ω	Film resistor, 1%	0805	Yageo	RC0805FR-070RL
6	R7, R8, R12, R13, R14, R22	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-070RL
1	R16	7.87kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-077K87L
1	R17	16.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0716K5L
1	R18	30kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0730KL
1	R19	51kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0751KL
1	R20	75kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0775KL
1	R21	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R23	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
2	L1, L2	0.47µH	Inductor, DCR = 1.53mΩ	SMT	Cyntec	VCMT104T-R47MN5
1	CN1	2x10-pin	Straight header	DIP	Wurth	61301021121
1	U1	MPQ5472 -AEC1	Fully integrated, 16V, 12A x 2, dual-output buck converter, AEC-Q100 qualified	QFN-26 (4mmx 4mm)	MPS	MPQ5472GRE-0000-AEC1

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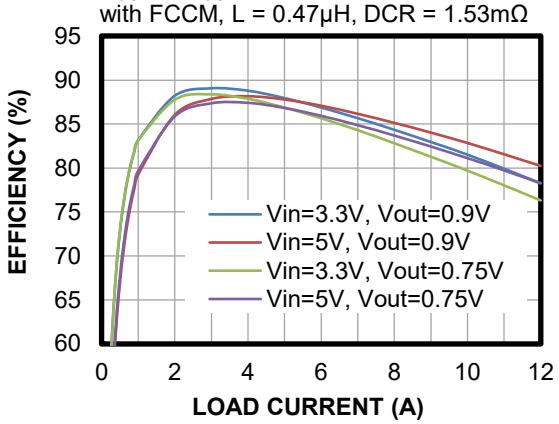
EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 5V, V_{OUT} = 0.9V, dual-phase single output, L = 4.7µH, f_{SW} = 500kHz, FCCM, T_A = 25°C, unless otherwise noted.

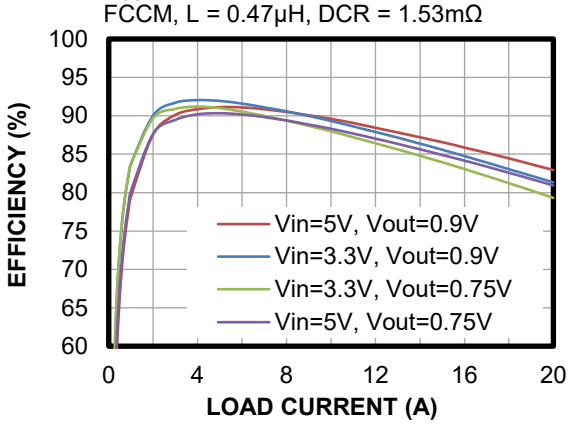
Efficiency vs. Load Current

Single-phase dual output,
V_{OUT1} = V_{OUT2} = 0.75V/0.9V, f_{SW} = 500kHz with FCCM, L = 0.47µH, DCR = 1.53mΩ



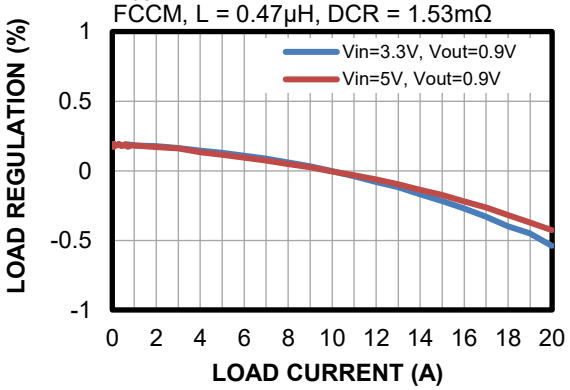
Efficiency vs. Load Current

Dual-phase single output,
V_{OUT} = 0.75V/0.9V, f_{SW} = 500kHz with FCCM, L = 0.47µH, DCR = 1.53mΩ



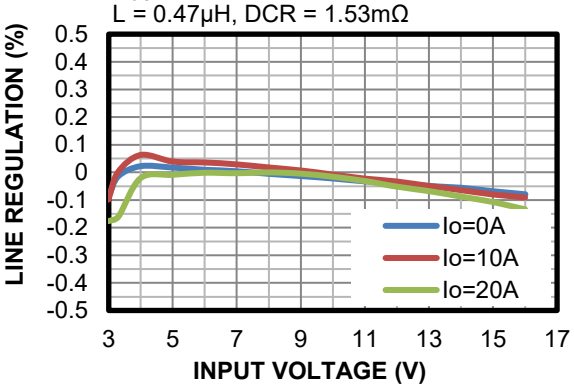
Load Regulation vs. Load Current

Dual-phase single output,
V_{OUT} = 0.75V/0.9V, f_{SW} = 500kHz with FCCM, L = 0.47µH, DCR = 1.53mΩ



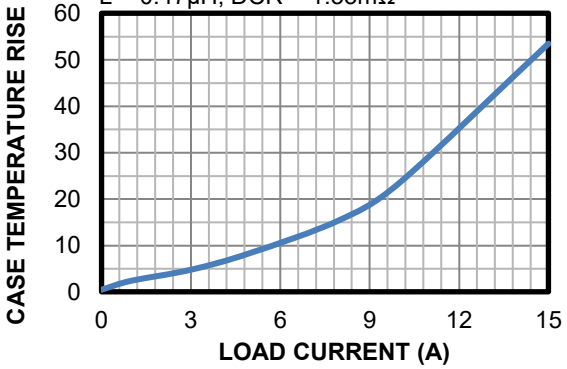
Line Regulation vs. Input Voltage

Dual-phase single output,
V_{OUT} = 0.9V, f_{SW} = 500kHz with FCCM, L = 0.47µH, DCR = 1.53mΩ



Case Temperature Rise vs. Load Current

V_{IN} = 5V, dual-phase single output,
V_{OUT} = 0.9V, f_{SW} = 500kHz with FCCM, L = 0.47µH, DCR = 1.53mΩ



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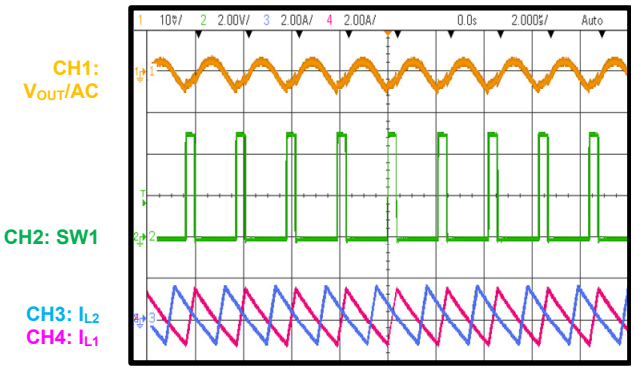
EVB TEST RESULTS *(continued)*

Performance curves and waveforms are tested on the evaluation board V_{IN} = 5V, V_{OUT} = 0.9V, dual-phase single output, L = 4.7µH, f_{SW} = 500kHz, FCCM, T_A = 25°C, unless otherwise noted.

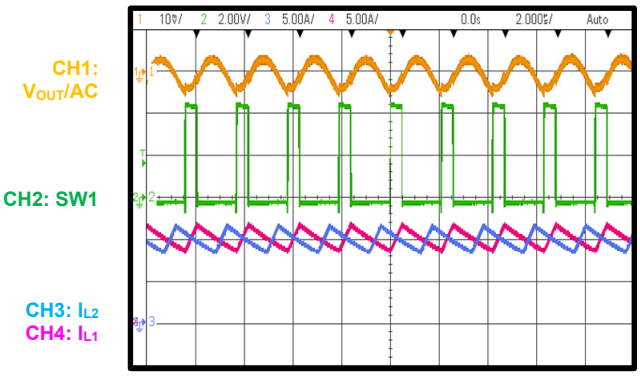
Steady State

Dual-phase single output, V_{OUT} = 0.9V, f_{SW} = 500kHz with FCCM, I_{OUT} = 0A



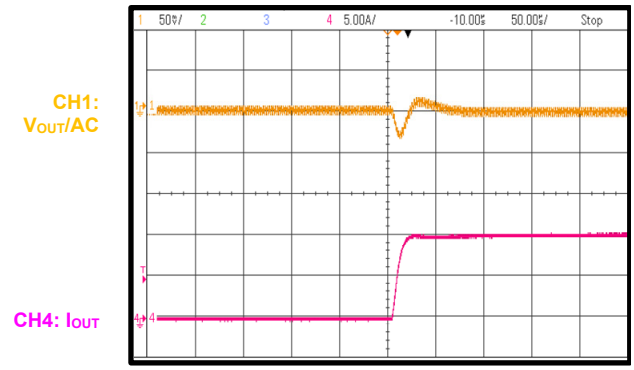
Steady State

Dual-phase single output, V_{OUT} = 0.9V, f_{SW} = 500kHz with FCCM, I_{OUT} = 20A



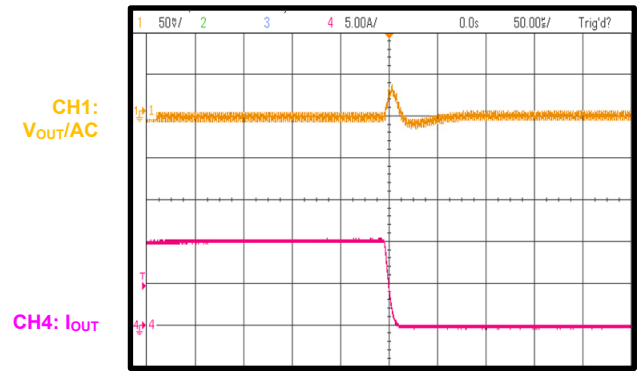
Load Transient

Dual-phase single output, V_{OUT} = 0.9V, I_{OUT} = 0A to 10A, slew rate = 1A/µs



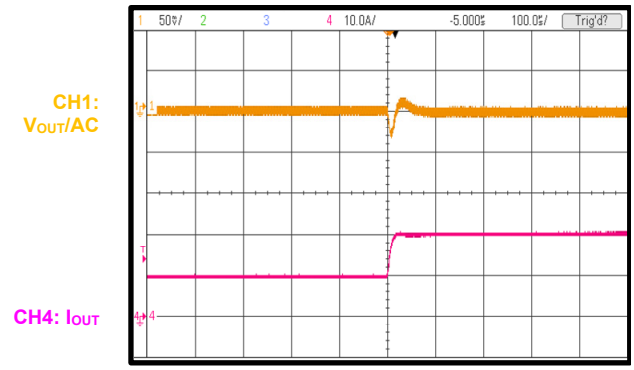
Load Transient

Dual-phase single output, V_{OUT} = 0.9V, I_{OUT} = 10A to 0A, slew rate = 1A/µs



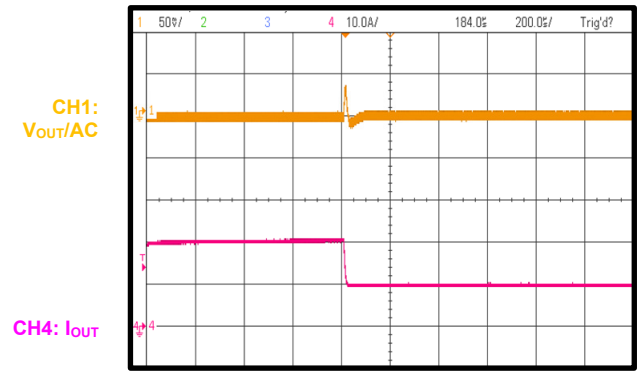
Load Transient

Dual-phase single output, V_{OUT} = 0.9V, I_{OUT} = 10A to 20A, slew rate = 1A/µs



Load Transient

Dual-phase single output, V_{OUT} = 0.9V, I_{OUT} = 20A to 10A, slew rate = 1A/µs



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PCB LAYOUT

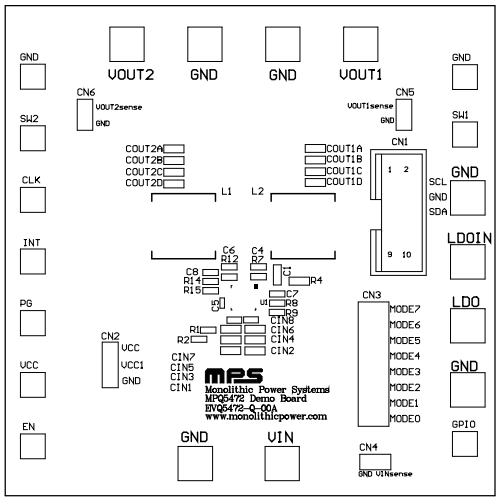

Figure 3: Top Silk

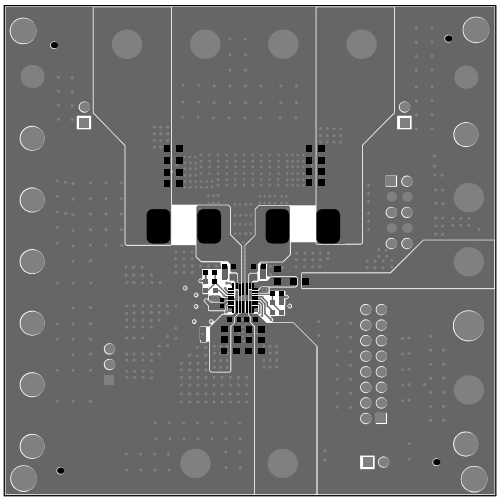

Figure 4: Top Layer

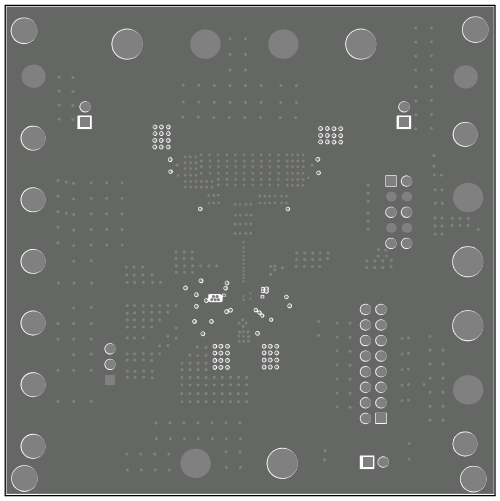

Figure 5: Mid-Layer 1

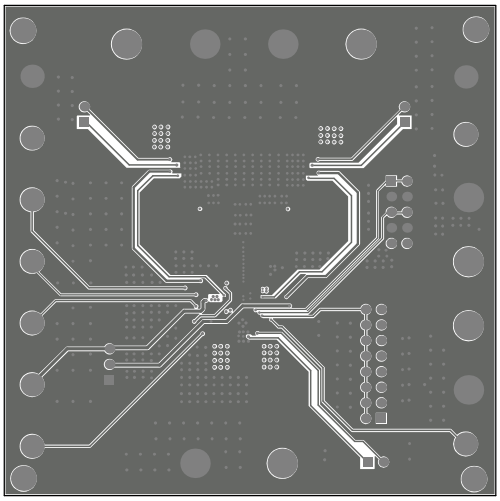

Figure 6: Mid-Layer 2

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PCB LAYOUT *(continued)*

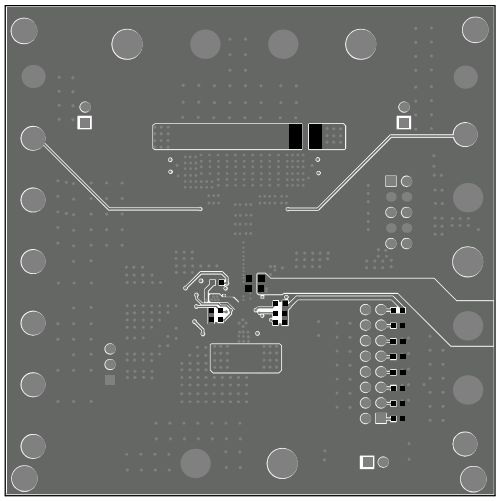

Figure 7: Bottom Layer

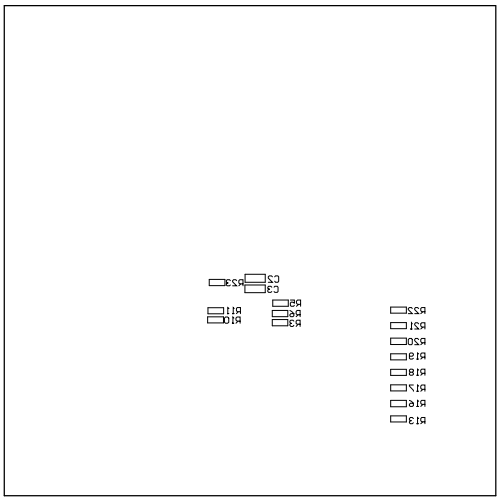

Figure 8: Bottom Silk

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REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	9/16/2024	Initial Release	-

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